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CHAPTER – 3

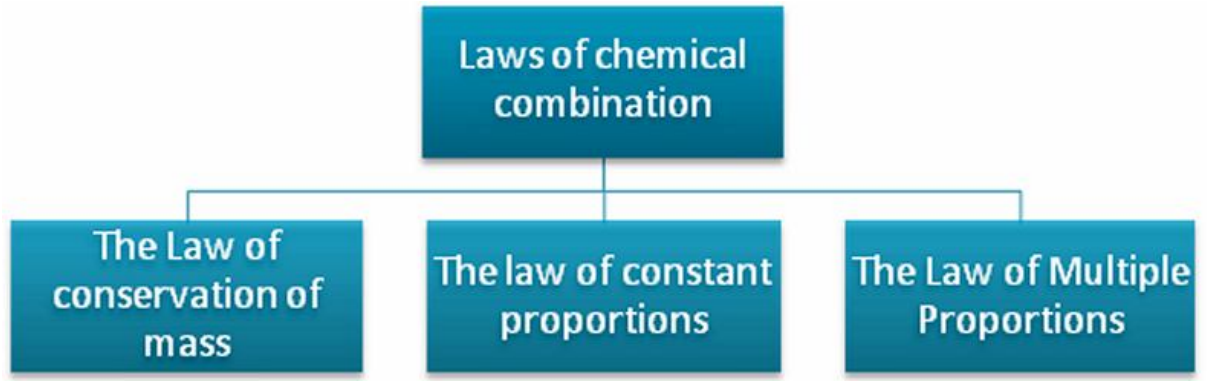
ATOMS AND MOLECULES

ATOMS AND MOLECULES

LAWS OF CHEMICAL COMBINATIONS

Before Dalton concept of atom was mere philosophical. Dalton explained about atom on the basis of Laws of Chemical Combinations.
There are three laws of chemical combination.

1. Law of Conservation of Mass
2. Law of Constant Proportions
3. Law of Multiple Proportions



LAW OF CONSERVATION OF MASS

Antoine L. Lavoisier, a French scientist, established the theory of Law of Conservation of Mass. The law of conservation of mass states, "**Mass can neither be created nor destroyed in a chemical reaction**".

All matters in the universe exist in three states. There are two ways of classification of matter.
1. According to physical state as solid, liquid or gas.
2. According to its composition as element, compound or mixture.

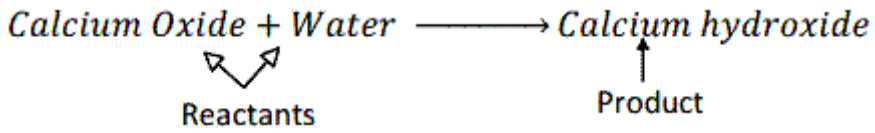
According to this law mass of an isolated system will remain constant over time. This means when mass is enclosed in a system and none is allowed in or out, its quantity will never change. That is mass will be conserved, and hence this is called Law of Conservation of Mass. This means total mass of products is always equal to the total mass of reactants. As there is no loss of mass of substances, i.e. mass is conserved, that's why Lavoisier called this the law of conservation of mass.

REACTANTS AND PRODUCTS:

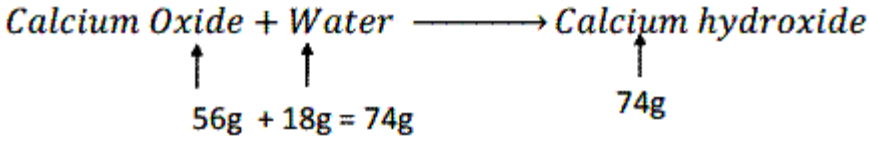
In a chemical reaction the substances that combine or react are known as reactants and the new substance/substances formed are called product or products.
A chemical reaction can be represented in general as follows:

$$Reactant + Reactant \longrightarrow Product$$

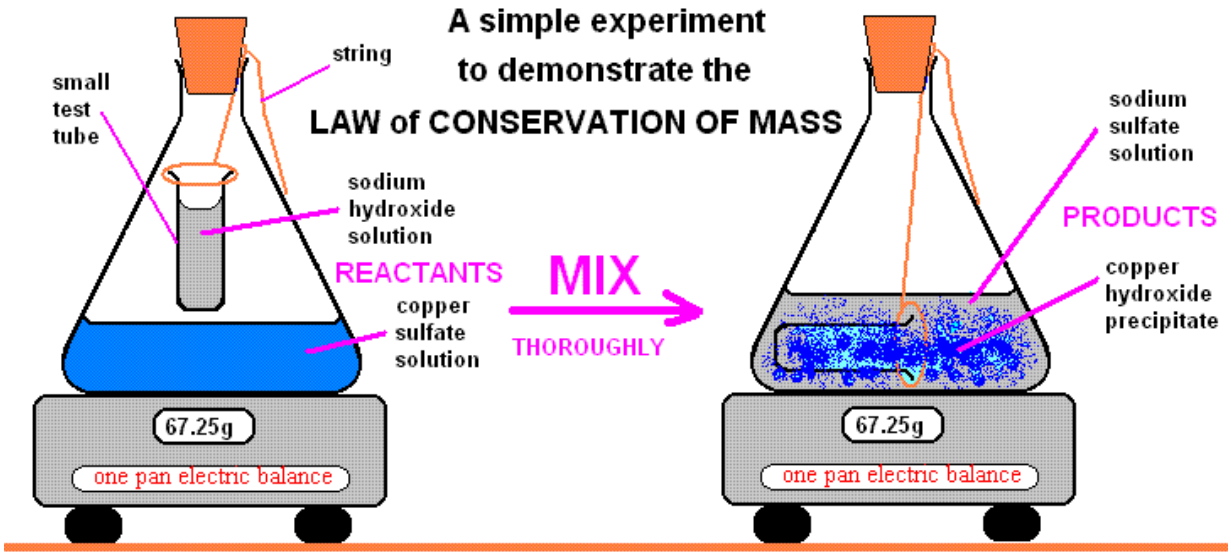
Example: When calcium oxide is dissolved in water calcium hydroxide is formed. The reaction involve in this can be written as:



In this reaction calcium oxide and water are reactants while calcium hydroxide is product.
In this reaction 74 g of calcium hydroxide is obtained when 56 g of calcium oxide reacts with 18 g of water, which is proved by experiment.



Here the total mass of reactants, i.e. calcium oxide and water is equal to 74 g. And the mass of product, i.e. calcium hydroxide is also equal to 74g. This proves that the total mass of reactants is always equal to the total mass of product, which proves the Law of Conservation of Mass.



LAW OF CONSTANT PROPORTIONS

Law of Constant Proportion states that **a chemical compound always contains exactly the same proportion of elements by mass.**
This law is also known as Law of definite proportions. Joseph Louis Proust gave this law hence, this law is also known as Proust's Law.

Explanation of the law:-

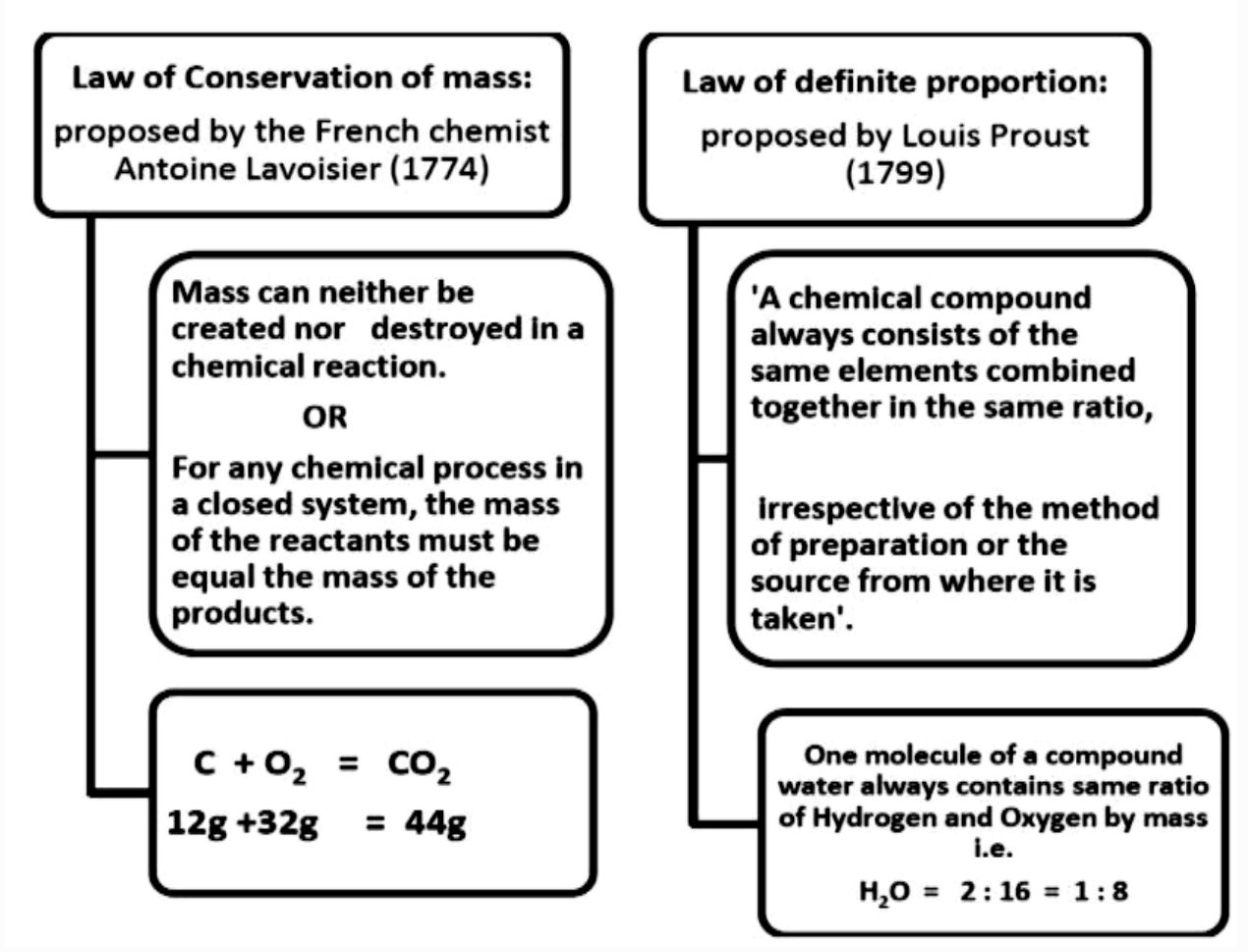
Compounds are formed by the combination of two or more elements. In a compound the ratio of the atoms or element by mass remains always same irrespective of the source of compound. This means a certain compound always formed by the combination of atoms in same ratio by mass. If the ratio of mass of constituent atoms will be altered the new compound is formed.

Examples:-

Water is formed by the combination of hydrogen and oxygen. The ratio of masses of hydrogen and oxygen is always in 1:8 in water irrespective of source of water. Whether you collect the water from a well, river, pond or from anywhere the ratio of their constituent atoms by mass will always same.

$$2H_2 + O_2 \rightarrow 2H_2O$$
$$\downarrow \quad \downarrow$$
$$4 \quad 32$$
$$\downarrow \quad \downarrow$$
$$1 : 8 \text{ (By Mass)}$$

Nitrogen dioxide is a compound, which is formed by the combination of nitrogen and oxygen. The ratio of nitrogen and oxygen by mass in nitrogen dioxide is in 7:16.
Nitrous oxide is a compound which is also formed by the combination of nitrogen and oxygen. The ratio of nitrogen and oxygen in nitrous oxide is in 28:16.
Nitric oxide is a compound, which is also formed by the combination of nitrogen and oxygen. The ratio of nitrogen and oxygen in nitric oxide is in 7:8.
From the above three examples it is clear that if the ratio of the atoms by mass is altered then the new compound is formed, such as in the case of nitrogen dioxide, nitrous oxide, nitric oxide. These three compounds are formed by the combination of same atoms but because of combination of the constituent atoms in different ratios by mass new compound is formed.

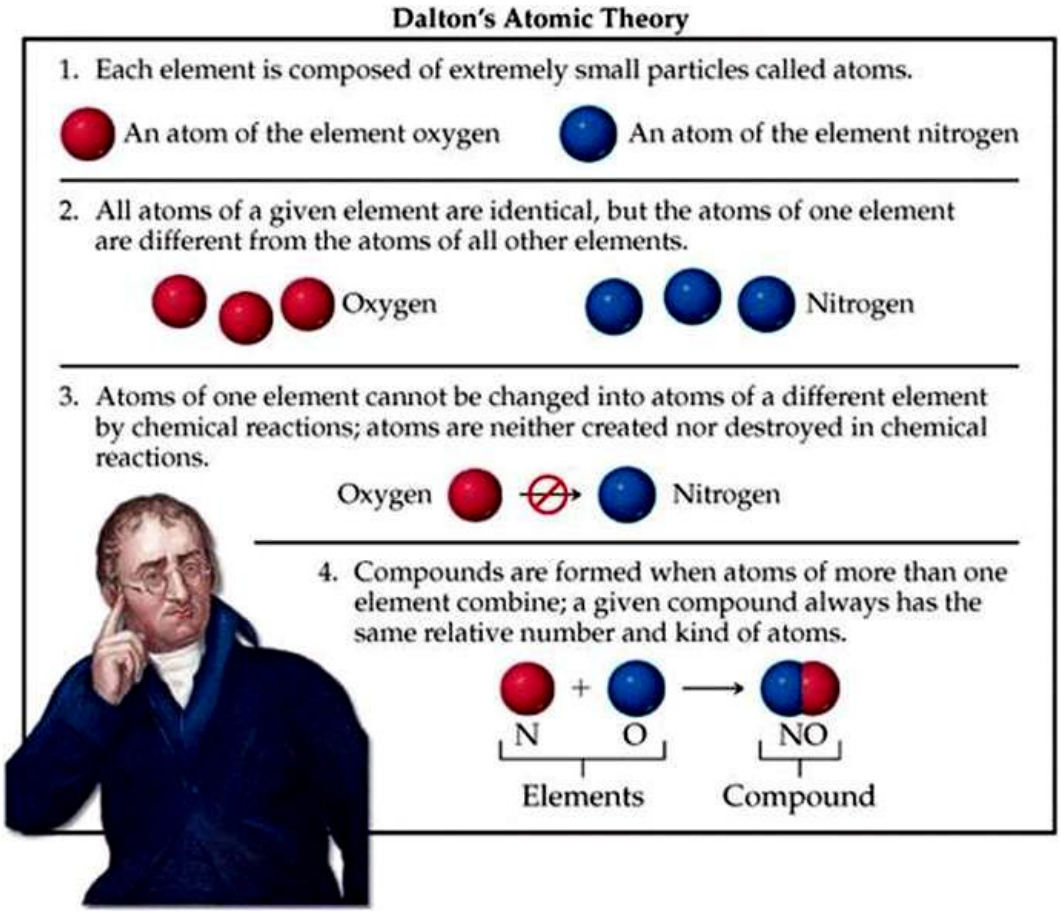


DALTON'S ATOMIC THEORY

John Dalton, a British Chemists and scientists gave the Atomic Theory in 1808. This theory is popularly known as Dalton's Atomic Theory in the honour of John Dalton. He gave the theory on the basis of Laws of Chemical Combination and explains them properly. In his theory he explains about atom.

Main postulates of Dalton's atomic theory

1. Elements are made of extremely small particles called atoms.
2. Atoms of a given element are identical in size, mass, and other properties;
3. Atoms of different elements differ in size, mass, and other properties.
4. Atoms cannot be subdivided, created, or destroyed.
5. Atoms of different elements combine in simple whole-number ratios to form chemical compounds.
6. In chemical reactions, atoms are combined, separated, or rearranged.



INTEXT QUESTIONS PAGE NO. 32

Q1. In a reaction, 5.3 g of sodium carbonate reacted with 6 g of ethanoic acid. The products were 2.2 g of carbon dioxide, 0.9 g water and 8.2 g of sodium ethanoate. Show that these observations are in agreement with the law of conservation of mass.

sodium carbonate + ethanoic acid → sodium ethanoate + carbon dioxide + water

Answer:

In the given reaction, sodium carbonate reacts with ethanoic acid to produce sodium ethanoate, carbon dioxide, and water.

sodium carbonate + ethanoic acid → sodium ethanoate + carbon dioxide + water

Mass of sodium carbonate = 5.3 g (Given)
Mass of ethanoic acid = 6 g (Given)
Mass of sodium ethanoate = 8.2 g (Given)
Mass of carbon dioxide = 2.2 g (Given)
Mass of water = 0.9 g (Given)
Now, total mass before the reaction = (5.3 + 6) g = 11.3 g
And, total mass after the reaction = (8.2 + 2.2 + 0.9) g = 11.3 g
Therefore, Total mass before the reaction = Total mass after the reaction

Hence, the given observations are in agreement with the law of conservation of mass.

Q2. Hydrogen and oxygen combine in the ratio of 1:8 by mass to form water. What mass of oxygen gas would be required to react completely with 3 g of hydrogen gas?
Answer:
It is given that the ratio of hydrogen and oxygen by mass to form water is 1:8.
Then, the mass of oxygen gas required to react completely with 1 g of hydrogen gas is 8 g.
Therefore, the mass of oxygen gas required to react completely with 3 g of hydrogen gas is 8×3 g = 24 g.

Q3. Which postulate of Dalton's atomic theory is the result of the law of conservation of mass?
Answer:
The postulate of Dalton's atomic theory which is a result of the law of conservation of mass is: Atoms are indivisible particles, which can neither be created nor destroyed in a chemical reaction.

Q4. Which postulate of Dalton's atomic theory can explain the law of definite proportions?
Answer:
The postulate of Dalton's atomic theory which is a result of the law of conservation of mass is: Atoms are indivisible particles, which can neither be created nor destroyed in a chemical reaction.

ATOMS

On the basis of Dalton's Atomic On the basis of Dalton's Atomic Theory atom can be defined as the smallest particles of matter are called atoms.
Characteristics of atoms:

- Atom is the smallest particle of matter.
- All elements are made of tiny particles called atom.
- Atoms are very small in size and cannot be seen through naked eyes.
- Atom does not exist in free-state in nature. But atom takes part in a chemical reaction.
- The properties of a matter depend upon the characteristics of atoms.
- Atoms are the building block of an element similar to a brick which combine together to make a building.
- The size of atoms is indicated by its radius.
- In ancient time atoms was considered indivisible.

SYMBOLS OF ATOMS OF ELEMENTS

Dalton was the first scientist to use the symbols for elements in a very specific sense. When he used a symbol for an element he also meant a definite quantity of that element, that is, one atom of that element. Berzilius suggested that the symbols of elements be made from one or two letters of the name of the element.

Many of the symbols are the first one or two letters of the element's name in English. The first letter of a symbol is always written as a capital letter (uppercase) and the second letter as a small letter (lowercase).

For convenience elements are represented by unique symbols. For example: Hydrogen is represented by 'H'. Oxygen is represented 'O'. Nitrogen is represented by 'N'. Iron is represented by 'Fe'. ments are represented by unique symbols. For example: Hydrogen is

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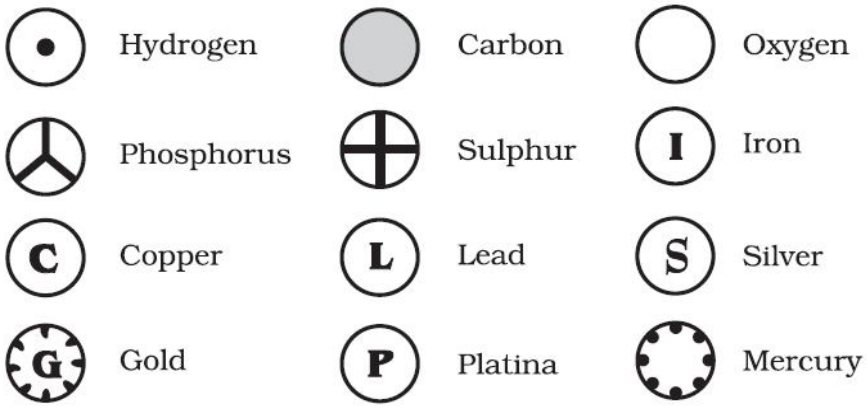


His worked proved as boon to science. For his marvelous work Berzilius, together with John Dalton, Antoine Lavoisier, and Robert Boyle is considered as the Father of Modern Chemistry.

Symbol and Name of some elements					
Element	**Symbol**	**Element**	**Symbol**	**Element**	**Symbol**
Hydrogen	H	Sodium	Na	Cromium	Cr
Helium	He	Magnesium	Mg	Mangese	Mn
Lithium	Li	Aluminium	Al	Iron	Fe
Beryllium	Be	Silicon	Si	Cobalt	Co
Boron	B	Phosphorous	P	Nickel	Ni
Carbon	C	Sulphur	S	Copper	Cu
Nitrogen	N	Chlorine	Cl	Zinc	Zn
Oxygen	O	Argon	Ar	Silver	Ag
Fluorine	F	Potassium	K	Gold	Au
Neon	Ne	Calcium	Ca	Mercury	Hg

Symbol of many elements are taken from their English name, while symbol of many elements are taken from their Greek or Latin names.

Symbol of some element which are derived from their Latin name

Several elements are named after the place where they discovered, such as ‘Copper’ which was taken from Cyprus. Some elements are named after their colour, such as ‘Gold’ which means yellow.

Symbols of some elements taken from their Latin Name		
English Name of Elements	**Symbol**	**Latin Name of Elements**
Sodium	Na	Natrium
Potassium	K	Kalium
Iron	Fe	Ferrum
Copper	Cu	Cuprum
Silver	Ag	Argentum
Gold	Au	Aurum
Mercury	Hg	Hydragyrum
Lead	Pb	Plumbum
Tin	Sn	Stannum

ATOMIC MASS

Mass of atom is called atomic mass. Since, atoms are very small consequently actual mass of an atom is very small. For example the actual mass of one atom of hydrogen is equal to 1.673 x 10^{-24} g. This is equal to 0.000000000000000000000001673 gram. To deal with such small nuber is very difficult. Thus for convenience relative atomic mass is used.
Carbon-12 is considered as unit to calculate atomic mass. Carbon-12 is an isotope of carbon. The relative mass of all atoms are found with respect to C-12.
One atomic mass = 1/12 of the mass of one atom of C-12.

$$This\ means\ atomic\ mass\ unit = \frac{1}{12} th\ of\ Carbon - 12$$

Atomic Mass of some elements					
Element	**Symbol**	**Atomic Mass**	**Element**	**Symbol**	**Atomic Mass**
Hydrogen	H	1u	Sodium	Na	23u
Helium	He	4u	Magnesium	Mg	24u
Lithium	Li	7u	Aluminium	Al	27u
Beryllium	Be	9u	Silicon	Si	28u
Boron	B	11u	Phosphorous	P	31u
Carbon	C	12u	Sulphur	S	32u
Nitrogen	N	14u	Chlorine	Cl	35u
Oxygen	O	16u	Potassium	K	39u
Fluorine	F	19u	Calcium	Ca	40u
Neon	Ne	20u	Iron	Fe	56

Thus atomic mass is the relative atomic mass of an atom with respect to 1/12 th of the mass of carbon-12 atom. ‘amu’ is the abbreviation of Atomic mass unit, but now it is denoted just by ‘u’.

The atomic mass of hydrogen atom = 1u.
This means one hydrogen atom is 1 times heavier than $1/12^{th}$ of the carbon atom.

The atomic mass of oxygen is 16u, this means one atom of oxygen is 16 times heavier than $1/12^{th}$of carbon atom.

Absolute mass or Actual atomic mass:
It is found that, the actual atomic mass of a carbon-12 atom is equal to 1.9926 X 10^{-23}g.

$$Therefore, 1u = \frac{1.9926 \times 10^{-23}}{12} g = 1.6605 \times 10^{-24} g$$

Thus by multiplying the relative atomic mass with 1.6605 × 10^{-24}g we can get the absolute or actual mass of an atom.

Example -1 - Find the absolute mass oxygen.
Solution:
The atomic mass of oxygen is 16u
We know 1u = 1.6605 x 10^{-24} g
Therefore, Absolute mass of oxygen = 1.6605 x 10^{-24} x 16 g
= 26.568 x 10^{-24} = 2.6568 x 10^{-25} g

Example – 2 – Find the absolute mass of Sodium.
Solution:
The atomic mass of Sodium is 23u
We know 1u = 1.6605 x 10^{-24} g
Therefore, Absolute mass of Sodium = 1.6605 x 10^{-24} x 23 g
= 38.191 x 10^{-24} = 3.8191 x 10^{-25} g

Example – 3 – Calculate the absolute mass of hydrogen atom.
Solution:
The atomic mass of hydrogen is 1u
We know 1u = 1.6605 x 10^{-24} g
Therefore, Absolute mass of hydrogen = 1.6605 x 10^{-24} x 1 g = 1.6605 x 10^{-24} g

Example – 4 - Calculate the absolute or actual mass of Nitrogen atom.
Solution:
The atomic mass of Nitrogen is 14u
We know 1u = 1.6605 x 10^{-24} g
Therefore, Absolute mass of hydrogen = 1.6605 x 10^{-24} x 14 g
= 23.247 x 10^{-24} g = 2.3247 x 10^{-25} g

EXISTENCE OF ATOMS

Atoms of most of the elements exist in the form of molecule or ion, since they are most reactive. For example, hydrogen, oxygen, chlorine, etc. However, atoms of some elements, which are non-reactive, exist in free-state in nature. For example helium, neon, argon, etc.
Usually atoms are exist in following two forms -
• In the form of molecules
• In the form of ions

INTEXT QUESTIONS PAGE NO. 35

Q1. Define the atomic mass unit.
Answer:

Mass unit equal to exactly one-twelfth $\left(\frac{1}{12^{th}}\right)$ the mass of one atom of carbon-12 is called one atomic mass unit. It is written as 'u'.

Q2. Why is it not possible to see an atom with naked eyes?
Answer:
The size of an atom is so small that it is not possible to see it with naked eyes. Also, the atom of an element does not exist independently.

MOLECULE

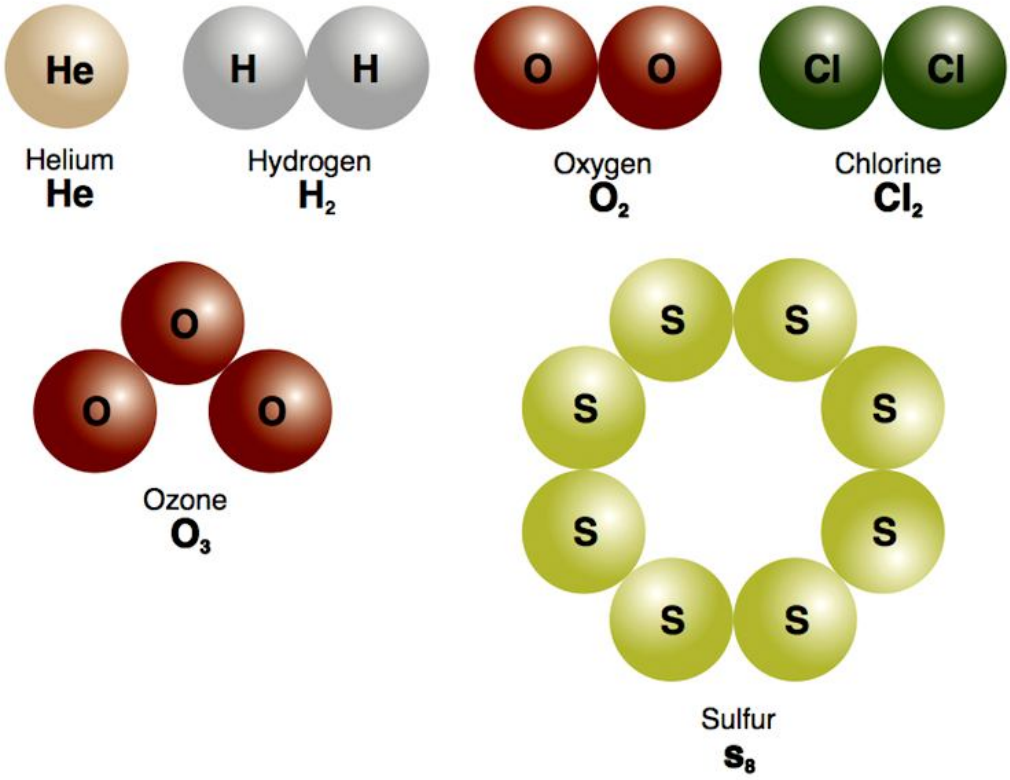
Molecule is the smallest particle of a compound.
Atoms exist in free states in the form of molecule.

- A molecule may be formed by the combination of two or more similar atoms of an element, such asoxygen molecule is formed by the combination of two oxygen atoms, molecule of hydrogen which is formed by the combination of two hydrogen atoms.
- Molecules may be formed by the combination of atoms of two or more different elements. For example molecule of water. It is formed by the combination of two atoms of hydrogen and one atom of oxygen. Molecule of Nitric oxide or nitrogen monoxide. It is formed by the combination of one nitrogen atom and one oxygen atom.
- A molecule takes part in chemical reaction.

Most of the atoms exist in the form of molecule. Molecules are formed by the combination of two or more elements.
Example: Molecule of hydrogen (H_2, Molecule of oxygen (O_2), Molecule of nitrogen (N_2), etc.
• Molecules of elements
• Molecules of Compounds

MOLECULES OF ELEMENTS

When two of more atoms of same element combine to form a molecule these are called molecules of element.
Example:
Hydrogen molecule (H_2). Hydrogen molecule (H_2). Molecule of hydrogen is formed by the combination of two hydrogen atoms.
Oxygen molecule (O_2). Molecule of oxygen is formed by the combination of two oxygen atoms.
Sulphur molecule (S_8). Molecule of sulphur is formed by the combination of eight sulphur atoms.
Phosphorous molecule (P_4). Molecule of phosphorous is formed by the combination of four phosphorous atoms.



Molecules of some non-reactive elements are formed by single atom. For example – helium, neon, argon, etc. molecules: Molecules of metals formed as big cluster of atoms. They are represented by their symbols simply. For example: Iron (Fe), Copper (Cu), Zinc (Zn), etc. These molecules are known as giant molecules.
Carbon is a non-metal, but it also exists as giant molecule and represented by its symbol 'C'.

ATOMICITY

Monoatomic:
When molecule is formed by single atom only, it is called monoatomic molecule. Generally noble gas forms monoatomic molecules. For example: Helium (He), Neon (Ne), Argon (Ar), Kr (Krypton), Xenon (Xe), Randon (Rn).

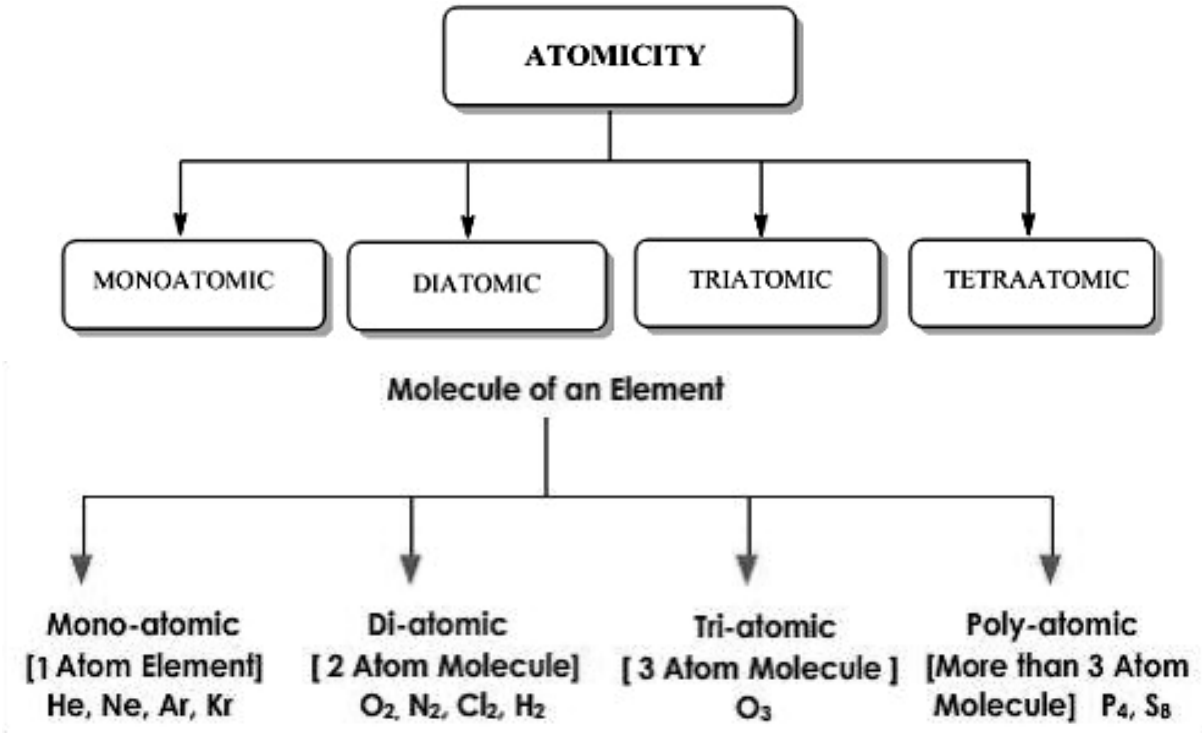
Diatomic
When molecule is formed by the cDiatomic: When molecule is formed by the combination of two atoms of it is called diatomic molecule. For example: Hydrogen (H_2), Oxygen (O_2) Nitrogen (N_2), Chlorine (Cl_2), etc.

Triatomic
When moleucule is formed by the combination of three atoms it is called triatomic molecule. For example: molecule of ozone (O_3

Tetra-atomic
When molecule is formed by the combination of four atoms it is called tetra-atomic molecule. For example: Phosphorous molecule (P_4)

Polyatomic
When molecule is formed by the combination of more than two atoms, it is called polyatomic molecule. For example: Sulphur molecule (S_8)

Atomicity of some elements		
Name	**Atomicity**	**Formula**
Argon	Monoatomic	Ar
Helium	Monoatomic	He
Oxygen	Diatomic	O_2
Hydrogen	Diatomic	H_2
Nitrogen	Diatomic	N_2
Chlorine	Diatomic	Cl_2
Phosphorous	Tetra-atomic	P_4
Sulphur	Poly-atomic	S_8

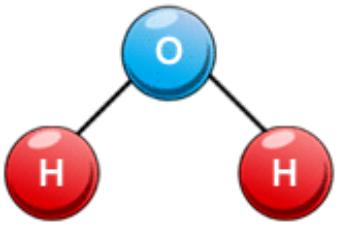


MOLECULES OF COMPOUNDS

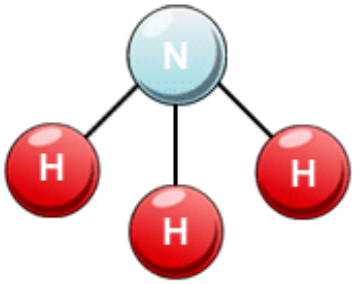
When molecule is formed by the combination of two or more atoms of different elements, it is called the molecule of compound.
Example:Molecule of water (H_2O). Molecule of water is formed by the combination of two hydrogen and one oxygen atoms.

Molecules of some compounds	
Compound	**Combining Elements**
Water (H_2O)	Hydrogen, Oxygen
Ammonia (NH_3)	Nitrogen, hydrogen
Carbon dioxide(CO_2)	Carbon, oxygen
Hydrogen Chloride (HCl)	Hydrogen, Chlorine
Methane (CH_4)	Carbon, Hydrogen
Ehtane (C_2H_6)	Carbon, hydrogen
Sodium chloride (NaCl)	Sodium, chlorine.
Copper oxide (CuO)	Copper and oxygen

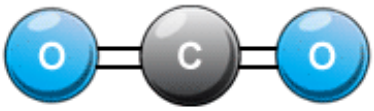
water



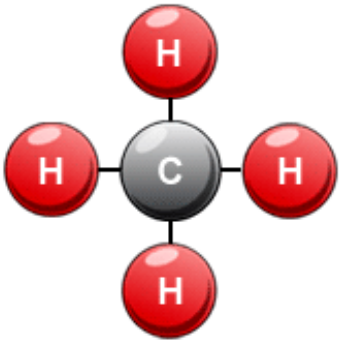
ammonia



carbon dioxide



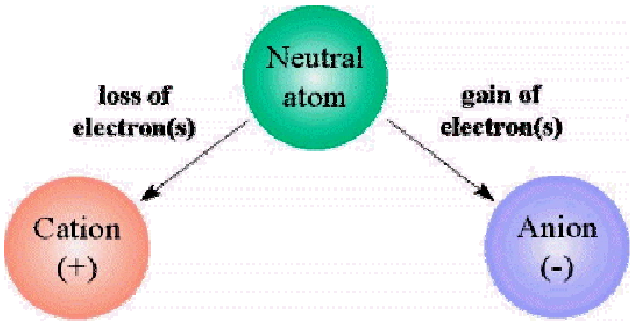
methane



IONS

Atoms of several elements exists in the form of ion. Atoms or molecule with negative or positive charge over them are called ions.

For example: Sodium ion (Na^+), postassiun ion (K^+), Chlorine ion (Cl^-), Fluoride ion (F^-)etc.



Cations:
Ions having positive charge over them are called cations.
For example: sodium ion (Na^+), potassium ion (K^+), etc
Anions:
Ions having negative charge over them are called anions.
For example: Chloride ion (Cl^-), Fluoride ion (F^-), etc
Monoatomic ions:
Ions formed by one atom are called monoatomic ions.
For example: sodium ion (Na^+), potassium ion (K^+), Chloride ion (Cl^-), Fluoride ion (F^-), etc.
Polyatomic ions:
Ions formed by two or more atoms are called polyatomic ions. These are group of atoms of different elements which behave as single units, and are known as polyatomic ions.
For example: Ammonium ion (NH_4^+), Hydroxide ion (OH^-), etc

Some Common ions					
Cations		**Anions**		**Polyatomic ions**	
Lithium ion	Li^+	Chloride ion	Cl^-	Hydroxide	OH^-
Sodium ion	Na^+	Fluorine	F^-	Ammonium	NH_4^+
Potassium ion	K^+	Iodide	I^-	Nitrate	NO_3^-
Silver ion	Ag^+	Hydride	H^-	Bicarbonate or Hydrogen carbonate	HCO_3^-
Copper ion	Cu^+	Oxide ion	O^{2-}		
Hydrogen ion	H^+	Sulphide	S^{2-}		
Magnesium ion	Mg^{++}	Nitride	N^{3-}	Sulphate	SO_4^{2-}
Calcium ion	Ca^{++}			Carbonate	CO_3^{2-}
Iron ion	Fe^{++}			Sulphite	SO_3^{2-}
Zinc ion	Zn^{++}			Phosphate	PO_4^{2-}
Copper ion	Cu^{++}				
Aluminium ion	Al^{+++}				

WRITING CHEMICAL FORMULA

Chemical formula of the compound is the symbolic representation of its composition. To write chemical formula of a compound, symbols and valencies of constituent elements must be known. The valency of atom of an element can be thought of as hands or arms of that atom.

Points to remember

- The symbols or formulas of the component radicals of the compound are written side by side.
- Positive radicals are written left and negative radicals on the right.

- The valencies of the radicals are written below the respective symbols.
- The criss-cross method is applied to exchange the numerical value of valency of each radical. It is written as subscript of the other radical.

- The radical is enclosed in a bracket and the subscript is placed outside the lower right corner.
- The common factor is removed.
- If the subscript of the radical is one, it is omitted.

The rules that you have to follow while writing a chemical formula are as follows:

- the valencies or charges on the ion must balance.
- when a compound consists of a metal and a non-metal, the name or symbol of the metal is written first. For example: calcium oxide (CaO), sodium chloride (NaCl), iron sulphide (FeS), copper oxide (CuO) etc., where oxygen, chlorine, sulphur are non-metals and are written on the right, whereas calcium, sodium, iron and copper are metals, and are written on the left.
- in compounds formed with polyatomic ions, the ion is enclosed in a bracket before writing the number to indicate the ratio.

The simplest compounds, which are made up of two different elements are called binary compounds. While writing the chemical formulae for compounds, we write the constituent elements and their valencies as shown below. Then we must crossover the valencies of the combining atoms.

The formulae of ionic compounds are simply the whole number ratio of the positive to negative ions in the structure. For magnesium chloride, we write the symbol of cation (Mg^{2+}) first followed by the symbol of anion (Cl^{-}). Then their charges are criss-crossed to get the formula.

EXAMPLES

Formula of Sodium oxide

write symbol	Na O
Remember charge	+1 -2
Cross the charge	Na_2O

Formula of Sodium hydroxide

write symbol	Na OH
Remember charge	+1 -1
Cross the charge	$NaOH$

Formula of Sodium Chloride

write symbol	Na Cl
Remember charge	+1 -1
Cross the charge	$NaCl$

Formula of Calcium chloride

write symbol	Ca Cl
Remember charge	+2 -1
Cross the charge	$CaCl_2$

Formula of Potassium hydroxide

write symbol	K OH
Remember charge	+1 -1
Cross the charge	KOH

Formula of Zinc hydroxide

write symbol	Zn OH
Remember charge	+2 -1
Cross the charge	$Zn(OH)_2$

Formula of Zinc chloride

write symbol	Zn Cl
Remember charge	+2 -1
Cross the charge	$ZnCl_2$

Formula of Aluminium hydroxide

write symbol	Al OH
Remember charge	+3 -1
Cross the charge	$Al(OH)_3$

Formula of Calcium oxide

write symbol	Ca O
Remember charge	+2 -2
Cross the charge	CaO

Formula of Aluminium oxide

write symbol	Al O
Remember charge	+3 -2
Cross the charge	Al_2O_3

Formula of Silver oxide

write symbol	Ag O
Remember charge	+1 -2
Cross the charge	Ag_2O

Formula of Silver chloride

write symbol	Ag Cl
Remember charge	+1 -1
Cross the charge	$AgCl$

Formula of Ammonium Choride

write symbol	NH_4 Cl
Remember charge	+1 -1
Cross the charge	NH_4Cl

Formula of Ammonium carbonate

write symbol	NH_4 CO_3
Remember charge	+1 -2
Cross the charge	$(NH_4)_2CO_3$

Formula of Silver Carbonate

write symbol	Ag CO_3
Remember charge	+1 -2
Cross the charge	Ag_2CO_3

Formula of Silver Sulphate

write symbol	Ag SO_4
Remember charge	+1 -2
Cross the charge	Ag_2SO_4

Formula of Calcium hydroxide

write symbol	Ca OH
Remember charge	+2 -1
Cross the charge	$Ca(OH)_2$

Formula of Ammonium sulphate

write symbol	NH_4 SO_4
Remember charge	+1 -2
Cross the charge	$(NH_4)_2SO_4$

INTEXT QUESTIONS PAGE NO. 39

Q1. Write down the formulae of
(i) sodium oxide
(ii) aluminium chloride
(iii) sodium suphide
(iv) magnesium hydroxide
Answer:
(i) Sodium oxide → Na_2O
(ii) Aluminium chloride → $AlCl_3$
(iii) Sodium sulphide → Na_2S
(iv) Magnesium hydroxide → $Mg(OH)_2$

Q2. Write down the names of compounds represented by the following formulae:
(i) $Al_2(SO_4)_3$
(ii) $CaCl_2$
(iii) K_2SO_4
(iv) KNO_3
(v) $CaCO_3$.
Answer:
(i) $Al_2(SO_4)_3$ →Aluminium Sulphate
(ii) $CaCl_2$ → Calcium Chloride
(iii) K_2SO_4 → Potassium sulphate
(iv) KNO_3 → Potassium nitrate
(v) $CaCO_3$. → Calcium carbonate

Q3. What is meant by the term chemical formula?
Answer:
The chemical formula of a compound means the symbolic representation of the composition of a compound. From the chemical formula of a compound, we can know the number and kinds of atoms of different elements that constitute the compound.
For example, from the chemical formula CO2 of carbon dioxide, we come to know that one carbon atom and two oxygen atoms are chemically bonded together to form one molecule of the compound, carbon dioxide.

Q4. How many atoms are present in a
(i) H_2S molecule and
(ii) PO_4^{3-} ion?
Answer:
(i) In an H_2S molecule, three atoms are present; two of hydrogen and one of sulphur.
(ii) In a PO_4^{3-} ion, five atoms are present; one of phosphorus and four of oxygen.

MOLECULAR MASS

Atomic mass: The atomic mass of an element is the mass of one atom of that element in atomic mass units or (u).

Atomic mass unit (amu): $1/12^{th}$ of the mass of an atom of carbon-12 is called atomic mass unit. It is a unit of mass used to express atomic masses and molecular masses.

Molar mass: The molar mass of an element is equal to the numerical value of the atomic mass. However, in case of molar mass, the units change from 'u' to 'g'. The molar mass of an atom is also known as gram atomic mass.
For example, the atomic mass of carbon =12 atomic mass units. So, the gram atomic mass of carbon = 12 grams.

Molecular mass of the molecule: The sum of the atomic masses of all the atoms in a molecule of a substance is called the molecular mass of the molecule.

Molecular mass - calculation: Generally we use relative atomic masses of atoms for calculating the molecular mass of 1 mole of any molecular or ionic substances.
Example: Molecular mass of H_2SO_4
Atomic mass of Hydrogen = 1
Atomic mass of sulphur = 32
Atomic mass of oxygen = 16
Molecular mass of H_2SO4 = 2(Atomic mass of Hydrogen) + 1 (Atomic mass of sulphur) + 4 (Atomic mass of oxygen) = 2×1 + 32 + 4× 16 = 98 u.

Calculation of molecular mass of hydrogen chloride:
Atomic mass of hydrogen + Atomic mass of chlorine = 1 + 35.5 = 36.5 u.

FORMULA UNIT MASS

The formula unit mass of a substance is the sum of the atomic masses of all atoms in a formula unit of a compound. The term 'formula unit' is used for those substances which are made up of ions.

Formula unit mass of NaCl: 1 x Atomic mass of Na + 1 x Atomic mass of Cl
1 x 23 +1 x 35.5 = 58.5 atomic mass units.

Formula unit mass of ZnO:
= 1 x Atomic mass of Zn + 1 x Atomic mass O
= 1 x 65 + 1 x 16 = 81 u.

INTEXT QUESTIONS PAGE NO. 40

Q1. Calculate the molecular masses of H_2, O_2, Cl_2, CO_2, CH_4, C_2H_6, C_2H_4, NH_3, CH_3OH.
Answer:
Molecular mass of O_2 = 2 × Atomic mass of O = 2 × 16 = 32 u
Molecular mass of Cl_2 = 2 × Atomic mass of Cl = 2 × 35.5 = 71 u
Molecular mass of CO_2 = Atomic mass of C + 2 × Atomic mass of O = 12 + 2 × 16 = 44 u
Molecular mass of CH_4 = Atomic mass of C + 4 × Atomic mass of H = 12 + 4 × 1 = 16 u
Molecular mass of C_2H_6 = 2 × Atomic mass of C + 6 × Atomic mass of H = 2 × 12 + 6 × 1 = 30 u
Molecular mass of C_2H_4 = 2 × Atomic mass of C + 4 × Atomic mass of H = 2 × 12 + 4 × 1 = 28 u

Molecular mass of NH_3 = Atomic mass of N + 3 × Atomic mass of H = 14 + 3 × 1 = 17 u
Molecular mass of CH_3OH = Atomic mass of C + 4 × Atomic mass of H + Atomic mass of O = 12 + 4 × 1 + 16 = 32 u

Q2. Calculate the formula unit masses of ZnO, Na_2O, K_2CO_3, given atomic masses of Zn = 65 u, Na = 23 u, K = 39 u, C = 12 u, and O = 16 u.
Answer:
Formula unit mass of ZnO = Atomic mass of Zn + Atomic mass of O = 65 + 16 = 81 u
Formula unit mass of Na_2O = 2 × Atomic mass of Na + Atomic mass of O
= 2 × 23 + 16 = 62 u
Formula unit mass of K_2CO_3 = 2 × Atomic mass of K + Atomic mass of C + 3 × Atomic mass of O = 2 × 39 + 12 + 3 × 16 = 138 u

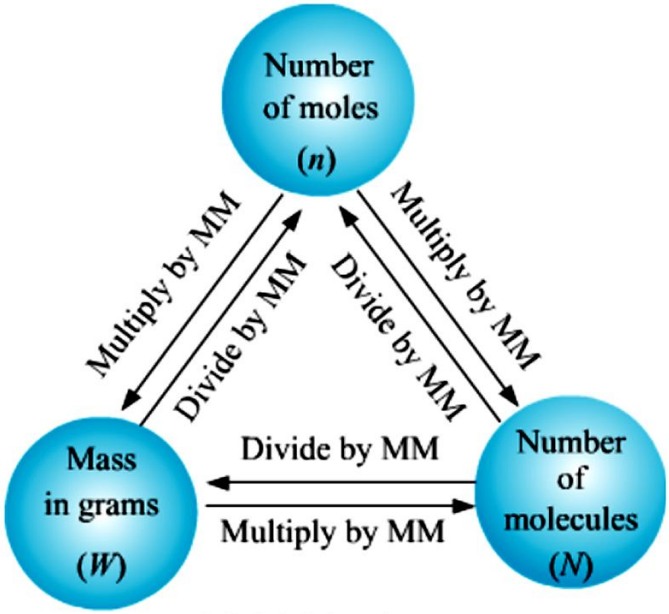
MOLE CONCEPT

Mole: Mole is the measurement in chemistry. It is used to express the amount of a chemical substance.
One mole is defined as the amount of substance of a system which contains as many entities like, atoms, molecules and ions as there are atoms in 12 grams of carbon - 12".

Avogadro number: The number of the particles present in one mole of any substance is equal to $6.022x10^{23}$. This is called avogadro's number or avogadro's constant.

Number of particles in 1 mole:
1 mole of hydrogen atoms represents 6.022×10^{23} hydrogen atoms.
1 mole of hydrogen molecules represents 6.022×10^{23} hydrogen molecules.
1 mole of water molecules represents 6.022×10^{23} water molecules.

Conversion of moles to mass and vice-versa



MM: Molecular mass

The key concept used in these kind of problems is that a mole of any substance contains gram formula mass or molecular mass of that substance i.e. molecular mass of Hydrogen is 2 a.m.u.

so mass of 1 mole of hydrogen which is also known as molar mass will be 2 gram. Similarly if we have 2 moles of hydrogen, it will weigh 2*2 grams which is equal to 4 grams.

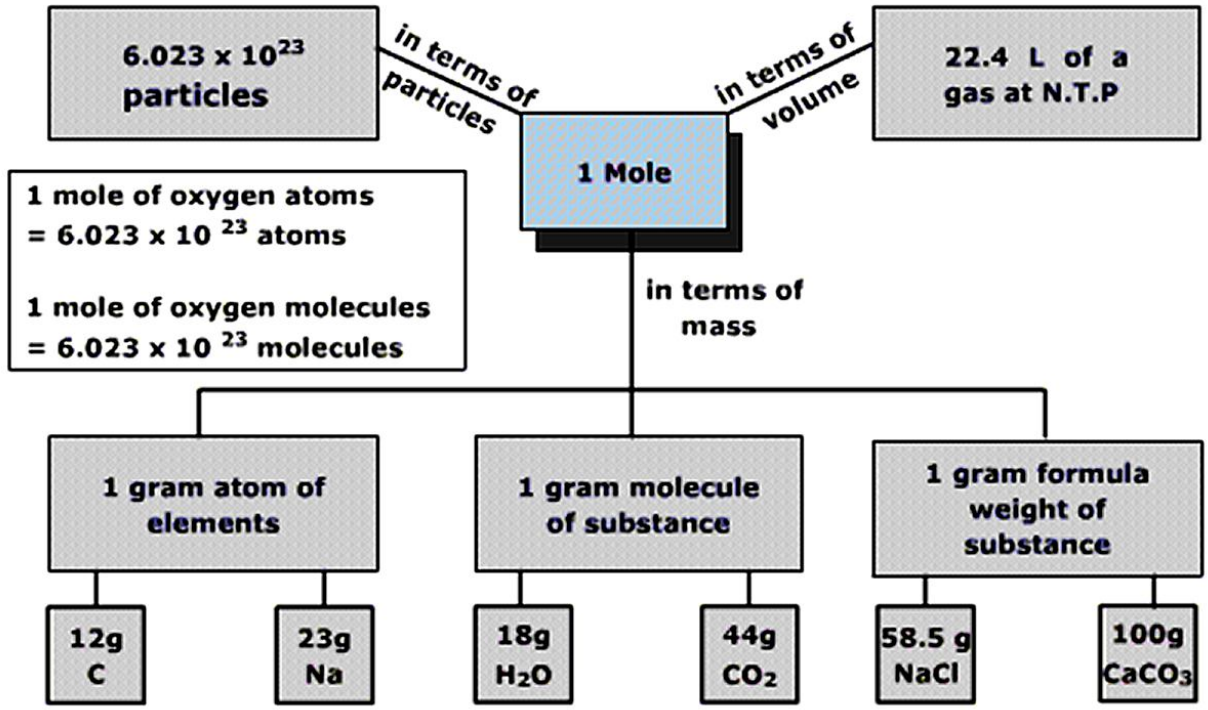
MOLE CONCEPT CALCULATION

This is the most basic and the most used calculation that a student comes across while solving a mole concept problem. Most of the times, moles or number of atoms or molecules are given in the question and the mass is needed to be calculated. In that case proceed as shown in the above example. In rest of the cases, mass will be given and moles or number will be needed to be calculated. In those questions also, proceed by:

STEP 1:- Establishing relationship between molar mass and the number (N_A) or moles of that particular entity (atom, molecule or ion).

STEP 2:- Use unitary method to calculate what is asked in the question.

NOTE: – When we say oxygen gas weighs 32 gram then we mean to say that 1 mole of oxygen molecule (O_2) weighs 32 grams and not 1 mole of oxygen atom which is O. This is because in natural form, oxygen exists as O_2 molecule.



PROBLEMS (BASED ON MOLE CONCEPT)

1. When the mass of the substance is given:

$$\text{Number of moles} = \frac{\text{given mass}}{\text{atomic mass}}$$

Example 1. Calculate the number of moles in 81g of aluminium

$$\text{Number of moles} = \frac{\text{given mass}}{\text{atomic mass}} = \frac{81}{27} = 3 \text{ moles of aluminium}$$

Example 2. Calculate the mass of 0.5 mole of iron
Solution: mass = atomic mass x number of moles
= 55.9 x 0.5 = 27.95 g

2. Calculation of number of particles when the mass of the substance is given:

$$\text{Number of particles} = \frac{\text{Avogadro number} \times \text{given mass}}{\text{gram molecular mass}}$$

Example 1. Calculate the number of molecules in 11g of CO_2
Solution: gram molecular mass of CO_2 = 44g

$$\text{Number of particles} = \frac{6.023\times10^{23}\times11}{44} = 1.51\times10^{23}\ \text{molecules}$$

3. Calculation of mass when number of particles of a substance is given:

$$\text{Mass of a substance} = \frac{\text{gram molecular mass} \times \text{number of particles}}{6.023\times10^{23}}$$

Example 1. Calculate the mass of 18.069 x 10^{23} molecules of SO_2
Sol: Gram molecular mass SO_2 = 64g

$$\text{Mass of } SO_2 = \frac{64\times18.069\times10^{23}}{6.023\times10^{23}} = 192g$$

Example 2. Calculate the mass of glucose in 2 x 10^{24} molecules
Gram molecular mass of glucose = 180g

$$\text{Mass of glucose} = \frac{180\times2\times10^{23}}{6.023\times10^{23}} = 597.7g$$

4. Calculation of number of moles when you are given number of molecules:

$$\text{Number of moles of atom} = \frac{\text{Number of molecules}}{\text{Avogadro Number}}$$

Example 1. Calculate number of moles in 12.046 x 10^{22} atoms of copper

$$\text{Number of moles of atom} = \frac{\text{Number of molecules}}{\text{Avogadro Number}} = \frac{12.046\times10^{22}}{6.023\times10^{23}} = 0.2\ \ moles$$

INTEXT QUESTIONS PAGE NO. 42

Q1. If one mole of carbon atoms weighs 12 gram, what is the mass (in gram) of 1 atom of carbon?
Answer:
One mole of carbon atoms weighs 12 g (Given)
i.e., mass of 1 mole of carbon atoms = 12 g
Then, mass of 6.022×10^{23} number of carbon atoms = 12 g

$$\text{Therefore, mass of 1 atom of carbon} = \frac{12}{6.022\times10^{23}}g = 1.9926\times10^{23}g$$

Q2. Which has more number of atoms, 100 grams of sodium or 100 grams of iron (given, atomic mass of Na = 23 u, Fe = 56 u)?

Answer:
Atomic mass of Na = 23 u (Given)
Then, gram atomic mass of Na = 23 g
Now, 23 g of Na contains = 6.022×10^{23} number of atoms
Thus, 100 g of Na contains $=\frac{6.022\times10^{23}}{23}\times100 = 2.6182\times10^{24}$ number of atoms
Again, atomic mass of Fe = 56 u(Given)
Then, gram atomic mass of Fe = 56 g
Now, 56 g of Fe contains 6.022×10^{23} number of atoms
Thus, 100 g of Fe contains $=\frac{6.022\times10^{23}}{56}\times100 = 1.0753\times10^{24}$ number of atoms
Therefore, 100 grams of sodium contain more number of atoms than 100 grams of iron.

EXERCISE QUESTIONS PAGE NO. 43, 44

Q1. A 0.24 g sample of compound of oxygen and boron was found by analysis to contain 0.096 g of boron and 0.144 g of oxygen. Calculate the percentage composition of the compound by weight.
Answer:
Mass of boron = 0.096 g (Given)
Mass of oxygen = 0.144 g (Given)
Mass of sample = 0.24 g (Given)
Thus, percentage of boron by weight in the compound $=\frac{0.096}{0.24}\times100 = 40\%$
And, percentage of oxygen by weight in the compound $=\frac{0.144}{0.24}\times100 = 60\%$

Q 2. When 3.0 g of carbon is burnt in 8.00 g oxygen, 11.00 g of carbon dioxide is produced. What mass of carbon dioxide will be formed when 3.00 g of carbon is burnt in 50.00 g of oxygen? Which law of chemical combination will govern your answer?
Answer:
Carbon + Oxygen → Carbon dioxide
3 g of carbon reacts with 8 g of oxygen to produce 11 g of carbon dioxide.
If 3 g of carbon is burnt in 50 g of oxygen, then 3 g of carbon will react with 8 g of oxygen.
The remaining 42 g of oxygen will be left un-reactive.
In this case also, only 11 g of carbon dioxide will be formed.
The above answer is governed by the law of constant proportions.

Q 3. What are polyatomic ions? Give examples.
Answer:
A polyatomic ion is a group of atoms carrying a charge (positive or negative). For example, ammonium ion (NH_4^+), hydroxide ion (OH^-), carbonate ion (CO_3^{2-}), sulphate ion(SO_4^{2-})

Q 4. Write the chemical formulae of the following.
(a) Magnesium chloride
(b) Calcium oxide
(c) Copper nitrate
(d) Aluminium chloride
(e) Calcium carbonate.
Answer:
(a) Magnesium chloride → $MgCl_2$

(b) Calcium oxide → CaO
(c) Copper nitrate → $Cu(NO_3)_2$
(d) Aluminium chloride → $AlCl_3$
(e) Calcium carbonate → $CaCO_3$

Q 5. Give the names of the elements present in the following compounds.
(a) Quick lime
(b) Hydrogen bromide
(c) Baking powder
(d) Potassium sulphate.
Answer:
(a) Quick lime
Chemical formula : CaO
Elements present: Calcium, Oxygen
(b) Hydrogen bromide
Chemical formula : HBr
Elements present: Hydrogen, Bromine

(c) Baking powder
Chemical formula : NaHCO3
Elements present: Sodium, Hydrogen, Carbon, Oxygen

(d) Potassium sulphate.
Chemical formula : K_2SO_4
Elements present: Potassium, Sulphur, Oxygen

Q 6. Calculate the molar mass of the following substances.
(a) Ethyne, C_2H_2
(b) Sulphur molecule, S_8
(c) Phosphorus molecule, P_4 (Atomic mass of phosphorus = 31)
(d) Hydrochloric acid, HCl
(e) Nitric acid, HNO_3
Answer:
(a) Molar mass of ethyne, $C_2H_2 = 2 \times 12 + 2 \times 1 = 26$ g
(b) Molar mass of sulphur molecule, $S_8 = 8 \times 32 = 256$ g
(c) Molar mass of phosphorus molecule, $P_4 = 4 \times 31 = 124$ g
(d) Molar mass of hydrochloric acid, $HCl = 1 + 35.5 = 36.5$ g
(e) Molar mass of nitric acid, $HNO_3 = 1 + 14 + 3 \times 16 = 63$ g

Q 7. What is the mass of _____
(a) 1 mole of nitrogen atoms?
(b) 4 moles of aluminium atoms (Atomic mass of aluminium = 27)?
(c) 10 moles of sodium sulphite (Na_2SO_3)?
Answer:
(a) The mass of 1 mole of nitrogen atoms is 14 g.
(b) The mass of 4 moles of aluminium atoms is (4×27) g = 108 g
(c) The mass of 10 moles of sodium sulphite (Na_2SO_3) is
$10 \times [2 \times 23 + 32 + 3 \times 16]$ g = 10×126 g = 1260 g

Q 8. Convert into mole.
(a) 12 g of oxygen gas
(b) 20 g of water
(c) 22 g of carbon dioxide.

Answer:
(a) 32 g of oxygen gas = 1 mole
Then, 12 g of oxygen gas $= \frac{12}{32}$ mole = 0.375 mole
(b) 18 g of water = 1 mole
Then, 20 g of water $= \frac{20}{18}$ mole = 1.11 moles (approx)
(c) 44 g of carbon dioxide = 1 mole
Then, 22 g of carbon dioxide $= \frac{22}{44}$ mole = 0.5 mole

Q 9. What is the mass of:
(a) 0.2 mole of oxygen atoms?
(b) 0.5 mole of water molecules?
Answer:
(a) Mass of one mole of oxygen atoms = 16 g
Then, mass of 0.2 mole of oxygen atoms = 0.2 × 16g = 3.2 g
(b) Mass of one mole of water molecule = 18 g
Then, mass of 0.5 mole of water molecules = 0.5 × 18 g = 9 g

Q 10. Calculate the number of molecules of sulphur (S_8) present in 16 g of solid sulphur.
Answer:
1 mole of solid sulphur (S_8) = 8 × 32 g = 256 g
i.e., 256 g of solid sulphur contains = 6.022×10^{23} molecules
Then, 16 g of solid sulphur contains $= \frac{6.022 \times 10^{23}}{256} \times 16$ molecules
= 3.76×10^{22} molecules (approx)

Q 11. Calculate the number of aluminium ions present in 0.051 g of aluminium oxide. (*Hint:* The mass of an ion is the same as that of an atom of the same element. Atomic mass of Al = 27 u)
Answer:
1 mole of aluminium oxide (Al_2O_3) = 2 × 27 + 3 × 16 = 102 g
i.e., 102 g of Al_2O_3 = 6.022×10^{23} molecules of Al_2O_3
Then, 0.051 g of Al_2O_3 contains $= \frac{6.022 \times 10^{23}}{102} \times 0.051$ molecules
= 3.011×10^{20} molecules of Al_2O_3
The number of aluminium ions (Al^{3+}) present in one molecule of aluminium oxide is 2.
Therefore, the number of aluminium ions (Al^{3+}) present in 3.011×10^{20} molecules (0.051 g) of aluminium oxide (Al_2O_3) = 2 × 3.011×10^{20} = 6.022×10^{20}

ASSIGNMENT QUESTIONS SET – 1
CHAPTER – 3
ATOMS AND MOLECULES

Calculate the mass of one mole of these substances.

1. $AlCl_3$
2. TeF_4
3. PbS
4. Cu_2O
5. AgI
6. N_2O
7. $MoCl_5$
8. Hg_2Br_2
9. Ta_2O_5
10. HgF_2
11. KCl
12. KF
13. ZnO
14. $Ba(SCN)_2$
15. K_2S
16. NH_4Cl
17. KH_2PO_4
18. C_2H_5NBr
19. $Ba(ClO_3)_2$
20. $Fe(OH)_3$
21. $(NH_4)_2S$
22. $CoCl_2$
23. $KMnO_4$
24. $CaSO_4$
25. H_2CO_3
26. CO_2
27. LiH
28. CO
29. SnI_4
30. KOH
31. K_2O
32. H_2SO_4
33. Hg_3N_2
34. SiF_4
35. NH_4OH
36. N_2O_5
37. $SnCrO_4$
38. Al_2O_3
39. $CuCO_3$
40. $Ba(BrO_3)_2$
41. Hg_2Cl_2
42. $Cr_2(SO_3)_3$
43. $Al(MnO_4)_3$
44. $CoSO_4$
45. $Ca(NO_3)_3$
46. NaH_2PO_4
47. $(NH_4)_3PO_4$
48. $KAl(SO_4)_2$
49. Hg_2SO_4
50. $Al_2(SO_4)_3$
51. $FePO_4$
52. $Ca(C_2H_3O_2)_2$
53. $AlBr_3$
54. P_2O_5
55. NH_4NO_3
56. $Ba(OH)_2$
57. $PbSO_4$
58. $Ba_3(PO_4)_2$
59. $NaC_2H_3O_2$
60. $Ba(OH)_2$
61. $NaHCO_3$
62. $Al(OH)_3$
63. NH_4MnO_4
64. Fe_2O_3
65. $CaCO_3$
66. HCl
67. K_2SO_4
68. $NaCl$
69. LiI
70. Hg_2O
71. HF
72. $FeCl_3$
73. $NaHSO_4$
74. Ag_2O
75. $Pb(ClO_2)_2$
76. CoF_3
77. $Al(C_2H_3O_2)_3$
78. $Na_2Al_2(SO_4)_4$
79. $(HOOCCH_2)_2NCH_2CH_2N(CH_2COOH)_2$
80. $(NH_4)_2CH(CH_2)_5COOH$

Answers (each answer has the units g/mol)

1. 133.34
2. 203.59
3. 239.3
4. 143.09
5. 234.77
6. 44.01
7. 273.20
8. 560.98
9. 441.89
10. 238.59
11. 74.55
12. 58.10
13. 81.38
14. 255.26
15. 110.26
16. 53.49
17. 136.08
18. 122.97
19. 304.23
20. 106.87
21. 68.14
22. 129.84
23. 158.03
24. 136.14
25. 62.02
26. 44.01
27. 7.95
28. 28.01
29. 626.31
30. 56.106
31. 94.20
32. 98.07
33. 629.78
34. 104.08
35. 35.046
36. 108.01
37. 234.68
38. 101.96
39. 123.555
40. 393.1314
41. 472.09
42. 344.1666
43. 383.788
44. 154.99
45. 226.09
46. 119.977
47. 149.087
48. 258.195
49. 497.24
50. 342.136
51. 150.82
52. 158.169
53. 266.69
54. 141.944
55. 80.04
56. 171.34
57. 303.26
58. 601.93
59. 82.03
60. 171.34
61. 84.007
62. 78.00
63. 136.97
64. 159.69
65. 100.09
66. 36.461
67. 174.25
68. 58.443
69. 133.846
70. 417.179
71. 20.006
72. 162.206
73. 120.055
74. 231.74
75. 342.10
76. 115.928
77. 204.12
78. 484.173
79. 292.246
80. 164.248

1. Who established the two important laws of chemical combinations?

2. What are the laws of chemical combinations?

3. What is the law of conservation of mass?

4. Give an example to show Law of conservation of mass applies to physical change also.

5. Explain with example that law of conservation of mass is valid for chemical reactions.

6. The 2.8 g of nitrogen gas was allowed to react with 0.6 g of hydrogen gas to produce 3.4 g of ammonia. Show that these observations are in agreement with the law of Conservation of mass.

7. If 12 g of carbon is burnt in the presence of 32 g of oxygen, how much carbon dioxide will be formed?

8. Who proposed Law of Definite Proportions (or Law of Constant Composition)?

9. State Law of constant proportions. Explain with an example.

10. Show that water illustrates the law of constant proportions.

11. Hydrogen and oxygen combine in the ratio of 1:8 by mass to form water. What mass of oxygen gas would be required to react completely with 3 g of hydrogen gas?

12. A 0.24 g sample of compound of oxygen and boron was found by analysis to contain 0.096 g of boron and 0.144 g of oxygen. Calculate the percentage composition of the compound by weight.

13. When 3.0 g of carbon is burnt in 8.00 g oxygen, 11.00 g of carbon dioxide is produced. What mass of carbon dioxide will be formed when 3.00 g of carbon is burnt in 50.00 g of oxygen? Which law of chemical combination will govern your answer?

14. Magnesium and oxygen combine in the ratio of 3 : 2 by mass to form magnesium oxide. How much oxygen is required to react completely with 12 g of magnesium?

15. What are the postulates of Dalton's atomic theory?

16. Which of the following statements is NOT true about an atom?

(a) Atoms are the building blocks from which molecules and ions are formed.

(b) Atoms cannot exist independently.

(c) Atoms are neutral in nature

(d) Atoms combine together to form matter that we can see, feel or touch.

17. What is an atom?

18. Why is it not possible to see an atom with naked eyes?

19. Who proposed the chemical notation based on first two letters of the name of the element?

20. Name the international organization who approves names of elements.

21. What is the chemical symbol for iron?

22. Name five elements have single letter chemical symbol.

23. Name the element having following Latin names

(i) Stibium

(ii) Cuprum

(iii) Argentum

(iv) Natrium

(v) Stannum

(vi) Wolfram

(vii) plumbum

(viii) Kalium

24. Write the chemical symbols of the following:

(i) Gold

(ii) Iron

(iii) Chlorine

(iv) Mercury

25. How will you define chemical symbol?

26. What is the significance of a chemical symbol?

27. Can atoms of an element exist independently? Give examples of elements which exist in atomic form. Give examples of elements that do not exist in atomic form.

28. Why do atoms of the most of the elements not exist independently?

29. Which element has the smallest atom in size?

30. What is the atomic mass unit?

31. Magnesium is two times heavier than C-12 atom, what shall be the mass of Mg atom in terms of atomic mass units? (Given mass of C-12 atom = 12u)

32. What is relative atomic mass of an element? How it is related to atomic mass unit?

33. Define molecule. What are its important properties?

34. Based on type of substance, how molecules are classified?

35. What is atomicity?

36. Based on atomicity, how molecules are categorized?

37. Give three examples of monoatomic molecules.

38. Give four examples of diatomic molecules.

39. (i) What is the chemical formula of Water molecule? (ii) What is its atomicity? (iii) Calculate the ratio of masses of atoms of elements present in water molecule. (iv) Calculate the ratio by number of atoms of elements present in water molecule.

40. What is an ion?

41. What are polyatomic ions? Give examples?

42. Give examples of triatomic molecules.

43. What is valency of an element?

44. What is meant by the term chemical formula?

45. Write down the formulae of

(i) sodium oxide

(ii) aluminium chloride

(iii) sodium suphide

(iv) magnesium hydroxide

46. Write down the names of compounds represented by the following formulae:

(i) $Al_2(SO_4)_3$

(ii) $CaCl_2$

(iii) K_2SO_4

(iv) KNO_3

(v) $CaCO_3$

47. Write the chemical formulae of the following. Also identify the ions present.

(a) Magnesium chloride

(b) Calcium oxide

(c) Copper nitrate

(d) Aluminium chloride

(e) Calcium carbonate.

48. Give the names of the elements present in the following compounds.

(a) Quick lime

(b) Hydrogen bromide

(c) Baking powder

(d) Potassium sulphate.

49. How many atoms are present in a (i) H_2S molecule and (ii) PO_4^{3-} ion?

50. (a) Write a chemical formula of a compound using zinc ion and phosphate ion. (b) Calculate the ratio by mass of atoms present in a molecule of carbon dioxide. (Given C =12, O =16)

51. What is the molecular mass of a substance?

52. What is Formula Unit Mass? How it is different from molecular mass?

53. Calculate the formula unit masses of ZnO, Na_2O, K_2CO_3, given atomic masses of Zn = 65 u, Na = 23 u, K = 39 u, C = 12 u, and O = 16 u.

54. What are ionic compounds?

55. How do we know the presence of atoms if they do not exist independently for most of the elements?

56. An element 'Z' forms the following compound when it reacts with hydrogen, chlorine, oxygen and phosphorus.

ZH_3, ZCl_3, Z_2O_3 and ZP

(a) What is the valency of element Z?

(b) Element 'Z' is metal or non-metal?

57. Name one element each which forms diatomic and tetra atomic molecule.

58. Name one element which forms diatomic and triatomic molecule.

59. What is gram-atomic mass of an element?

60. What is gram-molecular mass of a substance?

61. Define mole. What is its significance?

62. What is molar mass?

63. Who introduced the term 'mole' in chemistry?

64. When 'mole' was chosen internationally standard way to express larger number of chemical units?

65. How many moles are there in 4.6 gms of Sodium(Na)?

66. If one mole of carbon atoms weighs 12 gram, what is the mass (in gram) of 1 atom of carbon?

67. Which has more number of atoms, 100 grams of sodium or 100 grams of iron (given, atomic mass of Na = 23 u, Fe = 56 u)?

68. What is the mass of

(a) 1 mole of nitrogen atoms?

(b) 4 moles of aluminium atoms (Atomic mass of aluminium = 27)?

(c) 10 moles of sodium sulphite (Na_2SO_3)?

69. Convert into moles:

(a) 12 g of oxygen gas

(b) 20 g of water

(c) 22 g of carbon dioxide

70. What is the mass of: (a) 0.2 mole of oxygen atoms? (b) 0.5 mole of water molecules?

71. Find out number of atoms in 15 moles of He.

72. Calculate the number of molecules of sulphur (S_8) present in 16 g of solid sulphur.

73. Calculate the number of aluminium ions present in 0.051 g of aluminium oxide.

(Hint: The mass of an ion is the same as that of an atom of the same element. Atomic mass of Al = 27 u)

74. Calculate the mass percentage of Carbon(C) , Hydrogen (H) and Oxygen (O) in one molecule of glucouse ($C_6H_{12}O_6$).

(Atomic mass of C = 12u, H = 1u and O = 16u)

75. Calculate the number of molecules of phosphorus (P_4) present in 31 gram of phosphorus.

ASSIGNMENT QUESTIONS SET – 2
CHAPTER – 3
ATOMS AND MOLECULES

MOLECULAR MASS AND MOLE CALCULATION PROBLEMS

1. Calculate the number of moles in i) 4.6g sodium ii) 5.1g of Ammonia iii) 90g of water iv) 2g of NaOH

2. Calculate the number of molecules in 360g of glucose.

3. Find the mass of 2.5 mole of oxygen atoms

4. Calculate the mass of 12.046×10^{23} molecules in CaO.

5. Calculate the number of moles in 24.092×10^{22} molecules of water.

6. Calculate the number of moles in a) 12.046×10^{23} atoms of copper b) 27.95g of iron c) 1.51×10^{23} molecules of CO_2

7. If 3.0115×10^{23} particles are present in CO_2. Find the number of moles.

8. Find the number of moles present in 24.088×10^{23} particles of carbon dioxide

9. Calculate the number of atoms in 48g of Mg

10. Calculate the number of molecules in 3.6 g of water

11. Calculate the number of atoms in 0.5 moles of carbon

12. Calculate the number of moles in 12g of oxygen gas

13. Calculate the number of moles present in 14g of carbon monoxide .

14. Find the mass of 5 moles of aluminium atoms?

15. Calculate the molar mass of sulphur.

16. Calculate the mass of 0.2 mole of water molecules.

17. Which has greater number of atoms, 100g of sodium or 100g of iron?

18. How many atoms of oxygen are present in 300 grams of $CaCO_3$?

19. The mass of one atom of an element 'A' is 2.65×10^{-23} g. Calculate its atomic mass and name the element.

20. Calculate the number moles of magnesium in 0.478g of magnesium ?

21. In which of the following cases the number of hydrogen atoms is more ? Two moles of HCl or one mole of NH_3.

22. Calculation of number of hydrogen atoms present in 1 mole of NH_3

23. Find the number of oxygen atoms in 88g of CO_2?

24. Calculate the number of water molecules contained in a drop of water weighing 0.06g ?

25. Find the number of aluminium ions present in 0.051g of aluminium oxide(Al_2O_3). (Atomic masses: Al= 27u;O= 16u)

26. Calculate the mass of 1.000 mole of $CaCl_2$

27. Calculate grams in 3.0000 moles of CO_2

28. Calculate number of moles in 32.0 g of CH_4

29. Determine mass in grams of 40.0 moles of Na_2CO_3

30. Calculate moles in 168.0 g of HgS

31. Calculate moles in 510.0 g of Al_2S_3

32. How many moles are in 27.00 g of H_2O

33. Determine the mass in grams of Avogadro number of $C_{12}H_{22}O_{11}$

34. Find mass in grams of 9.03 moles of H_2S

35. Determine grams in 1.204 mole of NH_3

Consider the molecule $CuNH_4Cl_3$ as you answer 11 - 19.

36. Name the elements present.

37. How many atoms form the molecule?

38. How many of each atom in the molecule?

39. How many hydrogen atoms in one mole of molecules?

40. How many chlorine atoms in six moles of molecules?

41. What is the molar mass of this molecule?

42. Name this molecule.

43. What is the mass in grams of one molecule?

44. How many moles would be in 6.84 g of this substance?

45. You need 0.0100 mole of lead (II) chromate. How much should you weigh on the scale?

46. Given 6.40 g of HBr. How many moles is this?

47. Write the correct formula for calcium acetate and then answer 23 - 25 based on it.

48. What is the mass of exactly one mole of calcium acetate?

49. How many moles are contained in 1.58 g of the substance in #23?

50. How much does 0.400 mole of #23 weigh?

51. Write the formula for oxygen gas.

52. How many atoms (and moles) are represented by the formula in #26?

53. What is the mass of Avogadro Number of oxygen molecules?

54. Calculate the molar mass of HNO_3. [N = 14, O = 16, H = 1]

55. Calculate the formula mass of $CaCl_2$. [Ca = 40, Cl = 35.5]

56. A certain non-metal X forms two oxides I and II. The mass percentage of oxygen in oxide I (X_4O_6) is 43.7, which is same as that of X in oxide II. Find the formula of the second oxide.

57. Calculate the mass of 0.2 moles of water (O=16, H=1).

58. What is the volume of 7.1 g of chlorine (Cl=35.5) at S.T.P.

59. The reaction between aluminium carbide and water takes place according to the following equation: $Al_4C_3 + 12H_2O \longrightarrow 3CH_4 + 4Al(OH)_3$. Calculate the volume of CH_4 released from 14.4 g of Al_4C_3 by excess water at S.T.P. (C = 12, Al = 27)

60. A compound of sodium, sulphur and oxygen has the following percentage composition. Na=29.11%, S=40.51%, O=30.38%. Find its empirical formula (O=16, Na=23, S=32).

61. Solid ammonium dichromate with relative molecular mass of 252 g decomposes according to the equation: $(NH_4)Cr_2O_7 \longrightarrow N_2 + Cr_2O_3 + 4H_2O$. (i) What volume of nitrogen at S.T.P will be evolved when 63 g of $(NH_4)_2Cr_2O_7$ is decomposed? (ii) If 63 g of $(NH_4)_2Cr_2O_7$ is heated above 100^0C, what will be the loss of mass? (H=1, N=14, O=16, Cr=52).

62. How many litres of ammonia are present in 3.4 kg of it? (N = 14, H = 1)

63. About 640 mL of carbon monoxide is mixed with 800 mL of oxygen and ignited in an enclosed vessel. Calculate the total volume of gases after the burning is completed. All volumes are measured at S.T.P.

64. Calculate the number of moles of ammonium sulphate present in 15.84 kg of it. (H=1, N=14, O=16, S=32)

ASSIGNMENT QUESTIONS SET – 3
CHAPTER – 3
ATOMS AND MOLECULES

1. Avogadro's number represents the number of atoms in
(a) 12g of $C1_2$ (b) 320g of sulphur
(c) 32g of oxygen (d) 12.7g of iodine

2. The number of moles of carbon dioxide which contain 8 g of oxygen is
(a) 0.5 mol (b) 0.20 mol
(c) 0.40 mol (d) 0.25 mol

3. The total no of ions present in 111 g of $CaCl_2$ is
(a) One mole (b) Two mole
(c) Three mole (d) Four moles

4. Which of the following weighs the most ?
(a) one g-atom of nitrogen (b) One mole of water
(c) One mole of sodium (d) One molecule of $H2SO_4$

5. 5.0 litre of 0.4 M H_2SO_4 Contains-
(a) 2.0 Mole Of H_2SO_4 (b) 0.4 mole H_2SO_4
(c) 5.0 mole H_2SO_4 (d) 2.0 moles H_2O

6. Which of the following correctly represents 360 g of water?
(i) 2 moles of H_20
(ii) 20 moles of water
(iii) 6.022 × 1023 molecules of water
(iv) 1.2044×1025 molecules of water
(a) (i) (b) (i) and (iv)
(c) (ii) and (iii) (d) (ii) and (iv)

7. Which of the following statements is not true about an atom?
(a) Atoms are not able to exist independently
(b) Atoms are the basic units from which molecules and ions are formed
(c) Atoms are always neutral in nature
(d) Atoms aggregate in large numbers to form the matter that we can see, feel or touch

8. The chemical symbol for nitrogen gas is
(a) Ni (b) N2 (c) N+ (d) N

9. The chemical symbol for sodium is
(a) So (b) Sd (c) NA (d) Na

10. Which of the following would weigh the highest?
(a) 0.2 mole of sucrose (C_{12} H_{22} O_{11})
(b) 2 moles of CO_2
(c) 2 moles of $CaCO_3$
(d) 10 moles of H_2O

11. Which of the following has maximum number of atoms?
(a) 18g of H_2O
(b) 18g of O_2
(c) 18g of CO_2
(d) 18g of CH_4

12. Which of the following contains maximum number of molecules?
(a) 1g CO_2
(b) 1g N_2
(c) 1g H_2
(d) 1g CH_4

13. Mass of one atom of oxygen is
$(a)\frac{16}{6.023\times10^{23}}g$ $(b)\frac{32}{6.023\times10^{23}}g$ $(c)\frac{1}{6.023\times10^{23}}g$ $(d)8u$

14. 3.42 g of sucrose are dissolved in 18g of water in a beaker. The number of oxygen atoms in the solution are
(a) 6.68×10^{23}
(b) 6.09×10^{22}
(c) 6.022×10^{23}
(d) 6.022×10^{21}

15. A change in the physical state can be brought about
(a) only when energy is given to the system
(b) only when energy is taken out from the system
(c) when energy is either given to, or taken out from the system
(d) without any energy change

16. Which of the following represents a correct chemical formula? Name it.
(a) CaCl (b) $BiPO_4$ (c) $NaSO_4$ (d) NaS

17. Write the molecular formulae for the following compounds
(a) Copper (II) bromide
(b) Aluminium (III) nitrate
(c) Calcium (II) phosphate
(d) Iron (III) sulphide
(e) Mercury (II) chloride
(f) Magnesium (II) acetate

18. Write the molecular formulae of all the compounds that can be formed by the combination of following ions
Cu^{2+}, Na^{+}, Fe^{3+}, C1^{-}, SO_4^{2-}, PO_4^{3-}

19. Write the cations and anions present (if any) in the following compounds
(a) CH_3COONa
(b) NaCl
(c) H_2
(d) NH_4NO_3

20. Give the formulae of the compounds formed from the following sets of elements
(a) Calcium and fluorine

(b) Hydrogen and sulphur
(c) Nitrogen and hydrogen
(d) Carbon and chlorine
(e) Sodium and oxygen
(f) Carbon and oxygen

21. Which of the following symbols of elements are incorrect? Give their correct symbols
(a) Cobalt CO
(b) Carbon c
(c) Aluminium AL
(d) Helium He
(e) Sodium So

22. Give the chemical formulae for the following compounds and compute the ratio by mass of the combining elements in each one of them.
(a) Ammonia
(b) Carbon monoxide
(c) Hydrogen chloride
(d) Aluminium fluoride
(e) Magnesium sulphide

23. State the number of atoms present in each of the following chemical species
(a) CO_3^{2-}
(b) PO_4^{3-}
(c) P_2O_5
(d) CO

24. Find the ratio by mass of the combining elements in the compound – C_2H_5OH.

25. Give the formula of the compound formed by the elements calcium and fluorine.

26. What is the acid radical present in sodium peroxide?

27. Carbon and silicon have the same valency. What is the formula of sodium silicate?

28. What is the ratio by number of atoms in mercurous chloride?

29. Name the element whose Latin name is Stibium.

30. What is the valency of a sulphide ion?

31. How many atoms of oxygen are present in 50g of $CaCO_3$?

32. How many molecules are present in 1 ml of water?

33. What is the unit of measurement of atomic radius?

34. Name the international organization who approves names of elements.

35. How do we know the presence of atoms if they do not exist independently for most of the elements?

36. Give an example to show Law of conservation of mass applies to physical change also.

37. Explain with example that law of conservation of mass is valid for chemical reactions.

38. Is there any exception to law of conservation of mass?

39. In a reaction, 5.3 g of sodium carbonate reacted with 6 g of ethanoic acid. The products were 2.2 g of carbon dioxide, 0.9 g water and 8.2 g of sodium ethanoate. Show that these observations are in agreement with the law of conservation of mass.

sodium carbonate + ethanoic acid → sodium ethanoate + carbon dioxide + water

40. If 12 g of carbon is burnt in the presence of 32 g of oxygen, how much carbon dioxide will be formed?

41. A 0.24 g sample of compound of oxygen and boron was found by analysis to contain 0.096 g of boron and 0.144 g of oxygen. Calculate the percentage composition of the compound by weight.

42. When 3.0 g of carbon is burnt in 8.00 g oxygen, 11.00 g of carbon dioxide is produced. What mass of carbon dioxide will be formed when 3.00 g of carbon is burnt in 50.00 g of oxygen? Which law of chemical combination will govern your answer?

43. Magnesium and oxygen combine in the ratio of 3 : 2 by mass to form magnesium oxide. How much oxygen is required to react completely with 12 g of magnesium?

44. Why are Dalton's symbol not used in chemistry?

45. What is the fraction of the mass of water due to neutrons?

46. Does the solubility of a substance change with temperature? Explain with the help of an example.

47. Classify each of the following on the basis of their atomicity.

(a) F_2	(b) NO_2	(c) N_2O	(d) C_2H_6	(e) P_4	(f) H_2O_2
(g) P_4O_{10}	(h) O_3	(i) HCl	(j) CH_4	(k) He	(l) Ag

48. You are provided with a fine white coloured powder which is either sugar or salt. How would you identify it without tasting?

49. Calculate the number of moles of magnesium present in a magnesium ribbon weighing 12 g. Molar atomic mass of magnesium is 24g mol–1.

50. Verify by calculating that
(a) 5 moles of CO_2 and 5 moles of H_2O do not have the same mass.
(b) 240 g of calcium and 240 g magnesium elements have a mole ratio of 3:5.

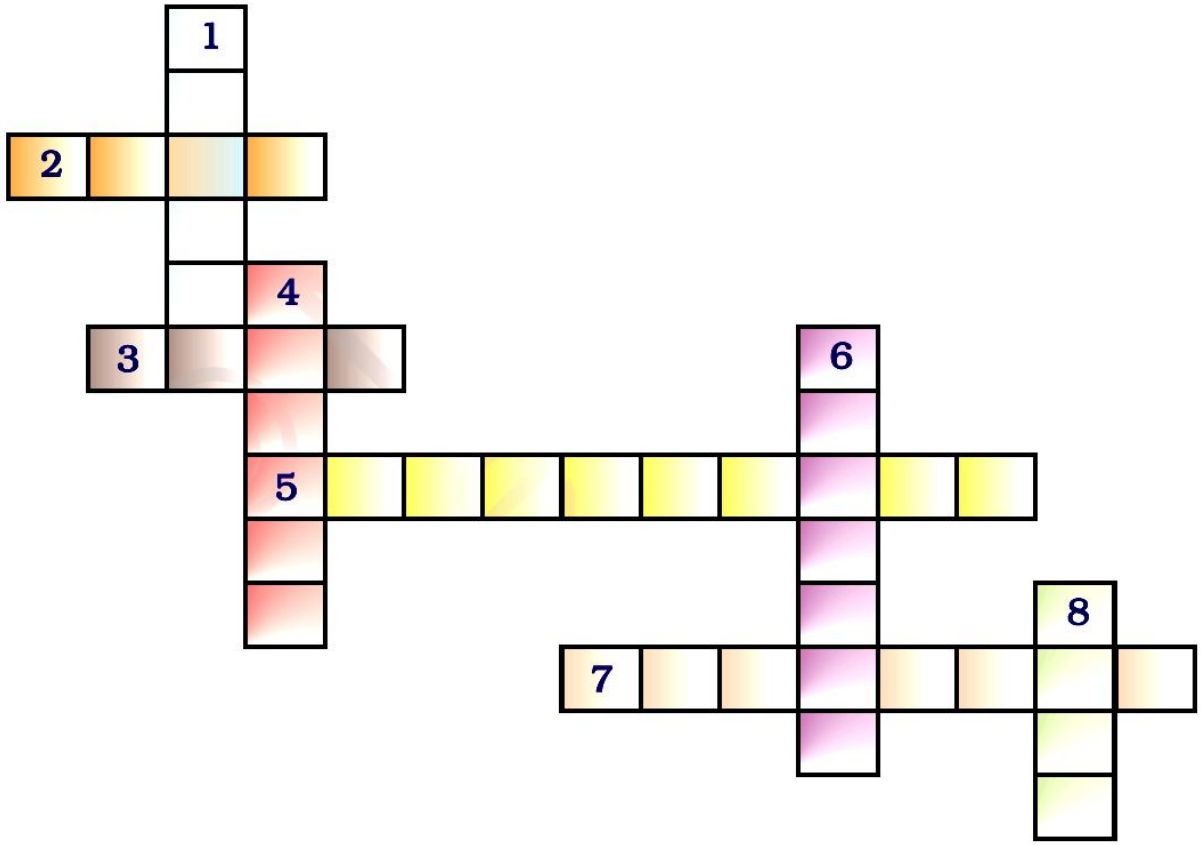
51. Find the ratio by mass of the combining elements in the following compounds.
(a) $CaCO_3$ (d) C_2H_5OH
(b) $MgCl_2$ (e) NH_3
(c) H_2SO_4 (f) $Ca(OH)_2$

52. Calcium chloride when dissolved in water dissociates into its ions according to the following equation.
$CaCl_2$ (aq) → Ca^{2+} (aq) + $2Cl^-$ (aq)
Calculate the number of ions obtained from $CaCl_2$ when 222 g of it is dissolved in water.

53. The difference in the mass of 100 moles each of sodium atoms and sodium ions is 5.48002g. Compute the mass of an electron.

54. Complete the following crossword puzzle (below Figure) by using the name of the chemical elements. Use the data given in below Table

Table 3.2	
Across	**Down**
2. The element used by Rutherford during his α–scattering experiment 3. An element which forms rust on exposure to moist air 5. A very reactive non–metal stored under water 7. Zinc metal when treated with dilute hydrochloric acid produces a gas of this element which when tested with burning splinter produces a pop sound.	1. A white lustrous metal used for making ornaments and which tends to get tarnished black in the presence of moist air 4. Both brass and bronze are alloys of the element 6. The metal which exists in the liquid state at room temperature 8. An element with symbol Pb



55. Fill in the missing data in the below Table

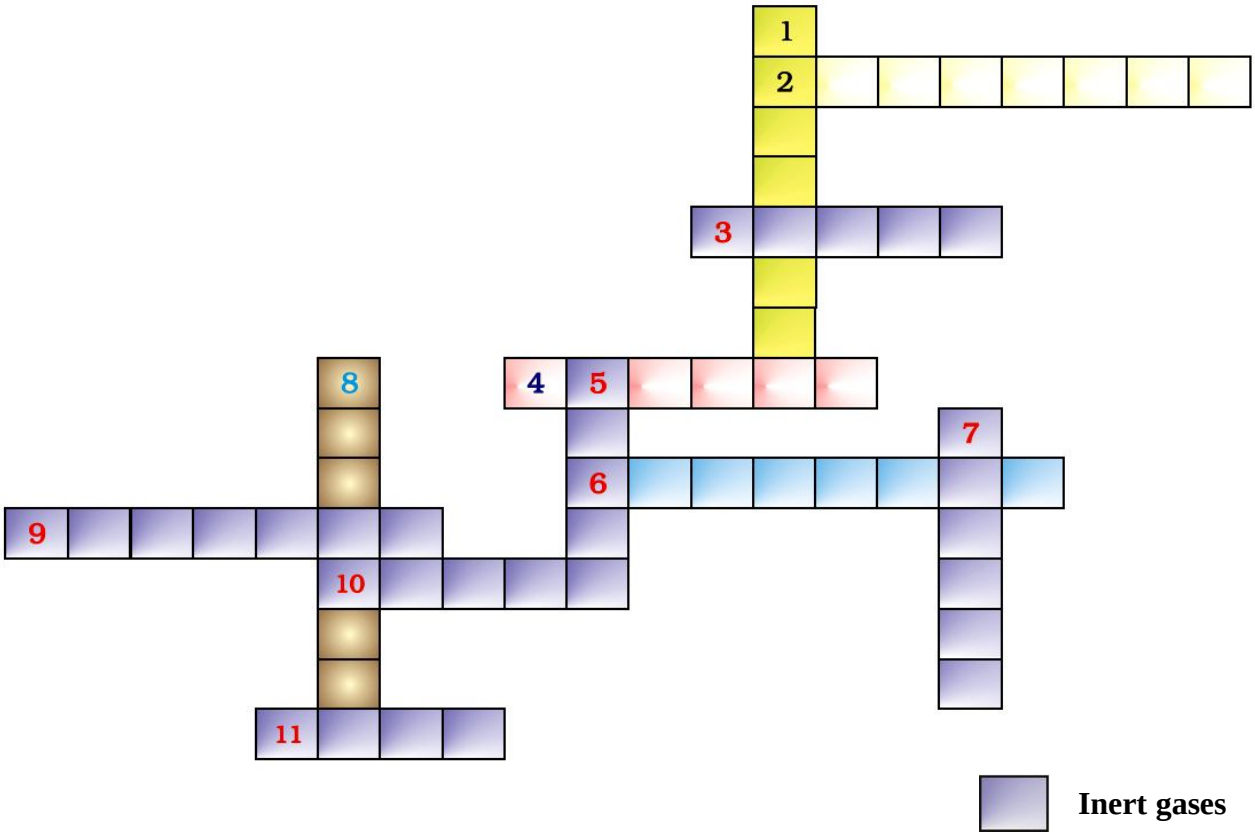
Species **Property**	**H_2O**	**CO_2**	**Na atom**	**$MgCl_2$**
No of moles	2			0.5
No. of particles		3.011×10^{23}		
Mass	36g		115g	

56. The visible universe is estimated to contain 10^{22} stars. How many moles of stars are present in the visible universe?

57. What is the SI prefix for each of the following multiples and submultiples of a unit?
(a) 10^{3} (b) 10^{-1} (c) 10^{-2} (d) 10^{-6} (e) 10^{-9} (f) 10^{-12}

58. (a) In this crossword puzzle (Fig 3.2), names of 11 elements are hidden. Symbols of these are given below. Complete the puzzle.

1. Cl
2. H
3. Ar
4. O
5. Xe
6. N
7. He
8. F
9. Kr
10. Rn
11. Ne



(b) Identify the total number of inert gases, their names and symbols from this cross word puzzle.

59. Express each of the following in kilograms
(a) 5.84×10^{-3} mg
(b) 58.34 g
(c) 0.584g
(d) 5.873×10^{-21}g

60. Compute the difference in masses of 103 moles each of magnesium atoms and magnesium ions. (Mass of an electron = 9.1×10^{-31} kg)

61. Which has more number of atoms? 100g of N_2 or 100 g of NH_3

62. Compute the number of ions present in 5.85 g of sodium chloride.

63. A gold sample contains 90% of gold and the rest copper. How many atoms of gold are present in one gram of this sample of gold?

64. Cinnabar (HgS) is a prominent ore of mercury. How many grams of mercury are present in 225 g of pure HgS? Molar mass of Hg and S are 200.6 g mol^{-1} and 32 g mol^{-1} respectively.

65. The mass of one steel screw is 4.11g. Find the mass of one mole of these steel screws. Compare this value with the mass of the Earth (5.98 × 1024kg). Which one of the two is heavier and by how many times?

66. A sample of vitamic C is known to contain 2.58 ×1024 oxygen atoms. How many moles of oxygen atoms are present in the sample?

67. Raunak took 5 moles of carbon atoms in a container and Krish also took 5 moles of sodium atoms in another container of same weight. (a) Whose container is heavier? (b) Whose container has more number of atoms?

68. What are ionic and molecular compounds? Give examples.

69. Compute the difference in masses of one mole each of aluminium atoms and one mole of its ions. (Mass of an electron is 9.1×10–28 g). Which one is heavier?

70. A silver ornament of mass 'm' gram is polished with gold equivalent to 1% of the mass of silver. Compute the ratio of the number of atoms of gold and silver in the ornament.

71. A sample of ethane (C_2H_6) gas has the same mass as 1.5×10^{20} molecules of methane (CH_4). How many C_2H_6 molecules does the sample of gas contain?

72. Fill in the blanks
(a) In a chemical reaction, the sum of the masses of the reactants and products remains unchanged. This is called ————.
(b) A group of atoms carrying a fixed charge on them is called ————.
(c) The formula unit mass of $Ca_3 (PO_4)_2$ is ————.
(d) Formula of sodium carbonate is _____and that of ammonium sulphate is ----------.

73. Write the formulae for the following and calculate the molecular mass for each one of them.
(a) Caustic potash
(b) Baking powder
(c) Lime stone
(d) Caustic soda
(e) Ethanol
(f) Common salt

74. In photosynthesis, 6 molecules of carbon dioxide combine with an equal number of water molecules through a complex series of reactions to give a molecule of glucose having a molecular formula C6 H12 O6. How many grams of water would be required to produce 18 g of glucose? Compute the volume of water so consumed assuming the density of water to be 1 g cm–3.

CHAPTER – 4

STRUCTURE OF THE ATOM

STRUCTURE OF THE ATOM

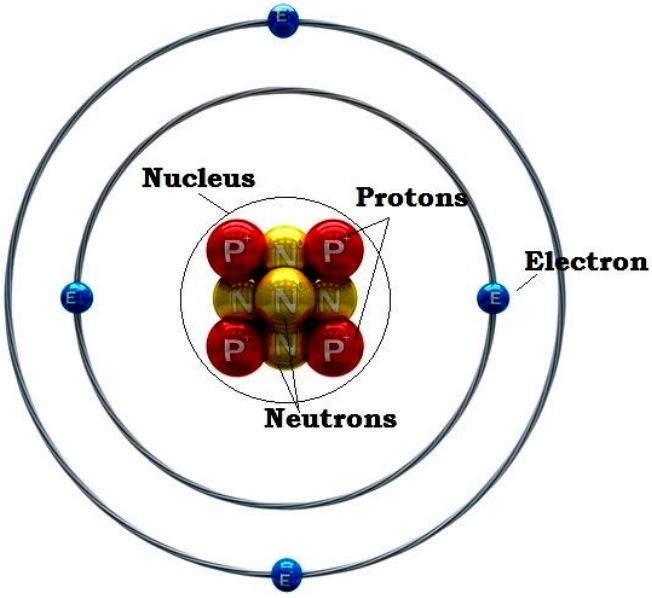
Atoms are the basic units of matter and the defining structure of elements. Matters are made of tiny particles called atom. Atom is made of three particles; electron, proton and neutron. These particles are called fundamental particles of an atom or sub atomic particles.

Electron (e^-) - Electron is denoted by 'e' and is a negatively charged particle. The absolute charge over an electron is equal to $1.6x10^{-19}$ of negative charge and is considered equal to – 1. The relative mass of electron is 1/1836. Since the mass of an electron is very small, thus it is considered equal to 0. Electrons revolve round the nucleus of atoms.

Proton (p^+) - Proton is denoted by 'p' and is positively charged particle. The absolute charge over proton is $1.6x10^{-19}$ coulomb of positive charge and it is considered as unit positive charge. Thus absolute charge over a proton is equal to +1.
The absolute mass of a proton is equal to $1.6x10^{-24}$ g and considered equal to 1 as it is equal to the mass of 1 hydrogen atom. Proton is present in the nucleus of atom.

Neutron (n) – Neutron is denoted by 'n' and is a neutral particle.

The absolute mass of neutron is 1.6×10^{-24} g. The relative mass of neutron is equal to 1. Neutron is presents in the nucleus of atom.
Nucleus – The centre of atom is called nucleus. Nucleus comprises of neutron and proton. Nucleus of an atom contains the whole mass of an atom.



INTEXT QUESTIONS PAGE NO. 47

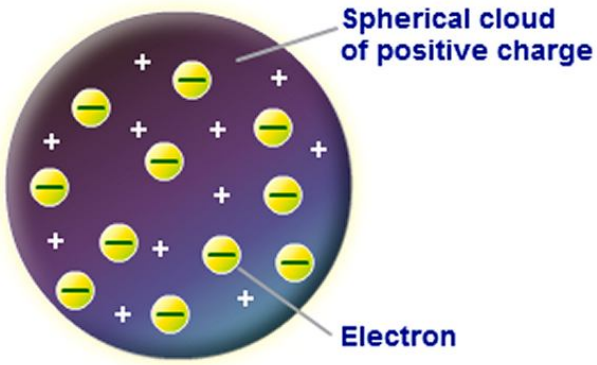
Q1. What are canal rays?
Answer:
Canal rays are positively charged radiations that can pass through perforated cathode plate. These rays consist of positively charged particles known as protons.

Q2. If an atom contains one electron and one proton, will it carry any charge or not?
Answer:
An electron is a negatively charged particle, whereas a proton is a positively charged particle. The magnitude of their charges is equal. Therefore, an atom containing one electron and one proton will not carry any charge. Thus, it will be a neutral atom.

Discovery of Electron
In 1897; J. J. Thomson, a British physicist, proposed that atom contains at least one negatively charged particle. Later this particle was named as electron. Thomson called those particles 'corpuscles'.
Discovery of Proton:
Ernest Goldstein in 1886 discovered the presence of new radiation in gas discharge tube even before the identification of electron. He called these rays as Canal Rays. His experiment led to the discovery of proton.
Discovery of Neutron:
In 1932 J. Chadwick discovered another subatomic particle called neutron. Neutron is present in the nucleus of all atoms.

THOMSON'S MODEL OF ATOM

J. J. Thomson proposed the model of atom similar to a Christmas Pudding or similar to a water melon. His model of atom is generally called plum and pudding model of atom.



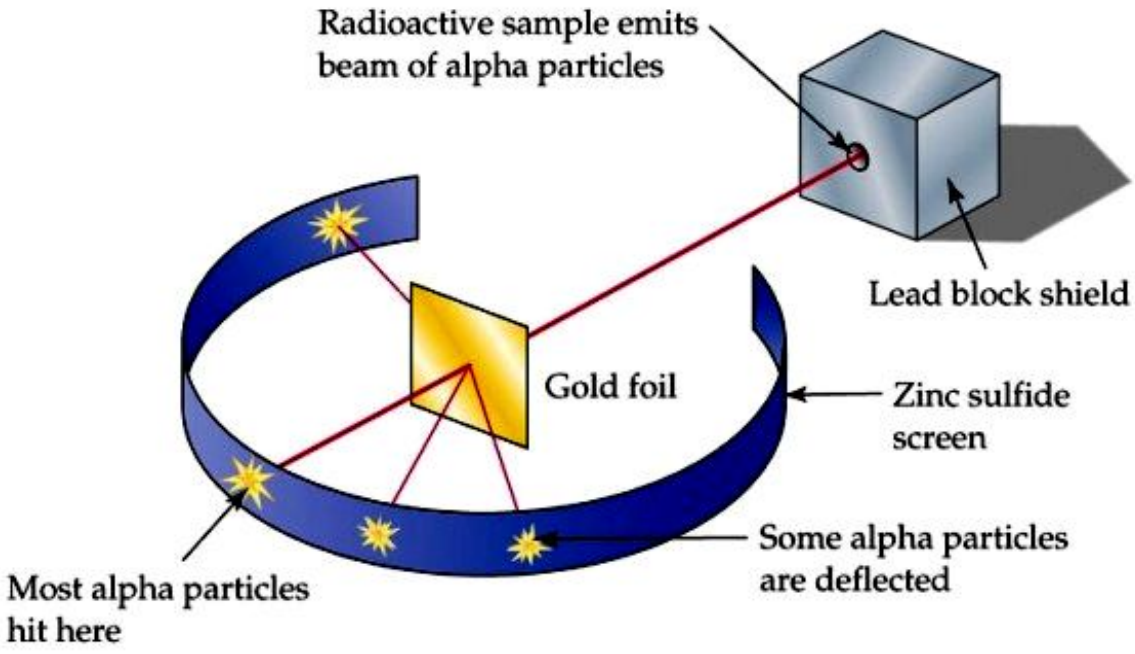
Thomson's Plum pudding model

He proposed that electrons are embedded the way black seeds of water melon are embedded; in the sphere of positive charge. According to Thomson
(a) An atom consists of positively charged sphere in which electrons are embedded.
(b) The quanta of negative and positive charges are equal. The equal number of negative charge and positive charge makes an atom electrically neutral.

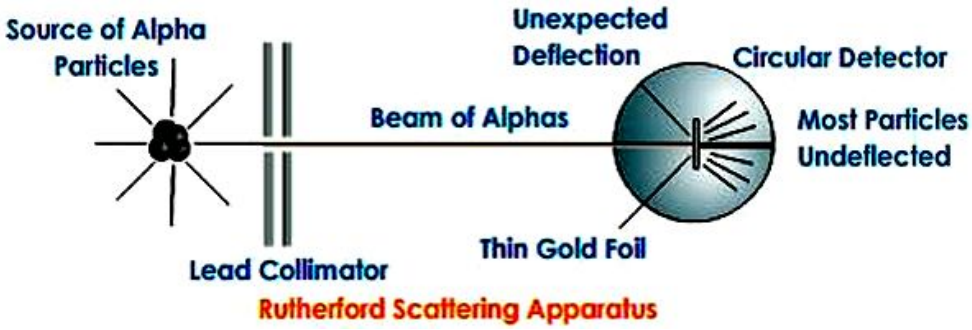
RUTHERFORD'S MODEL OF ATOM

Ernest Rutherford in 1909 with his team bombarded very thin gold foil with α – particles. He found that
(a) Most of the α – particles passed without any hindrance.
(b) Some of the α – particles deflected from their original path at noticeable angle.
(c) Very few of the α – particles bounced back at their original path.
On the basis of his observation, he proposed the model of atom. The Rutherford's Model of Atom is as follows:
(a) Most of the part in an atom is empty.
(b) There is a positively charged center in atom, which contains nearly the whole mass of atom. The centre is called nucleus.
(c) The size of nucleus is very small compared to an atom.

(d) Electrons revolve round the nucleus.



The Rutherford's Experiment is also known as Geiger-Marsden Experiment.



DRAWBACKS OF RUTHERFORD MODEL

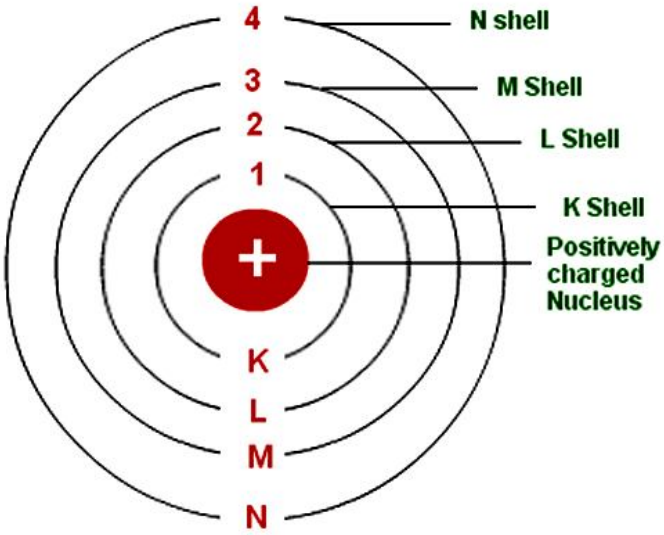
(a) According to Rutherford's Model, electron revolves round the positively charged nucleus which is not expected to be stable. But a charged particle in an accelerated motion along a circular path would lose energy because of radiation and finally would fall into nucleus. This makes an atom unstable while atoms are quite stable.
If atoms were not stable no matter would exist in nature.
(b) Rutherford model could not solve the problem of atomic mass of atom as it proposed only the existence of protons in the nucleus.
However, the problem of atomic mass could be solved after the discovery of neutron.

BOHR'S MODEL OF ATOM

Neils Bohr, a Danish physicist, in 1913 proposed model of atom which rectified the problems left by Rutherford's Model. He proposed that
(a) Electrons revolve round the nucleus in a fixed orbit.
(b) He called these orbits as 'stationary orbit'.
(c) Each stationary orbit is associated with fixed amount of energy, thus electrons do not radiate energy as long as they keep on revolving around the nucleus in fixed orbit.
The circular path around the nucleus is called orbit, energy level or shell. Energy level are represented by letter – K, L, M, N, …. and so on.
Therefore,

- 1st orbit is denoted by – K
- 2nd orbit is denoted by – L
- 3rd orbit is denoted by – M, and so on.

The orbits are denoted by 1, 2, 3, …. and so on.

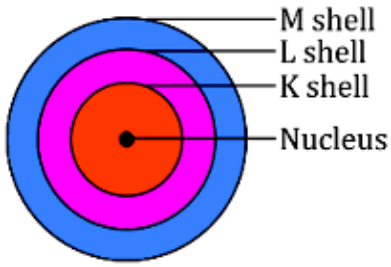


INTEXT QUESTIONS PAGE NO. 49

Q1. On the basis of Thomson's model of an atom, explain how the atom is neutral as a whole.
Answer:
As per Thomson's model of the atom, an atom consists both negative and positive charges which are equal in number and magnitude. So, they balance each other as a result of which atom as a whole is electrically neutral.

Q2. On the basis of Rutherford's model of an atom, which subatomic particle is present in the nucleus of an atom?
Answer:
On the basis of Rutherford's model of an atom, protons are present in the nucleus of an atom.

Q3. Draw a sketch of Bohr's model of an atom with three shells.
Answer:



Q4. What do you think would be the observation if the α-particle scattering experiment is carried out using a foil of a metal other than gold?
Answer:
If α-particle scattering experiment is carried out using a foil of any metal as thin as gold foil used by Rutherford, there would be no change in observations. But since other metals are not so malleable so, such a thin foil is difficult to obtain. If we use a thick foil, then more α-

particles would bounce back and no idea about the location of positive mass in the atom would be available with such a certainty.

INTEXT QUESTIONS PAGE NO. 49

Q1. Name the three sub-atomic particles of an atom.
Answer:
The three sub-atomic particles of an atom are:
(i) Protons
(ii) Electrons, and
(iii) Neutrons

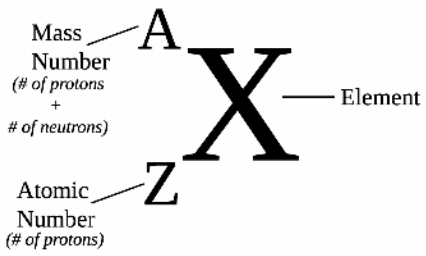
Q2. Helium atom has an atomic mass of 4 u and two protons in its nucleus. How many neutrons does it have?
Answer:
Number of neutrons = Atomic mass - Number of protons
Therefore, the number of neutrons in the atom = 4 - 2 = 2

DISTRIBUTION OF ELECTRONS IN ORBIT OR SHELL:

The distribution of electrons in an orbit is obtained by $2n^2$, where 'n' is number of orbit.
Therefore,
Number of electrons in K-shell i.e. in 1^{st} orbit.
Here n = 1
Therefore,
$2n^2 = 2 \times 1^2 = 2$
Thus, maximum number of electrons in K-shell i.e. 1^{st} shell = 2
Number of electrons in L-shell, i.e. in 2^{nd}orbit
Here n = 2, therefore,
$2n^2 = 2 \times 2^2 = 8$
Thus, maximum number of electrons in L-shell = 8
Number of electrons in M-shell, i.e. in 3^{rd} orbit
Here n = 3, therefore,
$2n^2 = 2 \times 3^2 = 18$
Thus, maximum number of electrons in M-shell = 18
Number of electrons in N-shell, i.e. in 4^{th} shell
Here n = 4, therefore,
$2n^2 = 2 \times 4^2 = 32$
Thus, maximum number of electrons in N-shell = 32
In similar way maximum number of electrons in any shell can be calculated.

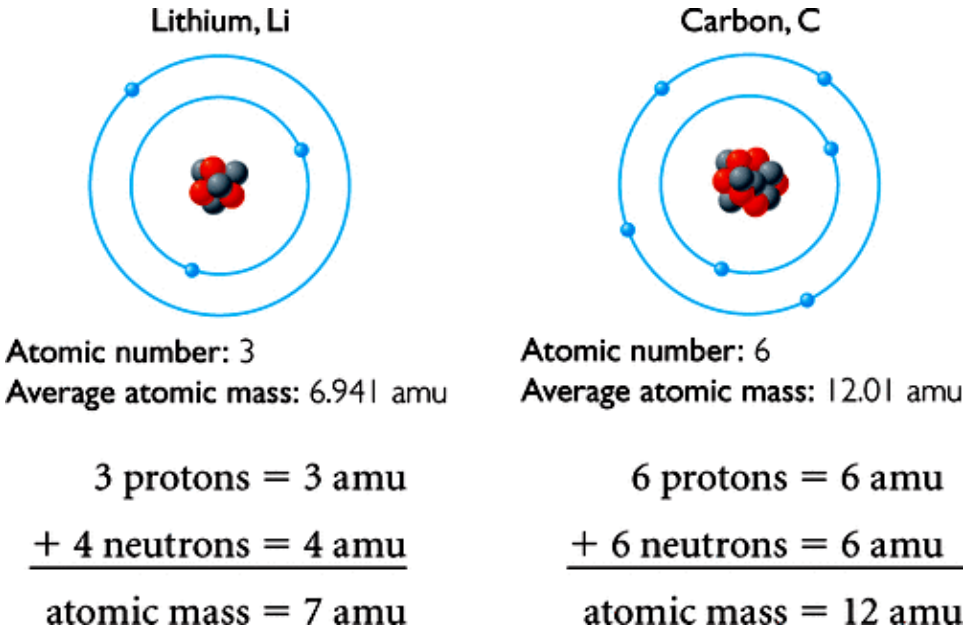
ATOMIC NUMBER

Atomic number is the fundamental properties of an atom. Every atom is identified by its unique atomic number. Atomic number is denoted by 'z'.
Atomic number is equal to the number of protons present in an atom.
Since an atom is electrically neutral, thus number of protons and number of electrons are equal to make an atom electrically neutral.



Atomic number = Number of protons = Number of electrons
Example :–
The atomic number of Hydrogen is 1, helium is 2, lithium is 3, beryllium is 4, boron is 5, carbon is 6, nitrogen is 7, oxygen is 8, etc.
Sample exercise:
(1) Atomic number of calcium is 20. Calculate the number of electrons and protons in calcium.
Solution:
Since, Atomic number = Number of protons = Number of electrons
Therefore,
Number of electrons in calcium = 20
Number of protons in calcium = 20

(2) Number of protons in sodium atom is 11, find the atomic number and number of electrons in a sodium atom.
Solution,
Since, Atomic number = Number of protons = Number of electrons
Therefore,
Atomic number of sodium = 11
Number of electrons in sodium = 11



MASS NUMBER OR ATOMIC MASS

Mass number of an atom is defined as the sum of the number of protons and number of neutrons. Mass number is nearly equal to the atomic mass of an atom. Since, protons and neutrons reside in the nucleus, thus they are also known as nucleons.
This means
Mass number of an atom = Number of protons + Number of neutrons
Example
(1) Atomic mass of aluminium is 27 u and atomic number is 13, find the number of protons and number of neutrons in aluminium.
Solution:
Since,
Atomic number = 13
Therefore, number of proton = 13
We know that; Atomic mass (Mass number) = Number of protons + Number of neutrons

Therefore,
27 u = 13 + n
Or, n = 27 – 13 = 14
Therefore, number of proton = 13 and number of neutron = 14
(2) The atomic number of carbon is 6 and number of neutron is equal to 6. Find the atomic mass or mass number of carbon.
Solution:
Since atomic number of carbon = 6
Therefore, number of proton = 6
Now, Atomic mass = number of proton + number of neutron
Or, Atomic mass or mass number = 6 + 6 = 12 u
Thus, mass number or atomic mass of carbon = 12u

ARRANGEMENT OF ELECTRONS IN AN ATOM – ELECTRONIC CONFIGURATION

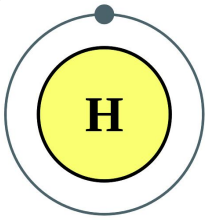
The maximum number of electrons can be obtained by $2n^2$; where 'n'is the orbit number. Thus after knowing the maximum number of electrons for a particular shell, the arrangement of electrons in an atom can be identified. It is called Bohr Bury Schemes.

Rules to write the electronic configuration of an atom

(a) Maximum number of electrons in an orbit is calculated by $2n^2$, where 'n' is number of orbit and may be equal to 1, 2, 3 , ...
(b) Electrons occupy the next orbit only after filling the inner orbit completely.
(c) The maximum number of electrons in outermost orbit will not be more than 8.

Electronic configuration of Hydrogen

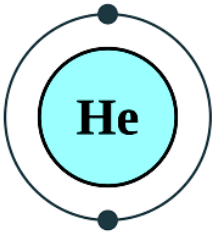
Atomic number of hydrogen = 1
Therefore number of electrons = 1
Maximum number of electrons in 1^{st} orbit = 2
Since, hydrogen has only one electron, therefore, it will reside in 1^{st} orbit.
Thus electronic configuration of hydrogen



Number of orbit present in hydrogen = 1

Electronic configuration of Helium

Atomic number of helium = 2
Therefore number of electrons = 2
Therefore, electronic configuration of helium is



Number of orbit in helium atom = 1

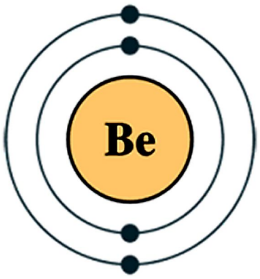
Electronic configuration of Lithium

Atomic number of Lithium = 3

Therefore number of electrons = 3
Since the maximum number of electrons in 1st orbit is equal to 2, therefore, after accommodating 2 electrons in 1st orbit, the third electron will go in 2nd orbit.
Thus, electronic configuration of lithium is

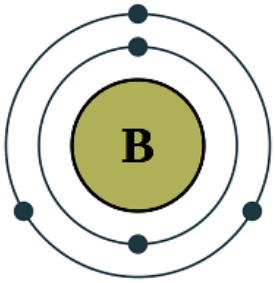
Number of orbit in Lithium atom = 3.

Electronic configuration of Beryllium
Atomic number of beryllium = 4.
Therefore number of electrons = 4.
Thus, electronic configuration of Beryllium is



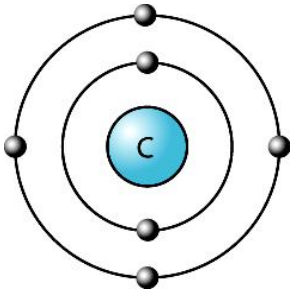
Number of orbit in beryllium = 2

Electronic configuration of Boron
Atomic number of boron = 5
Therefore number of electrons = 5
Thus, electronic configuration of boron is



Number of orbit in boron = 2

Electronic configuration of Carbon
Atomic number of carbon = 6
Therefore number of electrons = 6
Thus, electronic configuration of carbon is

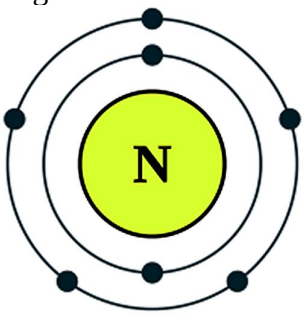


Number of orbit in carbon = 2

ELECTRONIC CONFIGURATION OF ELEMENTS – FROM NITROGEN (N) TO SODIUM (NA)

Electronic configuration of Nitrogen

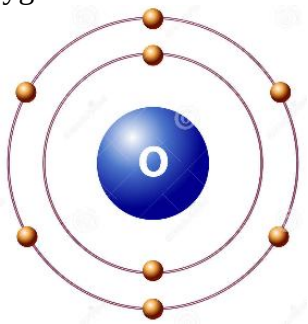
Atomic number of nitrogen = 7.
Therefore number of electrons = 7
Thus, electronic configuration of nitrogen is



Number of orbit in nitrogen = 2

Electronic configuration of Oxygen

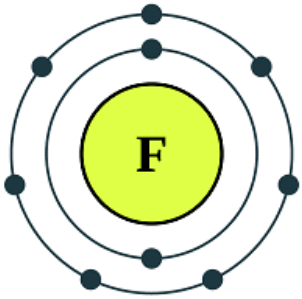
Atomic number of oxygen = 8.
Therefore number of electrons = 8.
Thus, electronic configuration of oxygen is



Number of orbit in oxgyen = 2

Electronic configuration of Fluorine

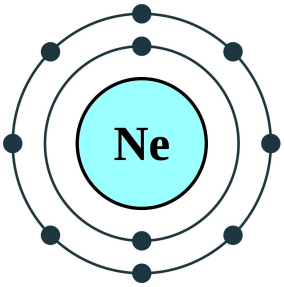
Atomic number of fluorine = 9
Therefore number of electrons = 9
Thus, electronic configuration of fluorine is



Number of orbit in fluorine = 2

Electronic configuration of Neon

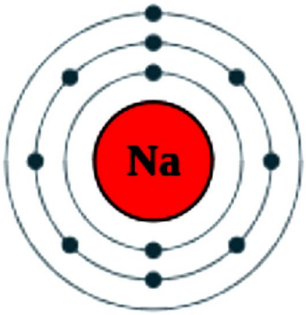
Atomic number of neon = 10
Therefore number of electrons = 10
Thus, electronic configuration of neon is



Number of orbit in Neon = 2

Electronic configuration of Sodium

Atomic number of sodium = 11
Therefore number of electrons = 11
Since, in ^{2nd} orbit the maximum number of electrons is equal to 8 and there are 11 electrons in sodium atom, thus the eleventh electron will go in third orbit.
Thus, electronic configuration of sodium is

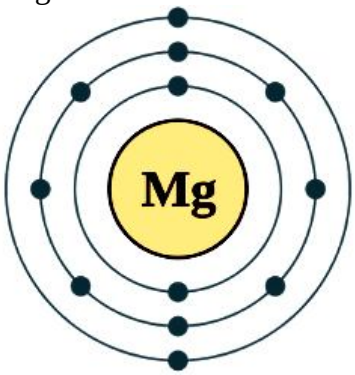


Number of orbit in sodium = 3

ELECTRONIC CONFIGURATION OF ELEMENTS – FROM MAGNESIUM TO CALCIUM

Electronic configuration of Magnesium

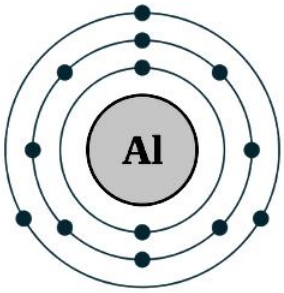
Atomic number of magnesium = 12
Therefore number of electrons = 12
Thus, electronic configuration of magnesium is



Number of orbit in magnesium = 3.

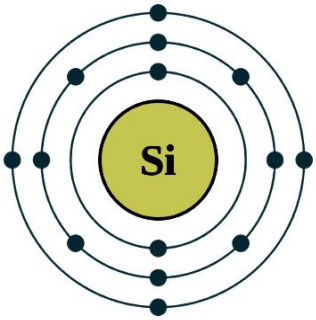
Electronic configuration of Aluminium

Atomic number of aluminium = 13.
Therefore number of electrons = 13.
Thus, electronic configuration of aluminium is



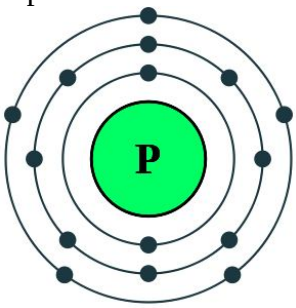
Number of orbit in aluminium = 3

Electronic configuration of Silicon
Atomic number of silicon = 14
Therefore number of electrons = 14
Thus, electronic configuration of silicon is



Number of orbit in silicon = 3

Electronic configuration of Phosphorous (P)
Atomic number of phosphorous = 15
Therefore number of electrons = 15
Thus, electronic configuration of phosphorous is

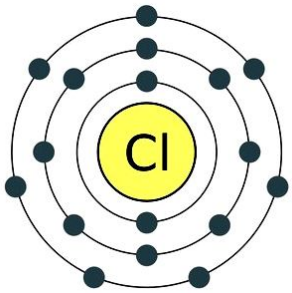


Number of orbit in phosphorous = 3

Electronic configuration of Sulphur (S)
Atomic number of sulphur = 16
Therefore number of electrons = 15
Thus, electronic configuration of sulphur is

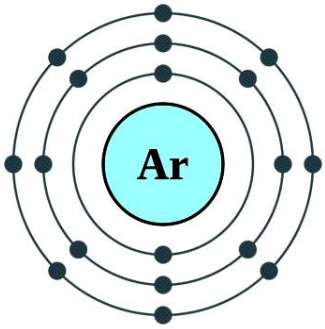
Number of orbit in sulphur = 3

Electronic configuration of Chlorine (Cl)
Atomic number of chlorine = 17
Therefore number of electrons = 17
Thus, electronic configuration of chlorine is



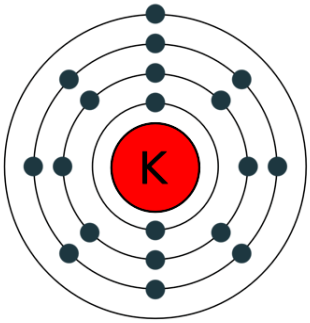
Number of orbit in chlorine = 3

Electronic configuration of Argon (Ar)
Atomic number of argon = 18
Therefore number of electrons = 18
Thus, electronic configuration of argon is



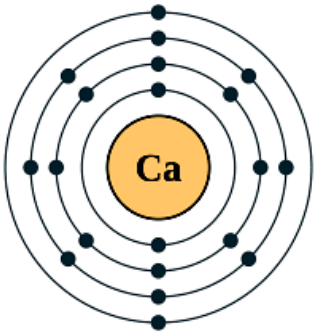
Number of orbit in argon = 3

Electronic configuration of Potassium (K)
Atomic number of potassium = 19
Therefore number of electrons = 19
Since, maximum number of electrons in outermost orbit will not be more than 8, thus the 19^{th} electron of potassium atom will reside in 4^{th} orbit.
Thus, electronic configuration of potassium is

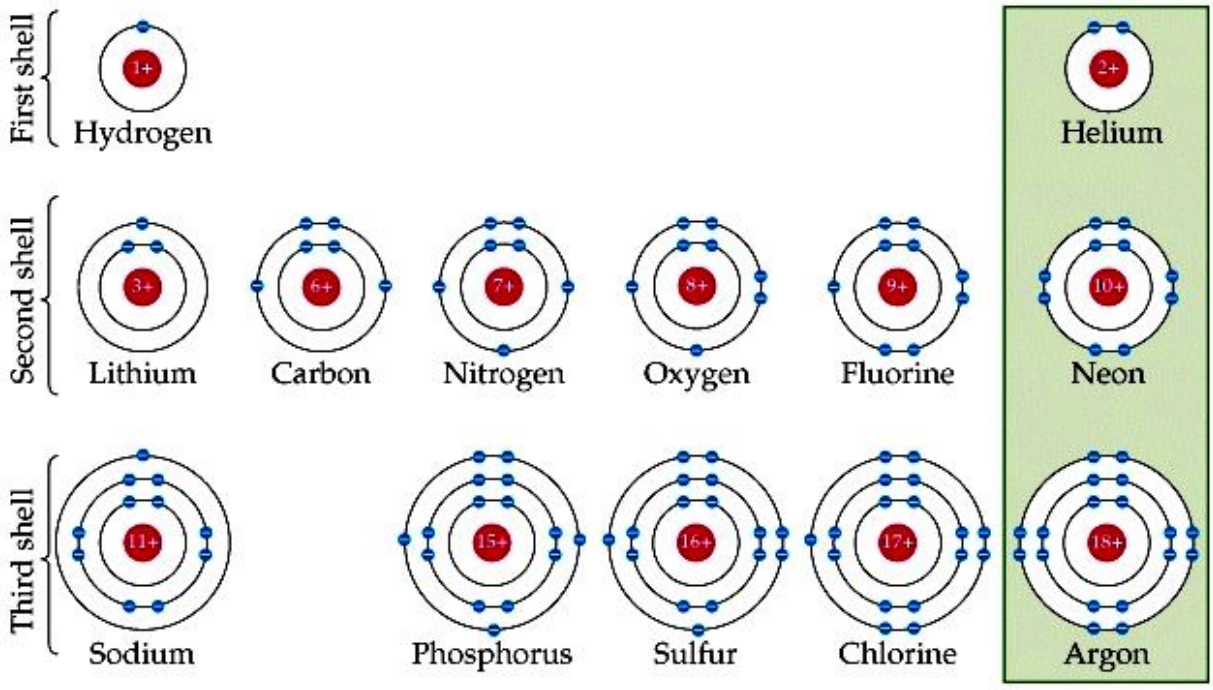


Number of orbit in potassium = 4

Electronic configuration of Calcium (Ca)
Atomic number of calcium = 20
Therefore number of electrons = 20
Thus, electronic configuration of calcium is



Number of orbit in calcium = 4



INTEXT QUESTIONS PAGE NO. 50

Q1. Write the distribution of electrons in carbon and sodium atoms.

Answer:

Carbon: The total number of electrons in a carbon atom is 6. The distribution of electrons in carbon atom is given by:
First orbit or K-shell = 2 electrons
Second orbit or L-shell = 4 electrons
Or, we can write the distribution of electrons in a carbon atom as 2, 4.

Sodium: The total number of electrons in a sodium atom is 11. The distribution of electrons in sodium atom is given by:
First orbit or K-shell = 2 electrons
Second orbit or L-shell = 8 electrons
Third orbit or M-shell = 1 electron
Or, we can write distribution of electrons in a sodium atom as 2, 8, 1.

Q2. If K and L shells of an atom are full, then what would be the total number of electrons in the atom?

Answer:

The maximum capacity of K shell is 2 electrons and L shell can accommodate maximum 8 electrons in it. Therefore, there will be ten electrons in the atom.

VALENCY

Noble gases have fully filled outermost shell. Due to this, they are stable and they do not react with other elements. Other elements also tend to attain stable configuration by completing the octet in their outermost orbit. This is important to note that, the number of electrons in the outermost orbit of an element is closer to octet. An element can lose or gain electron in order to complete the octet. This tendency of losing or gaining electrons imparts valency to an element.
Let us take example of hydrogen. Hydrogen can readily lose or gain an electron. So, its valency is one. Now, let us take example of Hydrochloric Acid (HCl). One atom of chlorine combines with one atom of hydrogen to form hydrochloric acid. In this case, hydrogen loses one electron and thus gets +1 charge. On the other hand, chlorine gains an electron and thus gets – 1 charge. So, valency of hydrogen and chlorine are one.

Valency can be defined as combining capacity of an atom.

Example :
Hydrogen molecule - Hydrogen has only one electron in its outermost orbit, thus it requires one more electrons to complete its outermost orbit. Therefore, in order to complete outermost orbit, hydrogen shares one electron with another hydrogen atom and form H_2 (hydrogen molecule).
In the case of LiCl (Lithium chloride) - Lithium has three electrons in its outermost orbit and chlorine has seven electrons in its outermost orbit. Thus in order to make outermost orbit completely filled lithium loses one electrons and chlorine gains one electron. After losing one electron, lithium has two electrons in its outermost orbit and after gaining one electron, chlorine has eight electrons in its outermost orbit. And they form LiCl (Lithium chloride)

Name, Symbol, Atomic number, Number of electrons, Distribution of electrons in shells (electronic configuration) and Valency of some elements (From Hydrogen to Calcium)

Elements	Symbol	Atomic Number	No. of electron	Distribution of electron				Valency
				K	L	M	N	
Hydrogen	H	1	1	1				1
Helium	He	2	2	2				0
Lithium	Li	3	3	2	1			1
Beryllium	Be	4	4	2	2			2
Boron	B	5	5	2	3			3
Carbon	C	6	6	2	4			4
Nitrogen	N	7	7	2	5			3
Oxygen	O	8	8	2	6			2
Fluorine	F	9	9	2	7			1
Neon	Ne	10	10	2	8			0
Sodium	Na	11	11	2	8	1		1
Magnesium	Mg	12	12	2	8	2		2
Aluminium	Al	13	13	2	8	3		3
Silicon	Si	14	14	2	8	4		4
Phosphorous	P	15	15	2	8	5		3
Sulphur	S	16	16	2	8	6		2
Chlorine	Cl	17	17	2	8	7		1
Argon	Ar	18	18	2	8	8		0
Potassium	K	19	19	2	8	8	1	1
Calcium	Ca	20	20	2	8	8	2	2

INTEXT QUESTIONS PAGE NO. 52

Q1. How will you find the valency of chlorine, sulphur and magnesium?
Answer:
If the number of electrons in the outermost shell of the atom of an element is less than or equal to 4, then the valency of the element is equal to the number of electrons in the outermost shell. On the other hand, if the number of electrons in the outermost shell of the atom of an element is greater than 4, then the valency of that element is determined by subtracting the number of electrons in the outermost shell from 8.

The distribution of electrons in chlorine, sulphur, and magnesium atoms are 2, 8, 7; 2, 8, 6 and 2, 8, 2 respectively.

Therefore, the number of electrons in the outer most shell of chlorine, sulphur, and magnesium atoms are 7, 6, and 2 respectively.
Thus, the valency of chlorine = 8 −7 = 1
The valency of sulphur = 8 − 6 = 2
The valency of magnesium = 2

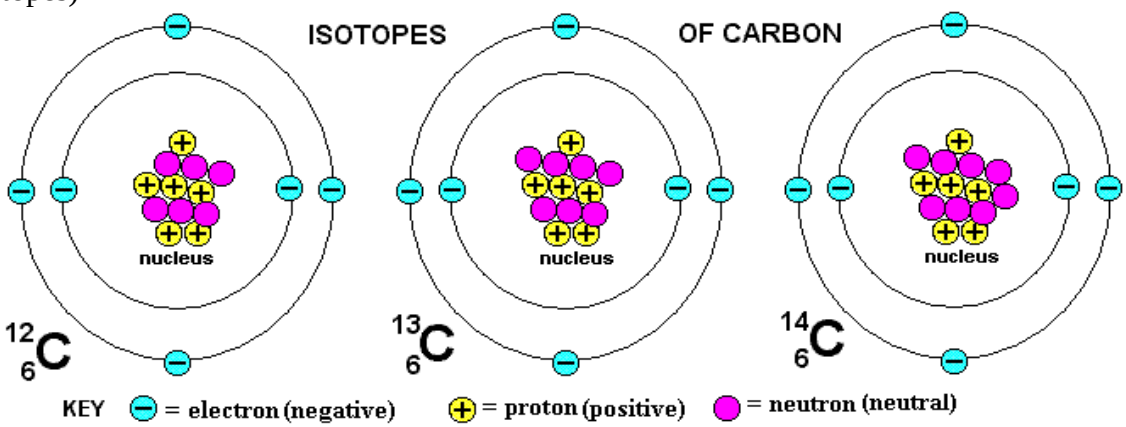
INTEXT QUESTIONS PAGE NO. 52

Q1. If number of electrons in an atom is 8 and number of protons is also 8, then (i) what is the atomic number of the atom? and (ii) what is the charge on the atom?
Answer:
(i) The atomic number is equal to the number of protons. Therefore, the atomic number of the atom is 8.
(ii) Since the number of both electrons and protons is equal, therefore, the charge on the atom is 0.

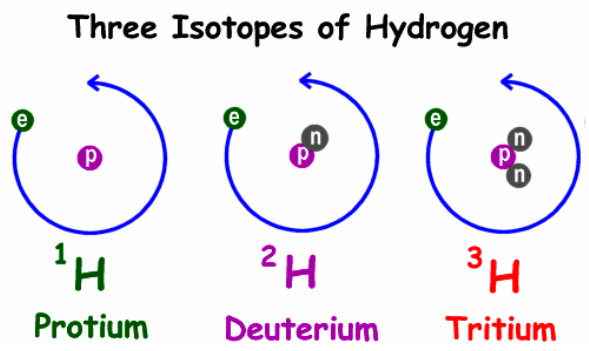
Q2. With the help of Table 4.1, find out the mass number of oxygen and sulphur atom.
Answer:
Mass number of oxygen = Number of protons + Number of neutrons = 8 + 8 = 16
Mass number of sulphur = Number of protons + Number of neutrons = 16 +16 = 32

ISOTOPES

Elements having same atomic number but different atomic masses are known as Isotopes.
Example –
Carbon-12, Carbon-13, Carbon-14 are thee isotopes of carbon atom. Here 12, 13 and 14 are the atomic masses of isotopes of carbon respectively. Since, atomic number is the unique property of an atom, thus the atomic number of carbon is 6 even in the case of three types of carbon (isotopes)



Hydrogen -1 , Deuterium – 2, Tritium -3 are three isotopes of hydrogen.
The isotopes of hydrogen are written as:



Use of Isotopes:
Carbon – 14 is used in carbon dating.
An isotope of uranium is used as fuel in nuclear reactor.
An isotope of cobalt is used in treatment of cancer.
An isotope of iodine is used in treatment of goitre.

ISOBARS

Atoms having same atomic mass and different atomic numbers are known as Isobars.

Example – ${}^{40}_{18}Ar$ (argon) and ${}^{40}_{20}Ca$ (calcium)

Both the elements have same atomic mass equal to 40 but different atomic numbers, i.e. argon has atomic number equal to 18 and calcium has atomic number equal to 20.

INTEXT QUESTIONS PAGE NO. 53

Q1. For the symbol H,D and T tabulate three sub-atomic particles found in each of them.
Answer:

Symbol	Proton	Neutron	Electron
H	1	0	1
D	1	1	1
T	1	2	1

Q2. Write the electronic configuration of any one pair of isotopes and isobars.
Answer:
$^{12}C_6$ and $^{14}C_6$ are isotopes, have the same electronic configuration as (2, 4).
$^{22}Ne_{10}$ and $^{22}Ne_{11}$ are isobars. They have different electronic configuration as given below:
$^{22}Ne_{10}$ – 2, 8
$^{22}Ne_{11}$ – 2, 8, 1

EXERCISE QUESTIONS PAGE NO. 55, 56

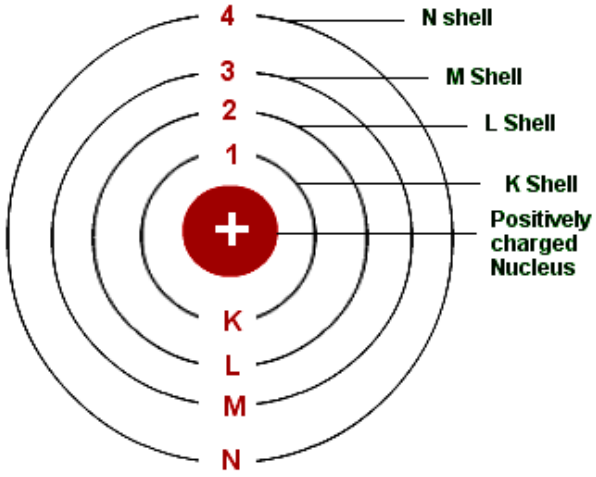
Q1. Compare the properties of electrons, protons and neutrons.
Answer:

Particle	Nature of Charge	Mass	Location
Electron	Electrons are negatively charged.	9×10^{-31} kg	Extra nuclear part distributed in different shell or orbits.
Proton	Protons are positively charged.	1.672×10^{-27} kg (1 μ) (approx. 2000 times that of the electron)	Nucleus
Neutron	Neutrons are neutral.	Equal to mass of proton	Nucleus

Q2. What are the limitations of J.J. Thomson's model of the atom?
Answer:
The limitations of J.J. Thomson's model of the atom are:
→ It could not explain the result of scattering experiment performed by rutherford.
→ It did not have any experiment support.

Q3. What are the limitations of Rutherford's model of the atom?
Answer:
The limitations of Rutherford's model of the atom are
→ It failed to explain the stability of an atom.
→ It doesn't explain the spectrum of hydrogen and other atoms.

Q4. Describe Bohr's model of the atom.
Answer:
→ The atom consists of a small positively charged nucleus at its center.
→ The whole mass of the atom is concentrated at the nucleus and the volume of the nucleus is much smaller than the volume of the atom.
→ All the protons and neutrons of the atom are contained in the nucleus.
→ Only certain orbits known as discrete orbits of electrons are allowed inside the atom.
→ While revolving in these discrete orbits electrons do not radiate energy. These orbits or cells are represented by the letters K, L, M, N etc. or the numbers, n = 1, 2, 3, 4, . . as shown in below figure.



Q5. Compare all the proposed models of an atom given in this chapter.
Answer:

Thomson's model	Rutherford's model	Bohr's model
→ An atom consists of a positively charged sphere and the electrons are embedded in it. → The negative and positive charges are equal in magnitude. As a result the atom is electrically neutral.	→ An atom consists of a positively charged center in the atom called the nucleus. The mass of the atom is contributed mainly by the nucleus. → The size of the nucleus is very small as compared to the size of the atom. → The electrons revolve around the nucleus in well-defined orbits.	→ Bohr agreed with almost all points as said by Rutherford except regarding the revolution of electrons for which he added that there are only certain orbits known as discrete orbits inside the atom in which electrons revolve around the nucleus. → While revolving in its discrete orbits the electrons do not radiate energy.

Q6. Summarise the rules for writing of distribution of electrons in various shells for the first eighteen elements.
Answer:
The rules for writing of the distribution of electrons in various shells for the first eighteen elements are given below.
→ If n gives the number of orbit or energy level, then $2n^2$ gives the maximum number of electrons possible in a given orbit or energy level. Thus,
First orbit or K-shell will have 2 electrons,
Second orbit or L-shell will have 8 electrons,
Third orbit or M-shell will have 18 electrons.
→ If it is the outermost orbit, then it should have not more than 8 electrons.
→ There should be step-wise filling of electrons in different orbits, i.e., electrons are not accompanied in a given orbit if the earlier orbits or shells are incompletely filled.

Q7. Define valency by taking examples of silicon and oxygen.
Answer:
The valency of an element is the combining capacity of that element. The valency of an element is determined by the number of valence electrons present in the atom of that element.
→ Valency of Silicon: It has electronic configuration: 2,8,4
Thus, the valency of silicon is 4 as these electrons can be shared with others to complete octet.
→ Valency of Oxygen: It has electronic configuration: 2,6
Thus, the valency of oxygen is 2 as it will gain 2 electrons to complete its octet.

Q8. Explain with examples (i) Atomic number, (ii) Mass number, (iii) Isotopes and iv) Isobars. Give any two uses of isotopes.
Answer:
(i) Atomic number
The atomic number of an element is the total number of protons present in the atom of that element. For example, nitrogen has 7 protons in its atom. Thus, the atomic number of nitrogen is 7.
(ii) Mass number
The mass number of an element is the sum of the number of protons and neutrons present in the atom of that element. For example, the atom of boron has 5 protons and 6 neutrons. So, the mass number of boron is 5 + 6 = 11.

(iii) Isotopes

Isotopes are atoms of the same element having the same atomic number, but different mass numbers. For example, hydrogen has three isotopes. They are protium ($_1^1H$), deuterium ($_1^2H$) and tritium ($_1^3H$).

(iv) Isobars

Isobars are atoms having the same mass number, but different atomic numbers i.e., isobars are atoms of different elements having the same mass number. For example, $_{20}^{40}Ca$ and $_{18}^{40}Ar$ are isobars.

Two uses of isotopes are:

(i) One isotope of uranium is used as a fuel in nuclear reactors.

(ii) One isotope of cobalt is used in the treatment of cancer.

Q9. Na^+ has completely filled K and L shells. Explain.

Answer:

An atom of Na has a total of 11 electrons. Its electronic configuration is 2, 8, 1. But, Na+ ion has one electron less than Na atom i.e., it has 10 electrons. Therefore, 2 electrons go to K-shell and 8 electrons go to L-shell, thereby completely filling K and L shells.

Q10. If bromine atom is available in the form of, say, two isotopes $_{35}^{79}Br$ (49.7%) and $_{35}^{81}Br$ (50.3%), calculate the average atomic mass of bromine atom.

Answer:

It is given that two isotopes of bromine are $_{35}^{79}Br$ (49.7%) and $_{35}^{81}Br$ (50.3%). Then, the average atomic mass of bromine atom is given by:

$$79\times\frac{49.7}{100}+81\times\frac{50.3}{100}=\frac{3926.3}{100}+\frac{4074.3}{100}$$

$$=\frac{8000.6}{100}=80.006u=80u(approx)$$

Q11. The average atomic mass of a sample of an element X is 16.2 u. What are the percentages of isotopes $_8^{16}X$ and $_8^{18}X$ in the sample?

Answer:

It is given that the average atomic mass of the sample of element X is 16.2 u.

Let the percentage of isotope $_8^{18}X$ be y%. Thus, the percentage of isotope $_8^{16}X$ will be (100 − y) %.

Therefore, $18\times\frac{y}{100}+16\times\frac{(100-y)}{100}=16.2$

$$\Rightarrow\frac{18y}{100}+\frac{16(100-y)}{100}=16.2$$

$$\Rightarrow\frac{18y+16(100-y)}{100}=16.2\Rightarrow\frac{18y+1600-16y}{100}=16.2$$

$$\Rightarrow 18y+1600-16y=1620$$

$$\Rightarrow 2y+1600=1620$$

$$\Rightarrow 2y=1620-1600=20$$

$$\Rightarrow y=10$$

Therefore, the percentage of isotope $_8^{18}X$ is 10%.

And, the percentage of isotope $_8^{16}X$ is (100 − 10) % = 90%.

Q12. If Z = 3, what would be the valency of the element? Also, name the element.
Answer:
By Z = 3, we mean that the atomic number of the element is 3. Its electronic configuration is 2, 1. Hence, the valency of the element is 1 (since the outermost shell has only one electron). Therefore, the element with Z = 3 is lithium.

Q13. Composition of the nuclei of two atomic species X and Y are given as under

	X	Y
Protons =	**6**	**6**
Neutrons =	**6**	**8**

Give the mass numbers of X and Y. What is the relation between the two species?
Answer:
Mass number of X = Number of protons + Number of neutrons = 6 + 6 = 12
Mass number of Y = Number of protons + Number of neutrons = 6 + 8 = 14
These two atomic species X and Y have the same atomic number, but different mass numbers. Hence, they are isotopes.

Q14. For the following statements, write T for True and F for False.
(a) J.J. Thomson proposed that the nucleus of an atom contains only nucleons.
(b) A neutron is formed by an electron and a proton combining together. Therefore, it is neutral.
(c) The mass of an electron is about $\frac{1}{2000}$ times that of proton.
(d) An isotope of iodine is used for making tincture iodine, which is used as a medicine.

Answer:
(a) False (b) False (c) True (d) False

Put tick (√) against correct choice and cross (X) against wrong choice in questions Q15, Q16 and Q17
Q15. Rutherford's alpha-particle scattering experiment was responsible for the discovery of
(a) Atomic Nucleus (b) Electron
(c) Proton (d) Neutron
Answer: (a) Atomic nucleus

Q16. Isotopes of an element have
(a) the same physical properties
(b) different chemical properties
(c) different number of neutrons
(d) different atomic numbers.
Answer: (c) different number of neutrons

Q17. Number of valence electrons in Cl^- ion are:
(a) 16 (b) 8 (c) 17 (d) 18
Answer: (b) 8

Q18. Which one of the following is a correct electronic configuration of sodium?
(a) 2,8 (b) 8,2,1 (c) 2,1,8 (d) 2,8,1.
Answer: (d) 2, 8, 1

Q19. Complete the following table.

Atomic number	Mass number	No. of neutrons	No. of Protons	No. of electrons	Name of the Atomic Species
9		10			
16	32				Sulphur
	24		12		
	2		1		
	1	0	1	0	

Answer:

Atomic number	Mass number	No. of neutrons	No. of Protons	No. of electrons	Name of the Atomic Species
9	**19**	10	**9**	**9**	**Fluorine**
16	32	**16**	**16**	**16**	Sulphur
12	24	**12**	12	**12**	**Magnesium**
1	2	**1**	1	**1**	**Deuterium**
1	1	0	1	0	**Hydrogen ion**

ASSIGNMENT QUESTIONS SET – 1
CHAPTER – 4
STRUCTURE OF ATOMS

1. Plum pudding Model of atom was discovered by _____

2. Combining capacity of an atom is called _____

3. Alpha - particle scattering experiment of Rutherford led to discovery of _____

4. Number of neutrons in $^{81}_{35}Br$ is _____

5. _____ are atoms having the same mass number but different atomic number.

6. The charge on the electron is found to be _____ coulombs.

7. The electronic configuration of silicon is ___. (Atomic number = 14)

8. _____ electrons are responsible for the chemical properties of an atom.

9. Rutherford's model of an atom was modified by _____.

10. ____ is an isotope of carbon used in determining the age of dead plants.

11. An atom with 3 protons and 4 neutrons will have a valency of _____.

12. What do you understand by valency of an element? What is valency of boron?

13. List the features of Rutherford's nuclear model of atom.

14. What are the postulates of Bohr Model of an atom?

15. Define Valency. What is the valency of chlorine, sulphur and magnesium?

16. Cl^- has completely filled K&L shells. Explain.

17. Na^+ is possible but Cl^+ is not possible. What is the reason?

18. What are isotopes? Give two examples .

19. What were the observations of Rutherford's Alpha particles scattering experiment?

20. What are the drawbacks of Rutherford's model of atom?

21. From what observations do you derive the following inferences?

(i) The most of the space inside the atom is empty.

(ii) The volume of the nucleus is very small.

(iii) Anode rays consist of positively charged particles.

22. Name the fundamental particle not present in the nucleus of hydrogen atom

23. Who discovered electrons?

24. Who discovered protons?

25. Who discovered neutrons?

26. Who discovered nucleus of an atom?

27. What are canal rays?

28. What are the properties of anode rays?

29. What are cathode rays?

30. Who discovered X-Rays?

31. If an atom contains one electron and one proton, will it carry any charge or not?

32. Complete the following table.

Particle	Electron	Proton	Neutron
(i) Symbol	_____	_____	_____
(ii) Nature	_____	_____	_____
(iii) Relative Charge	_____	_____	_____
(iv) Absolute Charge	_____	_____	_____
(v) Relative Mass	_____	_____	_____
(vi) Absolute Mass	_____	_____	_____

33. What is the mass of proton as compared to electron?

34. Describe briefly Thomson's model of an atom.

35. Write the limitations of J.J. Thomson's model of an atom.

36. What are α-particles?

37. On the basis of Rutherford's model of an atom, which subatomic particle is present in the nucleus of an atom?

38. Who is known as 'Father of Nucleus Physics'?

39. What were the observations of Rutherford's α-scattering experiment?

40. What were the important features of atomic model based on Rutherford's scattering experiment?

41. What are the limitations of Rutherford's model of the atom?

42. Draw a sketch of Bohr's model of an atom with three shells.

43. Describe Bohr's model of the atom.

44. What do you think would be the observation if the α-particle scattering experiment is carried out using a foil of a metal other than gold?

45. Write a short note on Nucleus.

46. What is Atomic Number? Who coined this term?

47. What is mass number?

48. If A = 23 and Z = 11 for Na atom, how many protons, electrons and neutrons present in Na atom?

49. What is ionization energy?

50. In a sample of ethyl ethanoate ($CH_3COOC_2H_5$) the two oxygen atoms have the same number of electrons but different number of neutrons. What can be the reason for it?

51. In the atom of element X, 6 electrons are present in the outermost shell. If it requires an octet configuration by accepting requisite number of electrons, then what would be the charge on the ion so formed?

52. Why do helium, neon & argon have a zero valency?

53. Write the atomic number and the symbol of an element which has mass number 32 and the number of neutrons 16 in the nucleus.

54. Helium atom has an atomic mass of 4 u and two protons in its nucleus. How many neutrons does it have?

55. If number of electrons in an atom is 8 and number of protons is also 8,then (i) what is the atomic number of the atom? (ii) what is the charge on the atom?

56. What are the limitations of J. J. Thomson's model of the atom?

57. Why was Thomson's model of atom discarded and replaced by Rutherford's model? Why is Rutherford's model also called the nuclear model of atom

58. The average atomic mass of a sample of an element X is 16.2u. What are the percentage of isotopes ${}^{16}_{8}X$ *and* ${}^{18}_{8}X$ in the sample?

59. What are the salient feautres of Bohr's Atomic Model? How is it advantageous over Rutherford's Nuclear Model?

60. What is the charge and mass of the anode rays emitted when, hydrogen gas is enclosed in the discharge tube experiment? What is the name of these particles?

61. Do the anode rays always consist of protons whatever be the gas enclosed in the discharge tube? Explain.

62. What is the other name of X-rays?

63. How are x-rays produced? Why was this name given?

64. How are x-rays made tools in diagnostic purposes in the medical field?

65. What is phosphorescence? How does it differ from fluorescence?

66. Who discovered the nuclear model of the atom?

67. Explain how Rutherford’s atomic structure cannot explain the stability of atom?

68. Explain how Bohr’s atomic model explains the emission and absorption of radiation.

69. What is the charge and mass of a β-particle? From which part of the atom are β-particles emitted?

70. The two elements, A and B have 17 electrons each in their atom. Element A has 35 nucleons while element B has 33 nucleons (nucleons are the total number of protons and neutrons in the nucleus). What is the relationship between these two elements? Explain. The element A reacts with hydrogen in diffused light. Does the element B also react with hydrogen?

71. One isotope of carbon with atomic mass 12, occupies group 14 in the 2nd period in the long form periodic Table. Predict the position of another radioactive isotope of carbon with atomic mass 14?

72. What is the name given to the rays, traveling from cathode to anode?

73. Do the cathode rays always consist of electrons only, whatever be the gas enclosed in the discourage tube?

74. Why are electrons in the outermost shell known as valence electrons?

ASSIGNMENT QUESTIONS SET – 2
CHAPTER – 4
STRUCTURE OF ATOMS

1. Which of the following correctly represent the electronic distribution in the Mg atom?
(a) 3, 8, 1 (b) 2, 8, 2 (c) 1, 8, 3 (d) 8, 2, 2

2. Rutherford's 'alpha (α) particles scattering experiment' resulted in to discovery of
(a) Electron (b) Proton (c) Nucleus in the atom (d) Atomic mass

3. The ion of an element has 3 positive charges. Mass number of the atom is 27 and the number of neutrons is 14. What is the number of electrons in the ion?
(a) 13 (b) 10 (c) 14 (d) 16

4. Elements with valency 1 are
(a) Always metals (b) always metalloids
(c) either metals or non-metals (d) always non-metals

5. The first model of an atom was given by
(a) N. Bohr (b) E. Goldstein
(c) Rutherford (d) J.J. Thomson

6. Is it possible for the atom of an element to have one electron, one proton and no neutron? If so, name the element.

7. Why did Rutherford select a gold foil in his α–ray scattering experiment?

8. Will Cl-35 and Cl-37 have different valences?

9. Calculate the number of neutrons present in the nucleus of an element X which is represented as 31 X15 .

10. The atomic number of calcium and argon are 20 and 18 respectively, but the mass number of both these elements is 40. What is the name given to such a pair of elements?

11. Why do Helium, Neon and Argon have a zero valency?

12. In what way the Rutherford proposed atomic model?

13. In what way the Thomson proposed atomic model?

14. What were the drawbacks of Rutherford's model of an atom?

15. What are the limitations of J.J. Thomson's model of an atom?

16. In television picture tube which type of rays are used?

17. Which is heavier, neutron or proton?

18. If electrons move from K to L shell, will the energy be absorbed or evolved?

19. Helium atom has an atomic mass of 4u and two protons in its nucleus. How many neutrons does it have?

20. An ion X^{2+} contains 18 electrons and 20 neutrons. Calculate the atomic number and mass no. of element X. Name the element X.

21. Give one Achievement and one limitation of J.J Thomson's model of atom?

22. In a given electric field, β- particles are deflected more than α- particles inspite of the fact that α - particles have larger charge, why?

23. What are valence electrons? What is their significance?

24. What would be the observation if the α - particle scattering experiment is carried out using a foil of a metal other than gold?

25. Electronic configuration of Potassium is 2,8,8,1 and Calcium 2,8,8,2, when M shell can have maximum of 18 electrons then why next element Scandium has electronic configuration 2,8,9,2 and not 2,8,8,3 ?

26. What are isotopes and Isobars? What are two isotopes of chlorine? Calculate the average atomic mass of a chlorine atom?

27. What is present concept of an atom? Explain in detail? Why this model is considered to be the most appropriate model?

28. Explain the Rutherford's alpha particle scattering experiment. What were the main conclusions drawn from this experiment?

29. A naturally occurring sample of :-

(i) 69.2% of 53Cu& 30.8% of 65Cu. Find the average atomic mass of a naturally occuring sample of copper.

(ii)7.42% of 6Li & 92.58% of 7Li.Find the average atomic mass of a naturally occuring sample of Lithium.

30. Calculate the no. of atoms of each element persent in 9.8 g of sulphuric acid, H_2SO_4. (H=1, S=32, O=16)

31. How to calculate the atomicity and the atomic mass of an atom?

32. To weight $BaCl_2$ or Na_2SO_4

a) use a polythene bags and spring balance

b) use a watch glass and spring balance

c) use a polythene bags and physical balance

d) use a watch glass and physical balance

33. To weight sodium sulphate or barium chloride it should be in form of

a) saturated solution b) large crystals c) small crystals d) fine powder

34. What is the distribution of electrons in an atom of Phosphorus and how can it have two valencies

35. The maximum no. of electrons present in shell is given by the formula 2n2and the maximum no. of electrons filled in M shell is 18. But in the element calcium we only fill 8 electrons in the M shell and move on to the N shell. why ?

36. What are alpha particles?

37. Write ddifference between atomic mass and mass number?

38. An ion (M^{2+}) contain 10 electrons and 12 neutrons what is the atomic number and mass number of the element M.

39. An ion M^{3+} contains 10 electrons and 14 neutrons. What are the atomic mass and mass number of the element M ? Name the element.

40. 10 gm of silver nitrate solution is added to 10 gm of sodium chloride solution. What change in mass do you expect after the reaction and why?

41. Write the atomicity of the following molecules: (i) H_2SO_4 (ii) CCl_4

42. Define the term mole.

43. What is the law of constant proportions?

44. What is molar mass? What are its units?

45. Define atomicity.

46. Calculate the formula unit mass of Na_2CO_3.
[Atomic mass of Na = 23 u, C = 12 u, O = 16 u]

47. Give the definition of a cation and an anion.

48. An element X has a valency 3. Write the formula of its oxide.

49. Calculate the number of moles is 52 g of He (Helium)

50. If 12 gm of carbon is burnt in the presence of 32 gm of oxygen, how much carbon dioxide will be formed ?

51. Calculate the number of moles in 17 gm of H_2O_2. (Atomic weight of H = 1 u, O = 16 u).

52. Define and explain atomic mass of an element.

53. If one mole of carbon atoms weighs 12 g. What is the mass of 1 atom of carbon ?

54. Calculate the mass of 1 molecule of oxygen gas.

55. The mass of single atom of an element is 2.65×10^{-23} g. Calculate its atomic mass. [NA = 6.022×10^{23} mol^{-1}]

56. Calculate percentage composition of glucose ($C_6H_{12}O_6$).

57. John placed 10 moles of sulphur molecules (S_8) and 5 moles of glucose ($C_6H_{12}O_6$) in the two different pans of a physical balance. Find which pan of the balance would be heavier, support your answer with calculations.
(atomic mass : O = 16 u, C = 12 u, H = 1 u, S = 32 u)

58. What is Avogadro constant ?

59. Calculate the number of particles present in 56 gm of N_2 molecule.

60. Calculate the number of moles present in (a) 60 g of calcium. (b) 3.011 × 1023 number of oxygen atoms.
[Given that Ca = 40u; Avogadro number, NA = 6.022×10^{23} per mole]

61. Give an account of the 'mole concept'.

62. Calculate the ratio by number of atoms for Magnesium sulphide.

63. (a) The average atomic mass of a sample of an element X is 35.5u. What are the percentages of isotopes ${}^{37}_{17}X$ *and* ${}^{35}_{17}X$ in the sample ?

(b) Write any two applications of isotopes.

64. Nitu presented a silver lamp to her mother on her birthday. The lamp contained 3.011×10^{23} atoms of silver in it. What is the mass of silver lamp and the cost of it if 1 gm silver costs Rs 60. Atomic mass of Ag = 108 u, $N_0 = 6.022 \times 10^{23}$ per mole.

65. Verify by calculating that 5 mole of CO2 and 5 mole of H_2S do not have the same mass. (Atomic mass of C = 12 u, O = 16 u, H = 1 u, S = 32 u)

66. A solution is made by dissolving sodium chloride in water and its concentration is expressed as 0.9% by mass. Calculate : (i) the number of moles, and (ii) number of molecules present in NaCl for this solution.

[Given : mass % = (Mass of solute×100)/ Mass of solution]

(Atomic mass of Na = 23.0 u, Cl = 35.5 u)

67. (i) What do the following symbols / formulae stand for :

(a) 2O (b) O_2 (c) O_3 (d) H_2O

(ii) Give the chemical formula of the following compounds :

(a) Potassium carbonate (b) Calcium chloride

(iii) Calculate the formula unit mass of $Al_2(SO_4)_3$.

(Given : Atomic mass of Al = 27 u, S = 32 u, O = 16 u)

68. An element ${}^{14}_{7}A$ exists as diatomic gas in nature which is relatively inert and forms 78% of earth's atmosphere.

(a) Identify the gas and write its molecular formula. Write the formulae of its nitrite and nitrate ions.

(b) How many moles of this gas would contain 12.044×10^{23} atoms of this element ?

(Avogadro's no. = 6.022×10^{23})

(c) Calculate the molecular mass of (a) NH_4NO_3 and (b) HNO_3

(Given atomic masses N = 14 u, O = 16 u, H = 1u)

69. (a) In ammonia, nitrogen and hydrogen are always present in the ratio 14 : 3 by mass. State the law which explains the above statement.

(b) During the formation of ammonia, what mass of hydrogen gas would be required to react completely with 42 g of nitrogen gas ?

70. (a) Calculate the number of moles in 112 g of iron.

(b) Calculate the mass of 0.5 moles of sugar ($C_{12}H_{22}O_{11}$).

(c) Define the term molecular mass.

(d) Determine the molecular mass of $ZnSO_4$.

[Atomic mass of Zn = 65 u, S = 32 u, O = 16 u]

(e) Calculate the number of molecules of carbon dioxide, present in 4.4 g of CO_2.

ASSIGNMENT QUESTIONS SET – 3
CHAPTER – 4
STRUCTURE OF ATOMS

1. Which of the following correctly represent the electronic distribution in the Mg atom?
(a) 3, 8, 1
(b) 2, 8, 2
(c) 1, 8, 3
(d) 8, 2, 2

2. Rutherford's 'alpha (α) particles scattering experiment' resulted in to discovery of
(a) Electron
(b) Proton
(c) Nucleus in the atom
(d) Atomic mass

3. The number of electrons in an element X is 15 and the number of neutrons is 16. Which of the following is the correct representation of the element?
$(a)^{31}_{15}X$ $(b)^{31}_{16}X$ $(c)^{16}_{15}X$ $(d)^{15}_{16}X$

4. Dalton's atomic theory successfully explained
(i) Law of conservation of mass
(ii) Law of constant composition
(iii) Law of radioactivity
(iv) Law of multiple proportion
(a) (i), (ii) and (iii)
(b) (i), (iii) and (iv)
(c) (ii), (iii) and (iv)
(d) (i), (ii) and (iv)

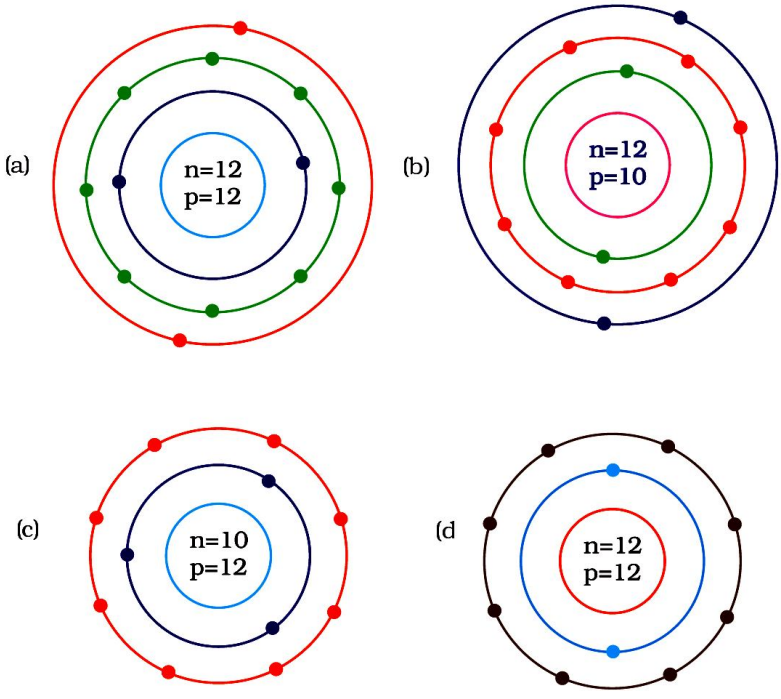
5. Which of the following statements about Rutherford's model of atom are correct?
(i) considered the nucleus as positively charged
(ii) established that the α –particles are four times as heavy as a hydrogen atom
(iii) can be compared to solar system
(iv) was in agreement with Thomson's model
(a) (i) and (iii)
(b) (ii) and (iii)
(c) (i) and (iv)
(d) only (i)

6. Which of the following are true for an element?
(i) Atomic number = number of protons + number of electrons
(ii) Mass number = number of protons + number of neutrons
(iii) Atomic mass = number of protons = number of neutrons
(iv) Atomic number = number of protons = number of electrons
(a) (i) and (ii)
(b) (i) and (iii)
(c) (ii) and (iii)
(d) (ii) and (iv)

7. In the Thomson's model of atom, which of the following statements are correct?
(i) the mass of the atom is assumed to be uniformly distributed over the atom
(ii) the positive charge is assumed to be uniformly distributed over the atom
(iii) the electrons are uniformly distributed in the positively charged sphere
(iv) the electrons attract each other to stabilise the atom
(a) (i), (ii) and (iii)
(b) (i) and (iii)
(c) (i) and (iv)
(d) (i), (iii) and (iv)

8. Rutherford's α –particle scattering experiment showed that
(i) electrons have negative charge
(ii) the mass and positive charge of the atom is concentrated in the nucleus
(iii) neutron exists in the nucleus
(iv) most of the space in atom is empty
Which of the above statements are correct?
(a) (i) and (iii)
(b) (ii) and (iv)
(c) (i) and (iv)
(d) (iii) and (iv)

9. Identify the Mg^{2+} ion from the Fig.4.1 where, n and p represent the number of neutrons and protons respectively



10. In a sample of ethyl ethanoate ($CH_3COOC_2H_5$) the two oxygen atoms have the same number of electrons but different number of neutrons. Which of the following is the correct reason for it?
(a) One of the oxygen atoms has gained electrons
(b) One of the oxygen atoms has gained two neutrons
(c) The two oxygen atoms are isotopes
(d) The two oxygen atoms are isobars.

11. The ion of an element has 3 positive charges. Mass number of the atom is 27 and the number of neutrons is 14. What is the number of electrons in the ion?
(a) 13
(b) 10
(c) 14
(d) 16

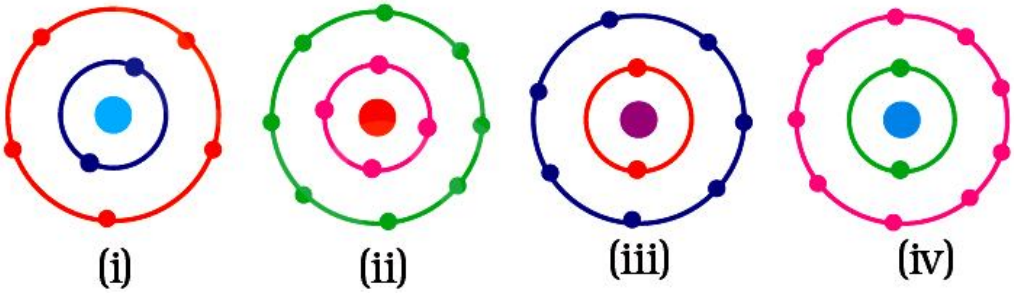
12. Elements with valency 1 are
(a) always metals
(b) always metalloids
(c) either metals or non-metals
(d) always non-metals

13. The first model of an atom was given by
(a) N. Bohr
(b) E. Goldstein
(c) Rutherford
(d) J.J. Thomson

14. An atom with 3 protons and 4 neutrons will have a valency of
(a) 3
(b) 7
(c) 1
(d) 4

15. The electron distribution in an aluminium atom is
(a) 2, 8, 3
(b) 2, 8, 2
(c) 8, 2, 3
(d) 2, 3, 8

16. Which of the following in Fig. 4.2 do not represent Bohr's model of an atom correctly?



(a) (i) and (ii)
(b) (ii) and (iii)
(c) (ii) and (iv)
(d) (i) and (iv)

17. Which of the following statement is always correct?
(a) An atom has equal number of electrons and protons.
(b) An atom has equal number of electrons and neutrons.
(c) An atom has equal number of protons and neutrons.
(d) An atom has equal number of electrons, protons and neutrons.

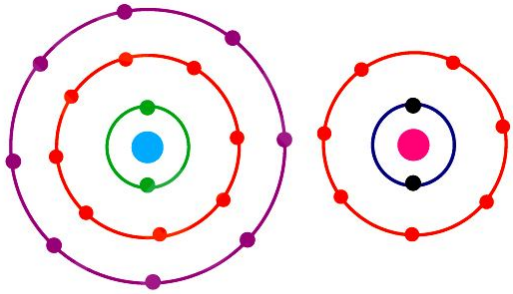
18. Atomic models have been improved over the years. Arrange the following atomic models in the order of their chronological order
(i) Rutherford's atomic model
(ii) Thomson's atomic model
(iii) Bohr's atomic model
(a) (i), (ii) and (iii)
(b) (ii), (iii) and (i)
(c) (ii), (i) and (iii)
(d) (iii), (ii) and (i)

19. Is it possible for the atom of an element to have one electron, one proton and no neutron. If so, name the element.

20. Write any two observations which support the fact that atoms are divisible.

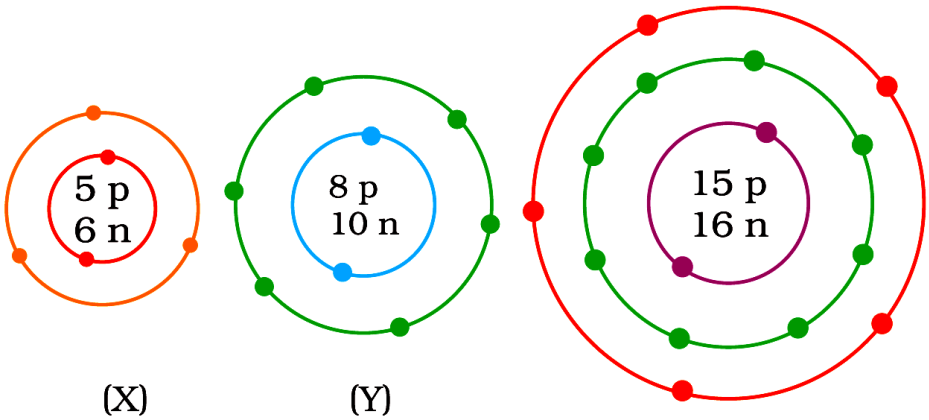
21. Will 35Cl and 37Cl have different valencies? Justify your answer.

22. Why did Rutherford select a gold foil in his α –ray scattering experiment?
23. Find out the valency of the atoms represented by the Fig. 4.3 (a) and (b).



(a) (b)

24. What information do you get from the Fig. 4.4 about the atomic number, mass number and valency of atoms X, Y and Z? Give your answer in a tabular form.



(X) (Y) (Z)

25. In response to a question, a student stated that in an atom, the number of protons is greater than the number of neutrons, which in turn is greater than the number of electrons. Do you agree with the statement? Justify your answer.

26. Calculate the number of neutrons present in the nucleus of an element X which is represented as ${}^{31}_{15}X$

27. One electron is present in the outer most shell of the atom of an element X. What would be the nature and value of charge on the ion formed if this electron is removed from the outer most shell?

28. Write down the electron distribution of chlorine atom. How many electrons are there in the L shell? (Atomic number of chlorine is 17).

29. In the atom of an element X, 6 electrons are present in the outermost shell. If it acquires noble gas configuration by accepting requisite number of electrons, then what would be the charge on the ion so formed?

30. Match the names of the Scientists given in column A with their contributions towards the understanding of the atomic structure as given in column B

(A)	(B)
(a) Ernest Rutherford	(i) Indivisibility of atoms
(b) J.J.Thomson	(ii) Stationary orbits
(c) Dalton	(iii) Concept of nucleus
(d) Neils Bohr	(iv) Discovery of electrons
(e) James Chadwick	(v) Atomic number
(f) E. Goldstein	(vi) Neutron
(g) Mosley	(vii) Canal rays

31. The atomic number of calcium and argon are 20 and 18 respectively, but the mass number of both these elements is 40. What is the name given to such a pair of elements?

32. Complete the Table 4.1 on the basis of information available in the symbols given below

$(a)\,{}^{35}_{17}Cl \qquad (b)\,{}^{12}_{6}C \qquad (c)\,{}^{81}_{35}Br$

Element	n_p	n_n

33. Helium atom has 2 electrons in its valence shell but its valency is not 2, Explain.

34. Fill in the blanks in the following statements

(a) Rutherford's α -particle scattering experiment led to the discovery of the ———

(b) Isotopes have same ———but different———.

(c) Neon and chlorine have atomic numbers 10 and 17 respectively. Their valencies will be———and———respectively.

(d) The electronic configuration of silicon is ———and that of sulphur is ———.

35. An element X has a mass number 4 and atomic number 2. Write the valency of this element?

36. Why do Helium, Neon and Argon have a zero valency?

37. The ratio of the radii of hydrogen atom and its nucleus is ~ 105. Assuming the atom and the nucleus to be spherical, (i) what will be the ratio of their sizes? (ii) If atom is represented by planet earth 'Re' = 6.4 ×106 m, estimate the size of the nucleus.

38. Enlist the conclusions drawn by Rutherford from his α -ray scattering experiment.

39. In what way is the Rutherford's atomic model different from that of Thomson's atomic model?

40. What were the drawbacks of Rutherford's model of an atom?

41. What are the postulates of Bohr's model of an atom?

42. Show diagramatically the electron distributions in a sodium atom and a sodium ion and also give their atomic number.

43. In the Gold foil experiment of Geiger and Marsden, that paved the way for Rutherford's model of an atom, ~ 1.00% of the α -particles were found to deflect at angles > 50 .؛If one mole of α -particles were bombarded on the gold foil, compute the number of α -particles that would deflect at angles less than 50^0.

CHAPTER – 10

GRAVITATION

NEWTON'S UNIVERSAL LAW OF GRAVITATION

Every object in the Universe attracts every other object with a force which is
(i) directly proportional to the product of their masses, and
(ii) inversely proportional to the square of the distance between their centres. The direction of the force is along the line joining the centres of two objects.

$F \propto m_1 m_2$ and $F \propto \frac{1}{r^2}$ $\Rightarrow F \propto \frac{m_1 m_2}{r^2}$

$F = \frac{G.m_1 m_2}{r^2}$ where G is a constant proportionality and is called universal gravitational constant.

UNITS AND VALUE OF GRAVITATIONAL CONSTANT

$F = \frac{G.m_1 m_2}{r^2}$

$\Rightarrow G.m_1 m_2 = F.r^2 \Rightarrow G = \frac{F.r^2}{m_1 m_2}$

Unit of G is Nm^2/kg^2.
If $m_1 = m_2 = 1$ kg, r = 1 then we have G = F
Hence, Universal gravitational constant G is numerically equal to the gravitational force of attraction between two bodies, each of unit mass kept at unit distance from each other.
Value of G = 6.67×10^{-11} Nm^2/kg^2.

KEPLER'S LAWS OF PLANETARY MOTION

KEPLER'S FIRST LAW

Every planet revolves around the Sun in an elliptical orbit, with the sun situated at any one of the foci of the ellipse.

KEPLER'S SECOND LAW

In the elliptical orbit of the planet, the line joining the centre of the planet to the centre of the Sun sweeps equal intervals of time.

KEPLER'S THIRD LAW

The square of time period of revolution of a planet around the Sun is directly proportional to the cube of the semi-major axis of the elliptical orbit.

$r^3 \propto T^2 \Rightarrow \frac{r^3}{T^2} = constant$

where r = radius of orbit = mean distance of planet from the Sun (inm), T = the time period of revolution of planet around the Sun (in second)

IMPORTANCE OF THE UNIVERSAL LAW OF GRAVITATION

The universal law of gravitation successfully explained several phenomena which were believed to be unconnected:
(i) the force that binds us to the earth;

(ii) the motion of the moon around the earth;
(iii) the motion of planets around the Sun; and
(iv) the tides due to the moon and the Sun.

INTEXT QUESTIONS PAGE NO. 134

1. State the universal law of gravitation
Ans. The universal law of gravitation states that every object in the universe attracts every other object with a force called the gravitational force. The force acting between two objects is directly proportional to the product of their masses and inversely proportional to the square of the distance between their centers. For two objects of masses m_1 and m_2 and the distance between them r, the force (F) of attraction acting between them is given by the universal law of gravitation as:

$$F = \frac{Gm_1m_2}{r^2}$$

Where, G is the universal gravitation constant given by: $G = 6.67 \times 10^{-11} Nm^2 / kg^2$

2. Write the formula to find the magnitude of the gravitational force between the earth and an object on the surface of the earth.
Ans. Let M_E be the mass of the Earth and m be the mass of an object on its surface. If R is the radius of the Earth, then according to the universal law of gravitation, the gravitational force (F) acting between the Earth and the object is given by the relation:

$$F = \frac{Gm_1m_2}{r^2}$$

FREE FALL

When an object falls from any height under the influence of gravitational force only, it is known as free fall. In the case of free fall no change of direction takes place but the magnitude of velocity changes because of acceleration.
This acceleration acts because of the force of gravitation and is denoted by 'g'. This is called acceleration due to gravity.

EXPRESSION FOR ACCELERATION DUE TO GRAVITATION 'G'.

Let mass of the object put under free fall = m.
And acceleration due to gravity = g.
Therefore, according to Newton's Second Law of Motion which states that Force is the product of mass and acceleration,
F = m x g ----------(i)
Now, according to Universal Law of gravitation,

$$F = G.\frac{M.m}{d^2} \text{ ……. (ii)}$$

Thus, from above two expressions, we get
Where, g is acceleration due to gravity,
G is the Universal Gravitational Constant.
M is the mass of earth.
And d is the distance between object and centre of earth.

WHEN OBJECT IS NEAR THE SURFACE OF EARTH

When an object is near the surface of earth, the distance between object and centre of the earth will be equal to the radius of earth because the distance of object is negligible in comparison of the radius of earth.

Let the radius of earth is equal to R.
Therefore, after substituting 'R' at the place of 'd' we get,

$$g = \frac{GM}{R^2} .....(iv)$$

Since, earth is not a perfect sphere rather it has oblique shape. Therefore, radius at the equator is greater than at the poles.
Since, value of 'g' is reciprocal of the square of radius of earth, thus, the value of 'g' will be greater at the poles and less at the equator.
And the value of 'g' will decrease with increase of distance of object from earth.
Calculation of value of 'g'
We know that
The accepted value of G is $6.673 \times 10^{-11} Nm^2/kg^2$.
The mass of earth, $M = 6 \times 10^{24}$ kg
The radius of earth, $R = 6.4 \times 10^6$ m
Therefore, by using expression, $g = \frac{GM}{R^2}$, the value of 'g' can be calculated.

Therefore, after substituting the value of G, M and R in the expression for 'g' we get.

$$g = \frac{6.673 \times 10^{-11} \times 6 \times 10^{24}}{(6.4 \times 10^6)^2}$$

$$\Rightarrow g = 9.8 m/s^2$$

Motion of an object under the influence of gravitational force of earth
The expression for 'g' is written as

$$g = \frac{GM}{R^2}$$

Since, the value of 'g' does not depend upon the mass or distance of an object, therefore, all objects fall over the earth with the same rate.
The equations for motion are as follows:

$v = u + at$ …….. (i)

$s = ut + \frac{1}{2} at^2$ ……. (ii)

$v^2 = u^2 + 2as$ …… (iii)

Therefore, the equations of motion are also applied to calculate the velocity, distance, etc by replacing 'a' by 'g'. After substituting 'g' at the place of 'a' we get above equations as follows:

$v = u + gt$ …….. (iv)

$s = ut + \frac{1}{2} gt^2$ ……. (v)

$v^2 = u^2 + 2gs$ …… (vi)

In the calculation; initial velocity (u), final velocity (v), time taken (t), or distance covered (s), the value of 'g' is taken as positive in the case of object moving towards earth and taken as negative in the case of object is thrown in opposite direction of earth.

MASS

Mass is the measurement of inertia and inertia is the property of any object which opposes the change in state of the object. It is inertia because of which an object in rest has tendency to remain in rest and an object in motion has tendency to remain in motion.

Inertia depends upon the mass of an object. Object having greater mass has greater inertia and vice versa. Mass of an object remains constant everywhere, i.e. mass will remain same whether that object is at the moon, at the earth or anywhere in the universe.

WEIGHT:

Earth attracts every object towards it. We know that force is the product of mass and acceleration due to gravity.

This means, F = m x g ----------(i)

The force by which earth attracts an object towards it is called the weight of the object, which is the product of mass (m) of the object and acceleration due to gravity (g).

Weight is denoted by 'W'.

Therefore, by substituting in the expression 'F = mg' we get,

W = m x g ----------(ii)

Since weight is the force which is acting vertically downwards, therefore, weight has both magnitude and direction and hence it is a vector quantity.

Since the value of 'g' is always constant at a given place,

Therefore, expression 'W = m x g' can be written as follows:

W α m ----------(iii)

This means weight of any object is directly proportional to its mass, i.e. weight will increase with the increase of mass and decrease with decrease in mass.

This is the cause that weight of any object is the measure of its mass.

The unit of weight

Since, weight of an object is equal to the force by which an object is attracted towards earth, therefore, unit of weight is same as the unit of force.

Therefore, Unit of weight is 'newton (N)'.

WEIGHT OF AN OBJECT ON THE SURFACE OF MOON

Let M_E be the mass of the Earth and m be an object on the surface of the Earth. Let R_E be the radius of the Earth. According to the universal law of gravitation, weight W_E of the object on the surface of the Earth is given by,

$$W_E = \frac{GM_E m}{R_E^{\,2}}$$

Let M_M and R_M be the mass and radius of the moon. Then, according to the universal law of gravitation, weight W_M of the object on the surface of the moon is given by:

$$W_M = \frac{GM_M m}{R_M^{\,2}} \qquad \Rightarrow \frac{W_M}{W_E} = \frac{\frac{GM_M m}{R_M^{\,2}}}{\frac{GM_E m}{R_E^{\,2}}} = \frac{M_M R_E^{\,2}}{M_E R_M^{\,2}}$$

$$where, M_E = 5.98\times10^{24}\,kg, M_M = 7.36\times10^{22}\,kg$$

$$R_E = 6.4\times10^{6}\,m, R_M = 1.74\times10^{6}\,m$$

$$\frac{W_M}{W_E} = \frac{7.36\times10^{22}\times(6.4\times10^{6})^2}{5.98\times10^{24}\times(1.74\times10^{6})^2} = 0.165 \approx \frac{1}{6}$$

Therefore, the weight of an object on the moon $\frac{1}{6}^{th}$ its weight on the earth

INTEXT QUESTIONS PAGE NO. 136

1. What do you mean by free fall?

Ans. Gravity of the Earth attracts every object towards its centre. When an object is released from a height, it falls towards the surface of the Earth under the influence of gravitational force. The motion of the object is said to have free fall.

2. What do you mean by acceleration due to gravity?
Ans. When an object falls towards the ground from a height, then its velocity changes during the fall. This changing velocity produces acceleration in the object. This acceleration is known as acceleration due to gravity (g). Its value is given by 9.8 m/s^2.

INTEXT QUESTIONS PAGE NO. 138

1. What are the differences between the mass of an object and its weight?
Ans.

Mass	Weight
Mass is the quantity of matter contained in the body.	Weight is the force of gravity acting on the body.
It is the measure of inertia of the body.	It is the measure of gravity.
Mass is a constant quantity.	Weight is not a constant quantity. It is different at different places.
It only has magnitude.	It has magnitude as well as direction.
Its SI unit is kilogram (kg).	Its SI unit is the same as the SI unit of force, i.e., Newton (N).

2. Why is the weight of an object on the moon $\frac{1}{6}^{th}$ its weight on the earth?

Ans. Let M_E be the mass of the Earth and m be an object on the surface of the Earth. Let R_E be the radius of the Earth. According to the universal law of gravitation, weight W_E of the object on the surface of the Earth is given by,

$$W_E = \frac{GM_E m}{R_E^{\ 2}}$$

Let M_M and R_M be the mass and radius of the moon. Then, according to the universal law of gravitation, weight W_M of the object on the surface of the moon is given by:

$$W_M = \frac{GM_M m}{R_M^{\ 2}}$$

$$\frac{W_M}{W_E} = \frac{\frac{GM_M m}{R_M^{\ 2}}}{\frac{GM_E m}{R_E^{\ 2}}} = \frac{M_M R_E^{\ 2}}{M_E R_M^{\ 2}}$$

$$where, M_E = 5.98\times10^{24} kg, M_M = 7.36\times10^{22} kg$$

$$R_E = 6.4\times10^{6} m, R_M = 1.74\times10^{6} m$$

$$\frac{W_M}{W_E} = \frac{7.36\times10^{22}\times(6.4\times10^{6})^2}{5.98\times10^{24}\times(1.74\times10^{6})^2} = 0.165 \approx \frac{1}{6}$$

Therefore, the weight of an object on the moon $\frac{1}{6}^{th}$ its weight on the earth

NUMERICAL

1. Calculate the force of gravity acting on your friend of mass 60kg. Given mass of earth = 6×10^{24} kg and radius of Earth = 6.4×10^{6}m.

2. Mass of an object is 10kg. What is its weight on Earth?

3. What is the mass of an object whose weight is 49N?

4. An object weighs 10N when measured on the surface of the earth. What would be its weight when measured on the surface of the Moon?

5. An object is thrown vertically upwards and rises to a height of 10m. Calculate (i) the velocity with which the object was thrown upwards and (ii) the time taken by the object to reach the highest point.

6. A force of 2 kg wt. acts on a body of mass 4.9kg. Calculate its acceleration.

7. A force of 20N acts upon a body weight is 9.8N. What is the mass of the body and how much is its acceleration?

8. A body has a weight of 10 kg on the surface of earth. What will be its mass and weight when taken to the centre of earth?

9. How much would a 70 kg man weigh on moon? What will be his mass on earth and moon? Given g on moon = 1.7 m/s^2.

10. The Earth's gravitational force causes an acceleration of 5 m/s^2 in a 1 kg mass somewhere in space. How much will the acceleration of a 3 kg mass be at the same place?

11. A particle is thrown up vertically with a velocity of 50m/s. What will be its velocity at the highest point of the journey? How high would the particle rise? What time would it take to reach the highest point? Take g = 10 m/s^2.

12. If a planet existed whose mass was twice that of Earth and whose radius 3 times greater, how much will a 1kg mass weigh on the planet?

13. A boy on cliff 49m high drops a stone. One second later, he throws a second stone after the first. They both hit the ground at the same time. With what speed did he throw the second stone?

14. A stone drops from the edge of a roof. It passes a window 2m high in 0.1s. How far is the roof above the top of the window?

15. A stone is dropped from the edge of a roof. (a) How long does it take to fall 4.9m ? (b) How fast does it move at the end of that fall? (c) How fast does it move at the end of 7.9m? (d) What is its acceleration after 1s and after 2s?

EXERCISE QUESTIONS PAGE NO. 143

1. How does the force of gravitation between two objects change when the distance between them is reduced to half?
Ans. According to the universal law of gravitation, gravitational force (*F*) acting between two objects is inversely proportional to the square of the distance (*r)* between them, i.e.,

$$F \propto \frac{1}{r^2}$$

If distance *r* becomes *r*/2, then the gravitational force will be proportional to $\frac{1}{\left(\frac{r}{2}\right)^2} = \frac{4}{r^2}$

Hence, if the distance is reduced to half, then the gravitational force becomes four times larger than the previous value.

2. Gravitational force acts on all objects in proportion to their masses. Why then, a heavy object does not fall faster than a light object?
Ans. All objects fall on ground with constant acceleration, called acceleration due to gravity (in the absence of air resistances). It is constant and does not depend upon the mass of an object. Hence, heavy objects do not fall faster than light objects.

3. What is the magnitude of the gravitational force between the earth and a 1 kg object on its surface? (Mass of the earth is 6×10^{24} kg and radius of the earth is 6.4×10^6 m).
Ans. According to the universal law of gravitation, gravitational force exerted on an object of mass *m* is given by:

$$F = \frac{GMm}{r^2}$$

Where,
Mass of Earth, $M = 6 \times 10^{24}$ kg
Mass of object, $m = 1$ kg
Universal gravitational constant, $G = 6.7 \times 10^{-11}$ Nm^2 kg^{-2}
Since the object is on the surface of the Earth, *r* = radius of the Earth (*R*)
$r = R = 6.4 \times 10^6$ m

Gravitational force, $F = \frac{GMm}{R^2} = \frac{6.7 \times 10^{-11} \times 6 \times 10^{24} \times 1}{(6.4 \times 10^6)^2} = 9.8N$

4. The earth and the moon are attracted to each other by gravitational force. Does the earth attract the moon with a force that is greater or smaller or the same as the force with which the moon attracts the earth? Why?
Ans. According to the universal law of gravitation, two objects attract each other with equal force, but in opposite directions. The Earth attracts the moon with an equal force with which the moon attracts the earth.

5. If the moon attracts the earth, why does the earth not move towards the moon?
Ans. The Earth and the moon experience equal gravitational forces from each other. However, the mass of the Earth is much larger than the mass of the moon. Hence, it

accelerates at a rate lesser than the acceleration rate of the moon towards the Earth. For this reason, the Earth does not move towards the moon.

6. What happens to the force between two objects, if
(i) the mass of one object is doubled?
(ii) the distance between the objects is doubled and tripled?
(iii) the masses of both objects are doubled?
Ans. According to the universal law of gravitation, the force of gravitation between two objects is given by: $F = \frac{Gm_1m_2}{r^2}$
(i) F is directly proportional to the masses of the objects. If the mass of one object is doubled, then the gravitational force will also get doubled.
(ii) F is inversely proportional to the square of the distances between the objects. If the distance is doubled, then the gravitational force becomes one-fourth of its original value. Similarly, if the distance is tripled, then the gravitational force becomes one-ninth of its original value.
(iii) F is directly proportional to the product of masses of the objects. If the masses of both the objects are doubled, then the gravitational force becomes four times the original value.

7. What is the importance of universal law of gravitation?
Ans. The universal law of gravitation proves that every object in the universe attracts every other object.

8. What is the acceleration of free fall?
Ans. When objects fall towards the Earth under the effect of gravitational force alone, then they are said to be in free fall. Acceleration of free fall is 9.8 m s^{-2}, which is constant for all objects (irrespective of their masses).

9. What do we call the gravitational force between the Earth and an object?
Ans. Gravitational force between the earth and an object is known as the weight of the object.

10. Amit buys few grams of gold at the poles as per the instruction of one of his friends. He hands over the same when he meets him at the equator. Will the friend agree with the weight of gold bought? If not, why? [*Hint*: The value of *g* is greater at the poles than at the equator].
Ans. Weight of a body on the Earth is given by:
$W = mg$
Where,
m = Mass of the body
g = Acceleration due to gravity
The value of g is greater at poles than at the equator. Therefore, gold at the equator weighs less than at the poles. Hence, Amit's friend will not agree with the weight of the gold bought.

11. Why will a sheet of paper fall slower than one that is crumpled into a ball?
Ans. When a sheet of paper is crumbled into a ball, then its density increases. Hence, resistance to its motion through the air decreases and it falls faster than the sheet of paper.

Gravitational force on the surface of the moon is only $\frac{1}{6}$ as strong as gravitational force on the Earth. What is the weight in newtons of a 10 kg object on the moon and on the Earth?

Ans. Weight of an object on the moon = $\frac{1}{6} \times$ Weight of an object on the Earth

Also,
Weight = Mass × Acceleration
Acceleration due to gravity, g = 9.8 m/s^2
Therefore, weight of a 10 kg object on the Earth = 10 × 9.8 = 98 N
And, weight of the same object on the moon = $\frac{1}{6} \times 98 = 16.3N$

12. A ball is thrown vertically upwards with a velocity of 49 m/s. Calculate
(i) the maximum height to which it rises.
(ii)the total time it takes to return to the surface of the earth.
Ans. According to the equation of motion under gravity:
$v^2 - u^2 = 2gs$
Where,
u = Initial velocity of the ball
v = Final velocity of the ball
s = Height achieved by the ball
g = Acceleration due to gravity
At maximum height, final velocity of the ball is zero, i.e., $v = 0$
u = 49 m/s
During upward motion, g = − 9.8 m s^{-2}
Let h be the maximum height attained by the ball.
Hence, $0 - 49^2 = 2 \times (-9.8) \times h$
$\Rightarrow h = \frac{49 \times 49}{2 \times 9.8} = 122.5m$
Let t be the time taken by the ball to reach the height 122.5 m, then according to the equation of motion:
$v = u + gt$
We get,
$0 = 49 + t \times (-9.8) \Rightarrow 9.8t = 49 \Rightarrow t = \frac{49}{9.8} = 5s$
But,
Time of ascent = Time of descent
Therefore, total time taken by the ball to return = 5 + 5 = 10 s

13. A stone is released from the top of a tower of height 19.6 m. Calculate its final velocity just before touching the ground.
Ans. According to the equation of motion under gravity:
$v^2 - u^2 = 2gs$
Where,
u = Initial velocity of the stone = 0
v = Final velocity of the stone
s = Height of the stone = 19.6 m
g = Acceleration due to gravity = 9.8 m s^{-2}
$\therefore v^2 - 0^2 = 2 \times 9.8 \times 19.6$
$v^2 = 2 \times 9.8 \times 19.6 = (19.6)^2$
v = 19.6 m s^{-1}
Hence, the velocity of the stone just before touching the ground is 19.6 m s^{-1}.

14. A stone is thrown vertically upward with an initial velocity of 40 m/s. Taking g = 10 m/s^2, find the maximum height reached by the stone. What is the net displacement and the total distance covered by the stone?

Ans. According to the equation of motion under gravity:
$v^2 - u^2 = 2\,gs$
Where,
u = Initial velocity of the stone = 40 m/s
v = Final velocity of the stone = 0
s = Height of the stone
g = Acceleration due to gravity = -10 m s^{-2}
Let h be the maximum height attained by the stone.
Therefore,

$$0-(40)^2 = 2\times h\times(-10) \Rightarrow h = \frac{40\times 40}{20} = 80m$$

Therefore, total distance covered by the stone during its upward and downward journey = 80 + 80 = 160 m
Net displacement of the stone during its upward and downward journey
= 80 + (−80) = 0

15. Calculate the force of gravitation between the earth and the Sun, given that the mass of the earth = 6×10^{24} kg and of the Sun = 2×10^{30} kg. The average distance between the two is 1.5×10^{11} m.
Ans. According to the universal law of gravitation, the force of attraction between the Earth and the Sun is given by: $F = \frac{GM_{Sun}M_{Earth}}{R^2}$
Where,
M_{Sun} = Mass of the Sun = 2×10^{30} kg
M_{Earth} = Mass of the Earth = 6×10^{24} kg
R = Average distance between the Earth and the Sun = 1.5×10^{11} m
G = Universal gravitational constant = 6.7×10^{-11} Nm^2 kg^{-2}

$$F = \frac{6.7\times10^{-11}\times2\times10^{30}\times6\times10^{24}}{(1.5\times10^{11})^2} = 3.57\times10^{22}\,N$$

16. A stone is allowed to fall from the top of a tower 100 m high and at the same time another stone is projected vertically upwards from the ground with a velocity of 25 m/s. Calculate when and where the two stones will meet.
Ans. Let the two stones meet after a time t.
(i) <u>For the stone dropped from the tower:</u>
Initial velocity, $u = 0$
Let the displacement of the stone in time t from the top of the tower be s.
Acceleration due to gravity, g = 9.8 m s^{-2}
From the equation of motion,

$$s = ut + \frac{1}{2}gt^2 = 0\times t + \frac{1}{2}\times 9.8\times t$$

$$\Rightarrow s = 7.9t^2 \text{ ------(1)}$$

(ii) <u>For the stone thrown upwards:</u>
Initial velocity, u = 25 m s^{-1}
Let the displacement of the stone from the ground in time t be s'.
Acceleration due to gravity, g = −9.8 m s^{-2}
Equation of motion,

$$s' = ut + \frac{1}{2}gt^2 = 25t - \frac{1}{2}\times 9.8\times t^2$$

$$\Rightarrow s' = 25t - 4.9t^2 \text{ ------(2)}$$

The combined displacement of both the stones at the meeting point is equal to the height of the tower 100 m.

$\therefore s + s' = 100$

$\Rightarrow \frac{1}{2}gt^2 + 25t - \frac{1}{2}gt^2 = 100$

$\Rightarrow t = \frac{100}{25} = 4s$

In 4 s, the falling stone has covered a distance given by equation (1) as

$s = \frac{1}{2} \times 10 \times 4^2 = 80m$

Therefore, the stones will meet after 4 s at a height (100 − 80) = 20 m from the ground

17. A ball thrown up vertically returns to the thrower after 6 s. Find
(a) the velocity with which it was thrown up,
(b) the maximum height it reaches, and
(c) its position after 4 s.

Ans. (a) Time of ascent is equal to the time of descent. The ball takes a total of 6 s for its upward and downward journey.
Hence, it has taken 3 s to attain the maximum height.
Final velocity of the ball at the maximum height, $v = 0$
Acceleration due to gravity, g = −9.8 m s^{-2}
Equation of motion, $v = u + gt$ will give,
$0 = u + (-9.8 \times 3)$
$u = 9.8 \times 3 = 29.4$ ms^{-1}
Hence, the ball was thrown upwards with a velocity of 29.4 m s^{-1}.
(b) Let the maximum height attained by the ball be *h*.
Initial velocity during the upward journey, u = 29.4 m s^{-1}
Final velocity, $v = 0$
Acceleration due to gravity, g = −9.8 m s^{-2}
From the equation of motion, $s = ut + \frac{1}{2}at^2$

$\Rightarrow h = 29.4 \times 3 + \frac{1}{2} \times (-9.8) \times 3^2 = 44.1m$

(c) Ball attains the maximum height after 3 s. After attaining this height, it will start falling downwards.
In this case,
Initial velocity, $u = 0$
Position of the ball after 4 s of the throw is given by the distance travelled by it during its downward journey in 4 s − 3 s = 1 s.
Equation of motion, $s = ut + \frac{1}{2}gt^2$ will give

$\Rightarrow s = 0 \times t + \frac{1}{2} \times (9.8) \times 1^2 = 4.9m$

Total height = 44.1 m
This means that the ball is 39.2 m (44.1 m − 4.9 m) above the ground after 4 seconds.

ASSIGNMENT QUESTIONS
GRAVITATION

MULTIPLE CHOICE QUESTIONS

1. Two objects of different masses falling freely near the surface of moon would
(a) have same velocities at any instant
(b) have different accelerations
(c) experience forces of same magnitude
(d) undergo a change in their inertia

2. The value of acceleration due to gravity
(a) is same on equator and poles
(b) is least on poles
(c) is least on equator
(d) increases from pole to equator

3. The gravitational force between two objects is *F*. If masses of both objects are halved without changing distance between them, then the gravitational force would become
(a) *F*/4 (b) *F*/2 (c) *F* (d) 2 *F*

4. A boy is whirling a stone tied with a string in an horizontal circular path. If the string breaks, the stone
(a) will continue to move in the circular path
(b) will move along a straight line towards the centre of the circular path
(c) will move along a straight line tangential to the circular path
(d) will move along a straight line perpendicular to the circular path away from the boy

5. An object is put one by one in three liquids having different densities. The object floats with $\frac{1}{9}, \frac{2}{11} and \frac{3}{7}$ parts of their volumes outside the liquid surface in liquids of densities d_1, d_2 and d_3 respectively. Which of the following statement is correct?
(a) $d_1 > d_2 > d_3$
(b) $d_1 > d_2 < d_3$
(c) $d_1 < d_2 > d_3$
(d) $d_1 < d_2 < d_3$

6. In the relation $F = G\,M\,m/d^2$, the quantity G
(a) depends on the value of *g* at the place of observation
(b) is used only when the earth is one of the two masses
(c) is greatest at the surface of the earth
(d) is universal constant of nature

7. Law of gravitation gives the gravitational force between
(a) the earth and a point mass only
(b) the earth and Sun only
(c) any two bodies having some mass
(d) two charged bodies only

8. The value of quantity G in the law of gravitation
(a) depends on mass of earth only
(b) depends on radius of earth only
(c) depends on both mass and radius of earth
(d) is independent of mass and radius of the earth

9. Two particles are placed at some distance. If the mass of each of the two particles is doubled, keeping the distance between them unchanged, the value of gravitational force between them will be

(a) $\frac{1}{4}$ (b) 4 times (c) $\frac{1}{2}$ times (d) unchanged

10. The earth attracts a body of mass 2 kg on its surface with a force of

(a) 9.8 N

(b) 19.6 N

(c) 6.67×10^{-11} N

(d) $2 \times 6.67 \times 10^{-11}$ N

11. A stone dropped from a building takes 4 s to reach the ground. The height of the building is

(a) 19.6 m

(b) 80.4 m

(c) 78.4 m

(d) 156.8 m

12. If g_e is acceleration due to gravity on earth and g_m is acceleration due to gravity on moon, then

(a) $g_e = g_m$

(b) $g_e < g_m$

(c) $g_e = \frac{1}{6} g_m$

(d) $g_m = \frac{1}{6} g_e$

13. The mass of a body on the surface of earth is 12 kg. If acceleration due to gravity on moon is $\frac{1}{6}$ of acceleration due to gravity on earth, then its mass on moon will be

(a) 2 kgf

(b) 72 kg

(c) 12 kg

(d) zero

14. The atmosphere is held to the earth by

(a) gravity

(b) wind

(c) clouds

(d) earth's magnetic field

15. The force of attraction between two unit point masses separated by a unit distance is called

(a) gravitational potential

(b) acceleration due to gravity

(c) gravitational field

(d) universal gravitational constant

16. The weight of an object at the centre of the earth of radius *R* is

(a) zero

(b) infinite

(c) *R* times the weight at the surface of the earth

(d) $1/R^2$ times the weight at surface of the earth

SHORT ANSWER QUESTIONS

17. What is the source of centripetal force that a planet requires to revolve around the Sun? On what factors does that force depend?

18. On the earth, a stone is thrown from a height in a direction parallel to the earth's surface while another stone is simultaneously dropped from the same height. Which stone would reach the ground first and why?

19. Suppose gravity of earth suddenly becomes zero, then in which direction will the moon begin to move if no other celestial body affects it?

20. Identical packets are dropped from two aeroplanes, one above the equator and the other above the north pole, both at height *h*. Assuming all conditions are identical, will those packets take same time to reach the surface of earth. Justify your answer.

21. The weight of any person on the moon is about 1/6 times that on the earth. He can lift a mass of 15 kg on the earth. What will be the maximum mass, which can be lifted by the same force applied by the person on the moon?

22. Calculate the average density of the earth in terms of *g*, G and *R*.

23. The earth is acted upon by gravitation of Sun, even though it does not fall into the Sun. Why?

24. Calculate the density of Earth from Newton's law of gravitation.

25. A body weighs more at poles than at the equator of earth. Why?

26. Two particles of equal mass(m) move in a circle of radius (r) under the action of their mutual gravitational attraction. Find the speed of each particle.

LONG ANSWER QUESTIONS

27. How does the weight of an object vary with respect to mass and radius of the earth. In a hypothetical case, if the diameter of the earth becomes half of its present value and its mass becomes four times of its present value, then how would the weight of any object on the surface of the earth be affected?

28. How does the force of attraction between the two bodies depend upon their masses and distance between them? A student thought that two bricks tied together would fall faster than a single one under the action of gravity. Do you agree with his hypothesis or not? Comment.

29. Two objects of masses m_1 and m_2 having the same size are dropped simultaneously from heights h_1 and h_2 respectively. Find out the ratio of time they would take in reaching the ground. Will this ratio remain the same if (i) one of the objects is hollow and the other one is solid and (ii) both of them are hollow, size remaining the same in each case. Give reason.

30. Distinguish between mass and weight. Show that mass of a body numerically equal to weight of the body except at the centre of earth.

CHAPTER – 11

WORK AND ENERGY

WORK

Work (W) is said to be done, when a force (F) acts on the body and point of application of the force is displaced (s) in the direction of force.

Work done = force x displacement
W = F x s

i). If the body is displaced in the same direction of force, work is done by a force
ii). If the displacement is against a force, the work is done against the force.
iii). If the displacement is perpendicular to the direction of the force, work done is zero.

Unit of work

Unit of work is joule (J).

One joule of work is said to be done when a force of 1 newton acting on a body displacing it by a distance of 1 m.

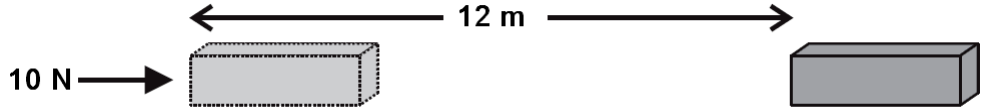
Larger units of work are

i) kilojoule (1000 joule)

ii) megajoule (10 lakh joule)

NUMERICALS

1. A force of 10 N acts on an object. The object is displaced through 12 m, in the direction of the force. If the force acts all through the displacement, find the work done by the force.



2. A porter lifts a luggage of 15 kg from the ground and puts it on his head 1.5 m above the ground. Calculate the work done by him on the luggage.

3. A boy pushes a book by applying a force of 40 N. Find the work done by this force on the book is displaced through 25 cm along the path.

4. A ball of mass 1 kg thrown upwards, reaches a maximum height of 4 m. Calculate the work done by the force of gravity during the vertical displacement. ($g = 10 m/s^2$)

5. Find the amount of work done by a labourers who carrier 'n' bricks of 'm' kg each to the roof of a house 'h' metre high by climbing a ladder.

6. An engine pulls a train 1 km over a level track. Calculate the work done by the train given that the frictional resistance is 5×10^5 N.

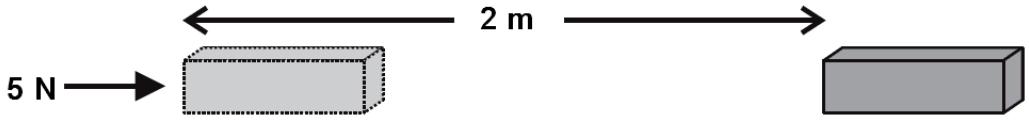
7. A man weighing 70 kg carries a weight of 10 kg on the top of a tower 100 m high. Calculate the work done by the man ($g = 10m/s^2$).

8. A boy of mass 55 kg runs up a flight of 40 stairs, each measuring 0.15m. Calculate the work done by the boy.

9. Calculate the work done in lifting 200 kg of water through a vertical height of 6 metres ($g = 10m/s^2$).

10. A crane pulls up a car of mass 500 kg to a vertical height of 4 m. Calculate the work done by the crane.

11. A force of 5 N acts on an object. The object id displaced through 8 m, in the direction of the force. If the force acts all through the displacement, find the work done by the force.



12. A porter lifts a luggage of 15 kg from the ground and puts it on his head 1.5 m above the ground. Calculate the work done by him on the luggage.

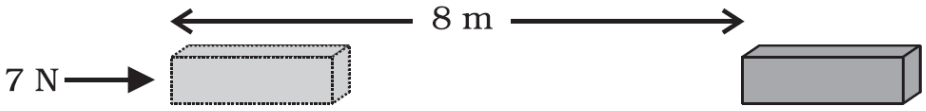
13. Calculate the work done by a student in lifting 0.5 kg book from the ground and keeping it on a shelf 1.5m high.

14. A collie carries a load of 50 kg on his head and walks on a level road upto 100 m. What is the work done by him?

15. A car weighing 1000 kg and traveling at 30m/s stops at a distance of 50m decelerating uniformly. What is the force exerted on it by the brakes? What is the work done by the brakes?

INTEXT QUESTIONS PAGE NO. 148

1. A force of 10 N acts on an object. The displacement is, say 8 m, in the direction of the force. Let us take it that the force acts on the object through the displacement. What is the work done in this case?



Ans: When a force F acts on an object to displace it through a distance S in its direction, then the work done W on the body by the force is given by:

Work done = Force × Displacement
$W = F \times S$
where, $F = 7$ N , $S = 8$ m
Therefore, work done, $W = 7 \times 8 = 56$ Nm $= 56$ J

INTEXT QUESTIONS PAGE NO. 149

1. **When do we say that work is done?**
   Ans: Work is done whenever the given conditions are satisfied:
   (i) A force acts on the body.
   (ii) There is a displacement of the body caused by the applied force along the direction of the applied force.

2. **Write an expression for the work done when a force is acting on an object in the direction of its displacement.**
   Ans: When a force F displaces a body through a distance S in the direction of the applied force, then the work done W on the body is given by the expression:
   Work done = Force × Displacement
   $W = F \times s$

3. **Define 1 J of work.**
   Ans: 1 J is the amount of work done by a force of 1 N on an object that displaces it through a distance of 1 m in the direction of the applied force.

4. **A pair of bullocks exerts a force of 140 N on a plough. The field being ploughed is 15 m long. How much work is done in ploughing the length of the field?**
   Ans: Work done by the bullocks is given by the expression:
   Work done = Force × Displacement
   $W = F \times d$
   Where,
   Applied force, F = 140 N
   Displacement, d = 15 m
   $W = 140 \times 15 = 2100$ J
   Hence, 2100 J of work is done in ploughing the length of the field.

ENERGY

The energy of the body is defined as its capacity to do work.

Unit of energy

Energy is measured in terms of work. Unit of energy is also joule. One joule of energy is required to do one joule of work.

DIFFERENT FORMS OF ENERGY

We live in a world where we have energy in many different forms. Some important forms of energy are mechanical energy, chemical energy, light energy, heat energy, electrical energy, nuclear energy and sound energy.

MECHANICAL ENERGY

The energy used to displace a body or to change the position of the body or to deform the body is known as mechanical energy.

Mechanical energy is of two types
i) Kinetic energy ii) Potential energy

KINETIC ENERGY

Energy possessed by an object due to its motion is called kinetic energy.
Kinetic energy of an object increases with its speed. Kinetic energy of an object moving with a velocity is equal to the work done on it to make it acquire that velocity.

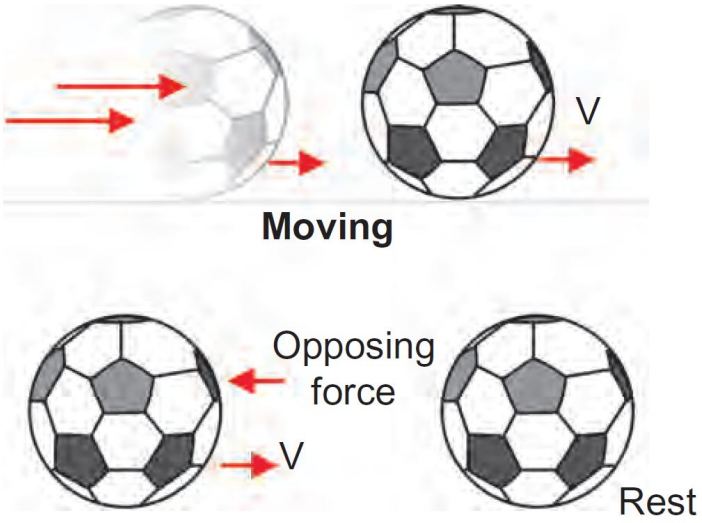
Example-1 Kinetic energy of a hammer is used to drive a nail into the wall.
Example-2 Bullet fi red from a gun can penetrate into a target due to its kinetic energy.

EXPRESSION FOR KINETIC ENERGY

Let a body (ball) of mass m is moving with an initial velocity v. If it is brought to rest by applying a retarding (opposing) force F, then it comes to rest by a displacement S. Let, E_k = work done against the force used to stop it.

$$E_k = F \cdot S \text{ -----> (1)}$$

But retarding force F = ma-----> (2)



Let initial velocity u = v, fi nal velocity v = 0
From III equation of motion, $v^2 = u^2 + 2as$ applying,

$$0 = v^2 - 2as \text{ (a is retardation)}$$

$$2as = v^2$$

$$\text{displacement, } s = \frac{v^2}{2a} \text{ ----------->(3)}$$

substituting (2) and (3) in (1), we get

$$E_k = ma.\frac{v^2}{2a}$$

$$\Rightarrow E_k = \frac{1}{2}mv^2$$

Kinetic Energy of a moving object is defined as half the product of the mass of the object square of the speed of the object.

Work done (W) = Change in kinetic energy(E_k)

$$W = \frac{1}{2}mv^2 - \frac{1}{2}mu^2 \text{ (when v > u)}$$

$$\text{Or } W = \frac{1}{2}mu^2 - \frac{1}{2}mv^2 \text{ (when u > v)}$$

INTEXT QUESTIONS PAGE NO. 152

1. **What is the kinetic energy of an object?**
   Ans:

Kinetic energy is the energy possessed by a body by the virtue of its motion. Every moving object possesses kinetic energy. A body uses kinetic energy to do work. Kinetic energy of hammer is used in driving a nail into a log of wood, kinetic energy of air is used to run wind mills, etc.

2. **Write an expression for the kinetic energy of an object.**
   Ans:
   If a body of mass m is moving with a velocity v, then its kinetic energy E_k is given by the expression, $E_k = \frac{1}{2}mv^2$. Its SI unit is Joule (J).

3. **The kinetic energy of an object of mass, m moving with a velocity of 5 ms^{-1} is 25 J. What will be its kinetic energy when its velocity is doubled? What will be its kinetic energy when its velocity is increased three times?**

   Ans: Expression for kinetic energy is $E_k = \frac{1}{2}mv^2$

   m = Mass of the object
   v = Velocity of the object = 5 m/s
   Given that kinetic energy, E_k = 25 J
   (i) If the velocity of an object is doubled, then v = 5 × 2 = 10 m/s.
   Therefore, its kinetic energy becomes 4 times its original value, because it is proportional to the square of the velocity. Hence, kinetic energy = 25 × 4 = 100 J.
   (ii) If velocity is increased three times, then its kinetic energy becomes 9 times its original value, because it is proportional to the square of the velocity. Hence, kinetic energy = 25 × 9 = 225 J.

NUMERICALS

1. How far should a man of mass 60 kg run so that his kinetic energy is 750 J?
2. Find the mass of the body which has 5 J of kinetic energy while moving at a speed of 2 m/s.
3. A player kicks a ball of mass 250 g at the centre of a field. The ball leaves his foot with a speed of 10m/s. Find the work done by the player on the ball.
4. A body of mass 5 kg, initially at rest, is subjected to a force of 20 N. What is the kinetic energy acquired by the body at the end of 10 s?
5. A bullet of mass 20g moving with a velocity of 500m/s, strikes a tree and goes out from the other side with a velocity of 400m/s. Calculate the work done by the bullet in joule in passing through the tree.
6. An object of mass 15 kg is moving with a uniform velocity of 4m/s. What is the kinetic energy possessed by the object?
7. What is the work done to increase the velocity of a car from 30 km/hr to 60 km/he if the mass of the car is 1500kg?
8. A bullet of mass 0.03kg moving with a velocity of 400m/s, penetrates 12 cm into fixed a constant resistive force of 1000 N to the motion of the bullet, find (a) the initial kinetic energy of the bullet (b) the distance through which the bullet has penetrated.

9. Two bodies of equal masses move with uniform velocities v and 3v respectively. Find the ratio of their kinetic energies.

10. The mass of a ball A is double the mass of another ball B. The ball A moves at half the speed of the ball B. Calculate the ratio of the kinetic energy of A to the kinetic energy of B.

11. A truck weighing 5000 kgf and a cart weighing 500 kgf are moving with the same speed. Compare their kinetic energies.

12. A bullet of mass 20g is found to pass two points 30m apart in 4s? Assuming the speed to be constant find its kinetic energy.

POTENTIAL ENERGY

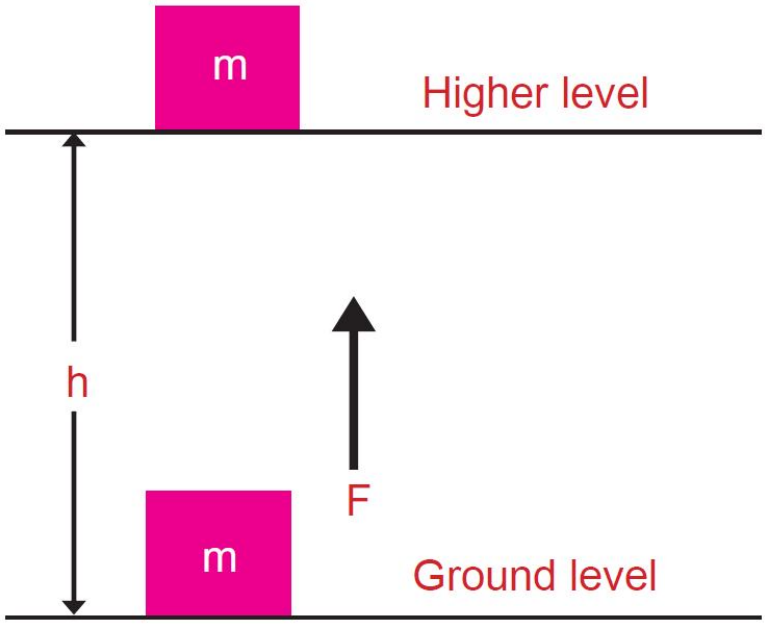
The energy possessed by a body by virtue of its position or due to state of strain, is called *potential energy*. The work done to lift a body above the ground level gives the potential energy of the body. Eg. weight lifting.

Example: Water stored in reservoir has large amount of potential energy due to which it can drive a water turbine when allowed to fall down. This is the principle of production of hydro-electric energy.

EXPRESSION FOR POTENTIAL ENERGY OF A BODY ABOVE THE GROUND LEVEL

Work is done in raising an object from the ground to certain height against the gravity is stored in the body as a potential energy.

Consider an object of mass m. It is raised through a height h from the ground. Force is needed to do this.



The downward force acting on the body due to gravity = mg.

The work has to be done to lift the body through a height h against the force of gravity as shown in above figure.

The object gains energy to do the work done (w) on it.

work done = force x displacement

w = F x h

w = mgh [Since F=ma and a=g, therefore F=mg]

Work done is equal to potential energy of an object.

$$Ep = mgh.$$

NOTE: The potential energy of an object at a height depends on the ground level or the zero level you choose. An object in a given position can have a certain potential energy with respect to one level and a different value of potential energy with respect to another level.

NUMERICALS

1. A body of mass 4 kg is taken from a height of 5m to a height 10m. Find the increase in potential energy.

2. An object of mass 1 kg is raised through a height 'h'. Its potential energy increases by 1 J, find the height 'h'.

3. A 5 kg ball is thrown upwards with a speed of 10m/s. (a) Find the potential energy when it reaches the highest point. (b) Calculate the maximum height attained by it.

4. A 5 kg ball is dropped from a height of 10m. (a) Find the initial potential energy of the ball (b) Find the kinetic energy just before it reaches the ground and (c) Calculate the velocity before it reaches the ground.

5. A body is thrown up with a kinetic energy of 10J. If it attains a maximum height of 5m, find the mass of the body.

6. A rocket of mass 3×10^6 kg takes off from a launching pad and acquires a vertical velocity of 1 km/s and an altitude of 25 km. Calculate its (a) potential energy (b) kinetic energy.

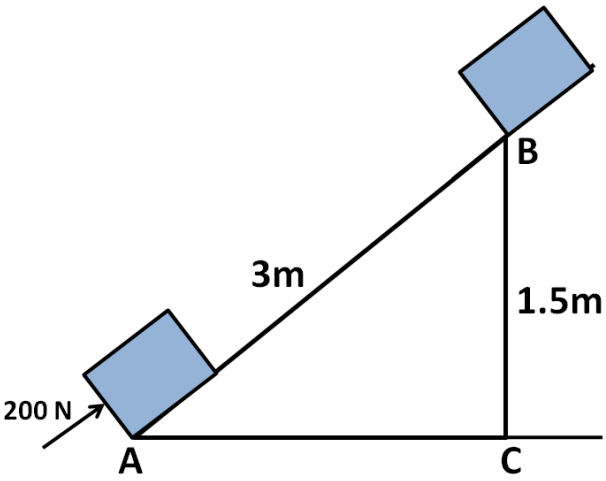
7. Find the energy possessed by an object of mass 10 kg when it is at a height of 6m above the ground. Given, $g = 9.8\ m/s^2$.

8. An object of mass 12 kg is at a certain height above the ground. If the potential energy of the object is 480 J, find the height at which the object is with respect to the ground. Given, $g = 10\ m/s^2$.

9. Calculate the increase in potential energy as a block of 2 kg is lifted through 2m.

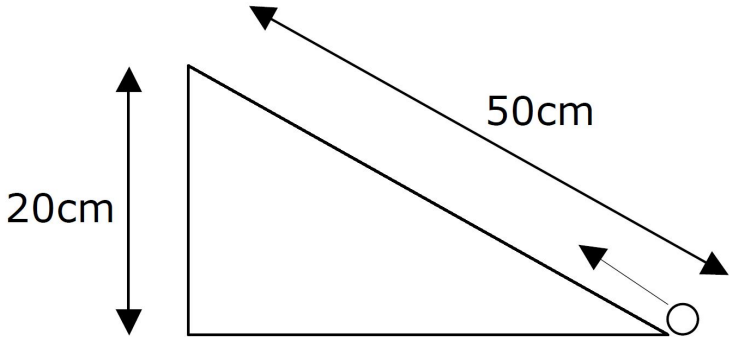
10. A ball of mass 1 kg is dropped from a height of 5m. (a) Find the kinetic energy of the ball just before it reaches the ground (b) What is the speed at this instant?

11. A block of mass 30 kg is pulled up by a rope as shown in below figure with a constant speed by applying of 200 N parallel to the slope. A and B are the initial and final positions of the block. Calculate (a) work done by the force in moving the block from A to B. (b) the potential energy gained by the block (c) account for the difference in work done by the force and the increase in potential energy of the block.



12. A body of mass 5 kg falls from height of 5m. How much energy does it possess at any instant?

13. A 800g ball is pulled up a slope as shown in the diagram. Calculate the potential energy it gains.



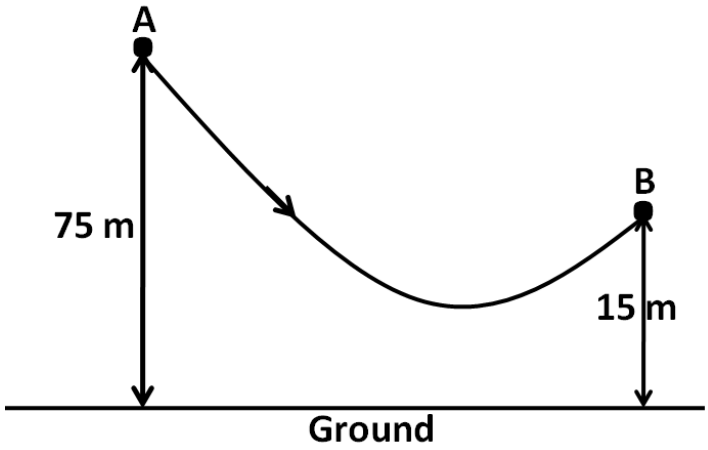
14. A spring is compressed by a toy cart of mass 150g. On releasing the cart, it moves with a speed of 0.2m/s. Calculate the elastic potential energy of the spring.

15. An object of mass 40 kg is raised to a height of 5 m above the ground. What is its potential energy? If the object is allowed to fall, find its kinetic energy when it is half-way down.

16. A box has a mass of 5.8kg. The box is lifted from the garage floor and placed on a shelf. If the box gains 145 J of Potential Energy (Ep), how high is the shelf?

17. A man climbs on to a wall that is 3.6m high and gains 2268J of potential energy. What is the mass of the man?

18. Below figure shows a ski- jump. A skier of mass 60 kg stands at A at the top of the ski-jump. He moves from A to B and takes off his jump at B. (a) Calculate the change in the gravitational potential energy of the skier between A and B (b) If 75% of the energy in part (a) becomes the kinetic energy at B, calculate the speed at which the skier arrives at B.



19. Consider the case of freely falling body given in the figure:

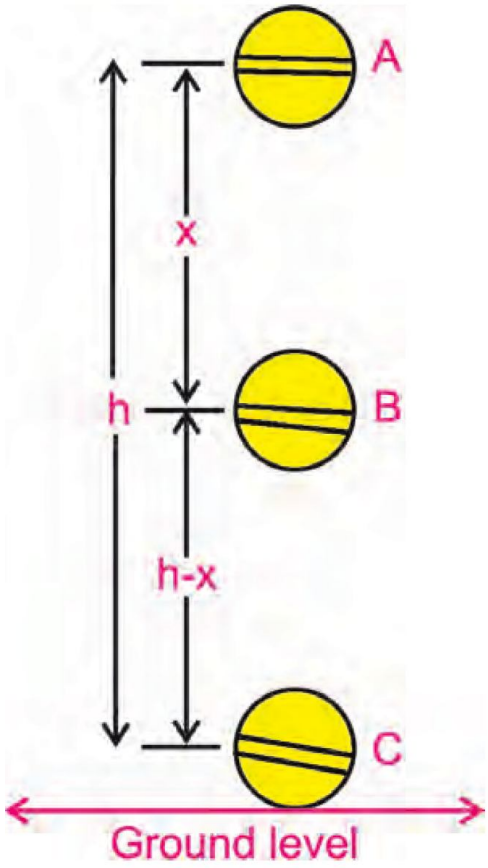
At A,
Kinetic energy=0 and
Potential energy=mgh
At B,
Kinetic energy=mgx
At C,
Kinetic energy=mgh and Potential energy=0

a) Find the potential energy of the body at B.

b) Find the total energy at A,B and C.

c) Is there any variation in total energy?

What do you infer from the result?



20. A bag of wheat weighs 200 kg. To what height should it be raised so that its potential energy may be 9800 joules? (9.8 m/s^2)

POWER

Power is defined as the rate of doing work or the rate of transfer of energy. If an agent does a work W in time t, then power is given by:

$$Power = \frac{Work}{Time} = \frac{Energy}{Time}$$

$$\Rightarrow P = \frac{W}{t}$$

The unit of power is watt having the symbol W. 1 watt is the power of an agent, which does work at the rate of 1 joule per second.
Power is 1 W when the rate of consumption of energy is 1 J/s.
1 watt = 1 joule/second or 1 W = 1 J/s.

Larger Units of Power

1 kilowatt = 1000 watts
1 kW = 1000 W

1 kW = 1000 J/s.

Commercial unit of energy is kilo watt hour.
A unit which is exclusively used in engineering is called a horse power (hp)

1 hp = 746 W

Commercial unit of energy: kilowatt hour (kWh)

1 kWh = 1 kW x 1 h = 1000 W x 3600 s = 3600000 J

= 3.6 x 10^6 J = 3.6 MJ(Mega Joule)

One kilowatt hour is the amount of energy consumed by an agent in one hour working at a constant rate of one kilowatt. It is also called unit of electrical energy

INTEXT QUESTIONS PAGE NO. 156

1. **What is power?**
   Ans:
   Power is the rate of doing work or the rate of transfer of energy. If W is the amount of work done in time t, then power is given by the expression,
   $Power = \frac{Work}{Time} = \frac{Energy}{Time} \qquad \Rightarrow P = \frac{W}{t}$
   It is expressed in watt (W).

2. **Define 1 watt of power.**
   Ans:
   1 watt is the power of an agent, which does work at the rate of 1 joule per second.
   Power is 1 W when the rate of consumption of energy is 1 J/s.
   1 watt = 1 joule/second or 1 W = 1 J/s.

3. **A lamp consumes 1000 J of electrical energy in 10 s. What is its power?**
   Ans: Here, electrical energy consumption, W = 1000 J, time, t = 10 s.
   $Power = \frac{W}{T} = \frac{1000}{10} = 100W$

4. **Define average power.**
   Ans: A body can do different amount of work in different time intervals. Hence, it is better to define average power. Average power is obtained by dividing the total amount of work done in the total time taken to do this work.
   $\text{Average power} = \frac{\text{total energy consumed}}{\text{total time taken}}$

NUMERICALS

1. Two girls each of weight 400N, climb up a rope through a height of 8m. We name one of the girls A and the other B. Girl A takes 20s while B takes 50s to accomplish this task. What is the power expended by each girl?
2. A boy of mass 50kg runs up a staircase of 45 steps in 9s. If the height of each step is 15cm, find his power. Take g = 10 m/s^2.
3. An electric bulb of 60W is used for 6 hr per day. Calculate the ‘units’ of energy consumed in one day by the bulb.
4. A 60 kg person climbs stairs of total height 20 m in 2 min. Calculate the power delivered.

5. The work done by the heart is 1 J per beat. Calculate the power of the heart if it beats 72 times/min.

6. A man exerts a force of 200 N in pulling a cart at a constant speed of 16m/s. Calculate the power spent by the man.

7. Calculate the power of an engine required to lift 10^5 kg of coal per hour from a mine 360m deep.

8. A man does 200 J of work in 10 s and a boy does 100 J of work in 4s. (a) Who is delivering more power? (b) Find the ratio of the power delivered by the man to that delivered by the boy.

9. A boy of mass 40 kg runs up a flight of 50 steps, each of 10cm high in 5s. Find the power developed by the boy.

10. A car of mass 2000 kg is lifted up a distance of 30m by a crane in 1 min. A second crane does the same job in 2 min. What is the power applied by each crane? Do the carne consume the same or different amounts of fuel? Neglect power dissipation against friction.

11. What should be the power of an engine required to lift 90 metric tones of coal per hour from a mine whose depth is 200m?

12. How much time does it take to perform 500 J of work at a rate of 10 W?

13. Calculate the units of energy consumed by 100 W electric bulb in 5 hours.

14. A lift is designed to carry a load of 4000 kg through 10 floors of a building, averaging 6 m per floor, in 10s. Calculate the power of the lift.

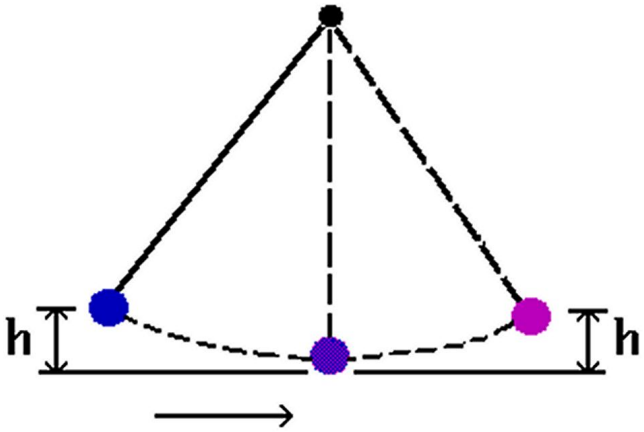
ENERGY TRANSFERMATION

- **Water from dam:** Potential energy into Kinetic energy
- **Microphone :** Sound energy into Electrical energy
- **TV Camera :** Light energy into Electrical energy
- **Solar Cell :** Light energy into Electrical energy
- **Iron Box :** Electrical energy into Heat energy
- **Loud speaker :** Electrical energy into Sound energy
- **Fan :** Electrical energy into Mechanical energy
- **Light :** Electrical energy into Light energy

LAW OF CONSERVATION OF ENERGY

Energy in a system may take on various forms (e.g. kinetic, potential, heat, light). The law of conservation of energy states that energy may neither be created nor destroyed. Therefore the sum of all the energies in the system is a constant.

The most commonly used example is the pendulum:



The formula to calculate the potential energy is: $PE = mgh$
The mass of the ball = 10kg
The height, h = 0.2m
The acceleration due to gravity, g = 9.8 m/s^2
Substitute the values into the formula and you get:
PE = 19.6J (J = Joules, unit of energy)

- The position of the blue ball is where the Potential Energy (PE) = 19.6J while the Kinetic Energy (KE) = 0.
  As the blue ball is approching the purple ball position the PE is decreasing while the KE is increasing. At exactly halfway between the blue and purple ball position the PE = KE.
- The position of the purple ball is where the Kinetic Energy is at its maximum while the Potential Energy (PE) = 0.
  At this point, theoretically, all the PE has transformed into KE> Therefore now the KE = 19.6J while the PE = 0.
- The position of the pink ball is where the Potential Energy (PE) is once again at its maximum and the Kinetic Energy (KE) = 0.

We can now say and understand that:

$$PE + KE = 0$$

$$PE = -KE$$

The sum of PE and KE is the total mechanical energy:

$$\text{Total Mechanical Energy} = PE + KE$$

COMMERCIAL UNIT OF ENERGY

The unit joule is too small and hence is inconvenient to express large quantities of energy. We use a bigger unit of energy called kilowatt hour (kW h).
The commercial unit of electric energy is kilowatt hour (kW h), commonly known as 'unit'.
1 kWh is the amount of energy consumed by an electrical gadget in one hour at the rate of 1000 J/s or 1kW.

$$1 \text{ kW h} = 1 \text{ kW} \times 1 \text{ h}$$
$$= 1000 \text{ W} \times 3600 \text{ s}$$
$$= 3600000 \text{ J}$$
$$1 \text{ kW h} = 3.6 \times 10^6 \text{ J}.$$

The energy used in households, industries and commercial establishments are usually expressed in kilowatt hour. For example, electrical energy used during a month is expressed in terms of 'units'. Here, 1 'unit' means 1 kilowatt hour.

EXERCISE QUESTIONS PAGE NO. 158 AND 159

1. **Look at the activities listed below. Reason out whether or not work is done in the light of your understanding of the term 'work'.**
   a). Suma is swimming in a pond.
   b). A donkey is carrying a load on its back.
   c). A wind-mill is lifting water from a well.
   d). A green plant is carrying out photosynthesis.
   e). An engine is pulling a train.
   f). Food grains are getting dried in the sun.
   g). A sailboat is moving due to wind energy.

Ans:

Work is done whenever the given two conditions are satisfied:

(i) A force acts on the body.

(ii) There is a displacement of the body by the application of force in or opposite to the direction of force.

(a) While swimming, Suma applies a force to push the water backwards. Therefore, Suma swims in the forward direction caused by the forward reaction of water. Here, the force causes a displacement. Hence, work is done by Seema while swimming.

(b) While carrying a load, the donkey has to apply a force in the upward direction. But, displacement of the load is in the forward direction. Since, displacement is perpendicular to force, the work done is zero.

(c) A wind mill works against the gravitational force to lift water. Hence, work is done by the wind mill in lifting water from the well.

(d) In this case, there is no displacement of the leaves of the plant. Therefore, the work done is zero.

(e) An engine applies force to pull the train. This allows the train to move in the direction of force. Therefore, there is a displacement in the train in the same direction. Hence, work is done by the engine on the train.

(f) Food grains do not move in the presence of solar energy. Hence, the work done is zero during the process of food grains getting dried in the Sun.

(g)Wind energy applies a force on the sailboat to push it in the forward direction. Therefore, there is a displacement in the boat in the direction of force. Hence, work is done by wind on the boat.

2. **An object thrown at a certain angle to the ground moves in a curved path and falls back to the ground. The initial and the final points of the path of the object lie on the same horizontal line. What is the work done by the force of gravity on the object?**

Ans: Work done by the force of gravity on an object depends only on vertical displacement. Vertical displacement is given by the difference in the initial and final positions/heights of the object, which is zero.

Work done by gravity is given by the expression,

$W = mgh$, where, h = Vertical displacement = 0

$W = mg \times 0 = 0$ J

Therefore, the work done by gravity on the given object is zero joule.

3. **A battery lights a bulb. Describe the energy changes involved in the process.**
Ans: When a bulb is connected to a battery, then the chemical energy of the battery is transferred into electrical energy. When the bulb receives this electrical energy, then it converts it into light and heat energy. Hence, the transformation of energy in the given situation can be shown as:
Chemistry Energy $\rightarrow$ Electrical Energy $\rightarrow$ Light Energy + Heat Energy

4. **Certain force acting on a 20 kg mass changes its velocity from 5 m s^{-1} to 2 m s^{-1}. Calculate the work done by the force.**

Ans: Kinetic energy is given by the expression, $(E_k)_v = \frac{1}{2}mv^2$

where, E_k = Kinetic energy of the object moving with a velocity, v

m= Mass of the object

(i) Kinetic energy when the object was moving with a velocity 5 m s−1

$(E_k)_5 = \frac{1}{2} \times 20 \times 5^2 = 250J$

Kinetic energy when the object was moving with a velocity 2 m s−1

$(E_k)_2 = \frac{1}{2} \times 20 \times 2^2 = 40J$

Work done by force is equal to the change in kinetic energy.

Therefore, work done by force = $(E_k)_2 - (E_k)_5$ = 40 − 250 = −210 J

The negative sign indicates that the force is acting in the direction opposite to the motion of the object.

5. **A mass of 10 kg is at a point A on a table. It is moved to a point B. If the line joining A and B is horizontal, what is the work done on the object by the gravitational force? Explain your answer.**
Ans: Work done by gravity depends only on the vertical displacement of the body. It does not depend upon the path of the body. Therefore, work done by gravity is given by the expression,
W = mgh
where, Vertical displacement, h = 0
Therefore, W = mg × 0 = 0
Hence, the work done by gravity on the body is zero.

6. **The potential energy of a freely falling object decreases progressively. Does this violate the law of conservation of energy? Why?**
Ans: No. The process does not violate the law of conservation of energy. This is because when the body falls from a height, then its potential energy changes into kinetic energy progressively. A decrease in the potential energy is equal to an increase in the kinetic energy of the body. During the process, total mechanical energy of the body remains conserved. Therefore, the law of conservation of energy is not violated.

7. **What are the various energy transformations that occur when you are riding a bicycle?**
Ans: While riding a bicycle, the muscular energy of the rider gets transferred into heat energy and kinetic energy of the bicycle. Heat energy heats the rider's body. Kinetic energy provides a velocity to the bicycle. The transformation can be shown as:
Mechanical Energy $\rightarrow$ Kinetic Energy + Heat Energy
During the transformation, the total energy remains conserved.

8. **Does the transfer of energy take place when you push a huge rock with all your might and fail to move it? Where is the energy you spend going?**
Ans: When we push a huge rock, there is no transfer of muscular energy to the stationary rock. Also, there is no loss of energy because muscular energy is transferred into heat energy, which causes our body to become hot.

9. **A certain household has consumed 250 units of energy during a month. How much energy is this in joules?**
Ans: 1 unit of energy is equal to 1 kilowatt hour (kWh).
1 unit = 1 kWh
1 kWh = 3.6×10^6 J
Therefore, 250 units of energy = $250 \times 3.6 \times 10^6 = 9 \times 10^8$ J

10. **An object of mass 40 kg is raised to a height of 5 m above the ground. What is its potential energy? If the object is allowed to fall, find its kinetic energy when it is half-way down.**
Ans: Gravitational potential energy is given by the expression,
W = mgh
Where,
h = Vertical displacement = 5 m
m = Mass of the object = 40 kg
g = Acceleration due to gravity = 9.8 m s^{-2}
Therefore, W = $40 \times 5 \times 9.8 = 1960$ J.
At half-way down, the potential energy of the object will be $\frac{1960}{2}$ = 980 J.
At this point, the object has an equal amount of potential and kinetic energy. This is due to the law of conservation of energy. Hence, half-way down, the kinetic energy of the object will be 980 J.

11. **What is the work done by the force of gravity on a satellite moving round the earth? Justify your answer.**
Ans: Work is done whenever the given two conditions are satisfied:
(i) A force acts on the body.
(ii) There is a displacement of the body by the application of force in or opposite to the direction of force.
If the direction of force is perpendicular to displacement, then the work done is zero.
When a satellite moves around the Earth, then the direction of force of gravity on the satellite is perpendicular to its displacement. Hence, the work done on the satellite by the Earth is zero.

12. **Can there be displacement of an object in the absence of any force acting on it? Think. Discuss this question with your friends and teacher.**
Ans: Yes. For a uniformly moving object
Suppose an object is moving with constant velocity. The net force acting on it is zero. But, there is a displacement along the motion of the object. Hence, there can be a displacement without a force.

13. **A person holds a bundle of hay over his head for 30 minutes and gets tired. Has he done some work or not? Justify your answer.**
Ans: Work is done whenever the given two conditions are satisfied:
(i) A force acts on the body.

(ii) There is a displacement of the body by the application of force in or opposite to the direction of force.

When a person holds a bundle of hay over his head, then there is no displacement in the bundle of hay. Although, force of gravity is acting on the bundle, the person is not applying any force on it. Hence, in the absence of force, work done by the person on the bundle is zero.

14. An electric heater is rated 1500 W. How much energy does it use in 10 hours?

Ans: Energy consumed by an electric heater can be obtained with the help of the expression, $P = \frac{W}{T}$

where, Power rating of the heater, P = 1500 W = 1.5 kW

Time for which the heater has operated, T = 10 h

Work done = Energy consumed by the heater

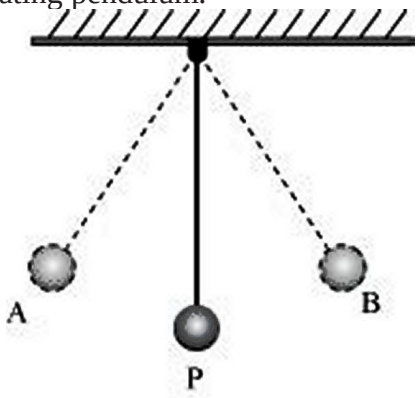
Therefore, energy consumed = Power × Time = 1.5 × 10 = 15 kWh

Hence, the energy consumed by the heater in 10 h is 15 kWh.

15. Illustrate the law of conservation of energy by discussing the energy changes which occur when we draw a pendulum bob to one side and allow it to oscillate. Why does the bob eventually come to rest? What happens to its energy eventually? Is it a violation of the law of conservation of energy?

Ans: The law of conservation of energy states that energy can be neither created nor destroyed. It can only be converted from one form to another.

Consider the case of an oscillating pendulum.



When a pendulum moves from its mean position P to either of its extreme positions A or B, it rises through a height h above the mean level P. At this point, the kinetic energy of the bob changes completely into potential energy. The kinetic energy becomes zero, and the bob possesses only potential energy. As it moves towards point P, its potential energy decreases progressively. Accordingly, the kinetic energy increases. As the bob reaches point P, its potential energy becomes zero and the bob possesses only kinetic energy. This process is repeated as long as the pendulum oscillates.

The bob does not oscillate forever. It comes to rest because air resistance resists its motion. The pendulum loses its kinetic energy to overcome this friction and stops after some time.

The law of conservation of energy is not violated because the energy lost by the pendulum to overcome friction is gained by its surroundings. Hence, the total energy of the pendulum and the surrounding system remain conserved.

16. An object of mass, *m* is moving with a constant velocity, *v*. How much work should be done on the object in order to bring the object to rest?

Ans: Kinetic energy of an object of mass, m moving with a velocity, v is given by the expression, $E_k = \frac{1}{2}mv^2$

To bring the object to rest, $\frac{1}{2}mv^2$ amount of work is required to be done on the object.

17. Calculate the work required to be done to stop a car of 1500 kg moving at a velocity of 60 km/h?

Ans: Kinetic energy, $E_k = \frac{1}{2}mv^2$

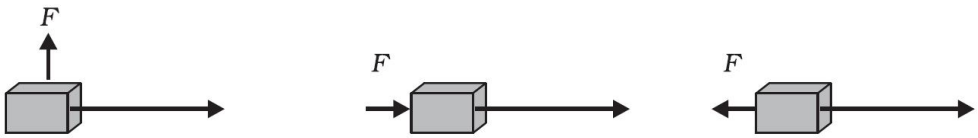
Where, Mass of car, m = 1500 kg

Velocity of car, v = 60 km/h $= 60 \times \frac{5}{18} ms^{-1}$

$\therefore E_k = \frac{1}{2} \times 1500 \times \left(60 \times \frac{5}{18}\right)^2 = 20.8 \times 10^4 J$

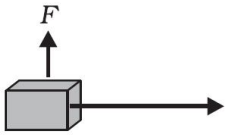
Hence, 20.8 × 104 J of work is required to stop the car.

18. In each of the following a force, *F* is acting on an object of mass, *m*. The direction of displacement is from west to east shown by the longer arrow. Observe the diagrams carefully and state whether the work done by the force is negative, positive or zero.



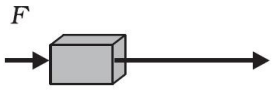
Ans: Work is done whenever the given two conditions are satisfied:
(i) A force acts on the body.
(ii) There is a displacement of the body by the application of force in or opposite to the direction of force.

Case I



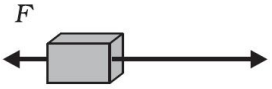
In this case, the direction of force acting on the block is perpendicular to the displacement. Therefore, work done by force on the block will be zero.

Case II



In this case, the direction of force acting on the block is in the direction of displacement. Therefore, work done by force on the block will be positive.

Case III



In this case, the direction of force acting on the block is opposite to the direction of displacement. Therefore, work done by force on the block will be negative.

19. Soni says that the acceleration in an object could be zero even when several forces are acting on it. Do you agree with her? Why?

Ans: Acceleration in an object could be zero even when several forces are acting on it. This happens when all the forces cancel out each other i.e., the net force acting on the object is zero. For a uniformly moving object, the net force acting on the object is zero. Hence, the acceleration of the object is zero. Hence, Soni is right.

20. Find the energy in kW h consumed in 10 hours by four devices of power 500 W each.

Ans: Energy consumed by an electric device can be obtained with the help of the expression for power, $P = \frac{W}{T}$

where, Power rating of the device, P = 500 W = 0.50 kW
Time for which the device runs, T = 10 h
Work done = Energy consumed by the device
Therefore, energy consumed = Power × Time = 0.50 × 10 = 5 kWh
Hence, the energy consumed by four equal rating devices in 10 h will be 4 × 5 kWh = 20 kWh = 20 Units

21. A freely falling object eventually stops on reaching the ground. What happenes to its kinetic energy?

Ans: When an object falls freely towards the ground, its potential energy decreases and kinetic energy increases. As the object touches the ground, all its potential energy gets converted into kinetic energy. As the object hits the hard ground, all its kinetic energy gets converted into heat energy and sound energy. It can also deform the ground depending upon the nature of the ground and the amount of kinetic energy possessed by the object.

ASSIGNMENT QUESTIONS
WORK AND ENERGY

MULTIPLE CHOICE QUESTIONS

1. When a body falls freely towards the earth, then its total energy
(a) increases
(b) decreases
(c) remains constant
(d) first increases and then decreases

2. A car is accelerated on a levelled road and attains a velocity 4 times of its initial velocity. In this process the potential energy of the car
(a) does not change
(b) becomes twice to that of initial
(c) becomes 4 times that of initial
(d) becomes 16 times that of initial

3. In case of negative work the angle between the force and displacement is
(a) 00 (b) 450 (c) 900 (d) 1800

4. An iron sphere of mass 10 kg has the same diameter as an aluminium sphere of mass is 3.5 kg. Both spheres are dropped simultaneously from a tower. When they are 10 m above the ground, they have the same
(a) acceleration
(b) momenta
(c) potential energy
(d) kinetic energy

5. A girl is carrying a school bag of 3 kg mass on her back and moves 200 m on a levelled road. The work done against the gravitational force will be (g =10 m s^{-2})
(a) 6 ×103 J
(b) 6 J
(c) 0.6 J
(d) zero

6. Which one of the following is not the unit of energy?
(a) joule
(b) newton metre
(c) kilowatt
(d) kilowatt hour

7. The work done on an object does not depend upon the
(a) displacement
(b) force applied
(c) angle between force and displacement
(d) initial velocity of the object

8. Water stored in a dam possesses
(a) no energy
(b) electrical energy
(c) kinetic energy

(d) potential energy

9. A body is falling from a height *h*. After it has fallen a height *h*/2 , it will possess
(a) only potential energy
(b) only kinetic energy
(c) half potential and half kinetic energy
(d) more kinetic and less potential energy

10. A car is accelerated on a levelled road and acquires a velocity 4 times of its initial velocity. During this process, the potential energy of the car :
(a) does not change
(b) becomes twice that of initial potential energy
(c) becomes 4 times that of initial potential energy
(d) becomes 16 times that of initial potential energy

11. A car is accelerated on a levelled road and attains a speed of 4 times its initial speed. In this process, the kinetic energy of the car :
(a) does not change
(b) becomes 4 times that of initial kinetic energy
(c) becomes 8 times that of initial kinetic energy
(d) becomes 16 times that of initial kinetic energy

12. In case of negative work, the angle between the force and displacement is :
(a) 0° (b) 45° (c) 90° (d) 180°

13. An iron sphere of mass 10 kg has the same diameter as an aluminium sphere of mass 3.5 kg. Both the spheres are dropped simultaneously from a tower. When they are 10 m above the ground, they have the same :
(a) acceleration (b) momentum (c) potential energy (d) kinetic energy

14. A girl is carrying a school bag of 3 kg mass on her back and moves 200 m on a levelled road. If the value of g be 10 m/s2, the work done by the girl against the gravitational force will be :
(a) 6000 J (b) 0.6 J (c) 0 J (d) 6 J

15. The work done on an object does not depend on the :
(a) displacement
(b) angle between force and displacement
(c) force applied
(d) initial velocity of the object

16. Water stored in a dam possesses :
(a) no energy (b) electrical energy
(c) kinetic energy (d) potential energy

17. The momentum of a bullet of mass 20 g fired from a gun is 10 kg.m/s. The kinetic energy of this bullet in kJ will be :
(a) 5 (b) 1.5 (c) 2.5 (d) 25

18. A girl weighing 400 N climbs a vertical ladder. If the value of g be 10 m s–2, the work done by her after climbing 2 m will be :
(a) 200 J (b) 800 J (c) 8000 J (d) 2000 J

19. Each of the following statement describes a force acting. Which force is causing work to be done ?
(a) the weight of a book at rest on a table
(b) the pull of a moving railway engine on its coaches
(c) the tension in an elastic band wrapped around a parcel
(d) the push of a person's feet when standing on the floor

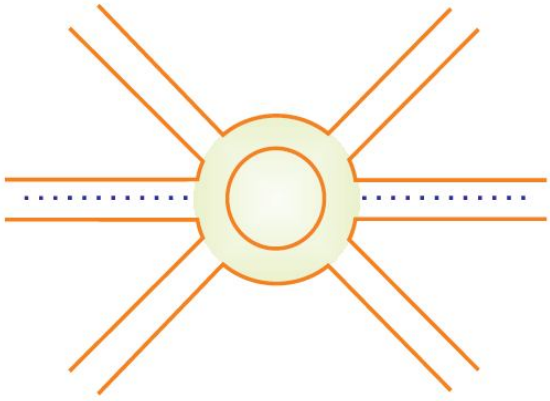
20. Which of the following does not possess the ability to do work not because of motion ?
(a) a sparrow flying in the sky
(b) a sparrow moving slowly on the ground
(c) a sparrow in the nest on a tree
(d) a squirrel going up a tree

SHORT ANSWER QUESTIONS

21. A rocket is moving up with a velocity v. If the velocity of this rocket is suddenly tripled, what will be the ratio of two kinetic energies?

22. Avinash can run with a speed of 8 m s–1 against the frictional force of 10 N, and Kapil can move with a speed of 3 m s–1 against the frictional force of 25 N. Who is more powerful and why?

23. A boy is moving on a straight road against a frictional force of 5 N. After travelling a distance of 1.5 km he forgot the correct path at a round about (see below figure) of radius 100 m. However, he moves on the circular path for one and half cycle and then he moves forward upto 2.0 km. Calculate the work done by him.



24. Can any object have mechanical energy even if its momentum is zero? Explain.

25. Can any object have momentum even if its mechanical energy is zero? Explain.

26. The power of a motor pump is 2 kW. How much water per minute the pump can raise to a height of 10 m? (Given g = 10 m s^{-2})

27. The weight of a person on a planet A is about half that on the earth. He can jump upto 0.4 m height on the surface of the earth. How high he can jump on the planet A?

28. The velocity of a body moving in a straight line is increased by applying a constant force F, for some distance in the direction of the motion. Prove that the increase in the kinetic energy of the body is equal to the work done by the force on the body.

29. Is it possible that an object is in the state of accelerated motion due to external force acting on it, but no work is being done by the force. Explain it with an example.

30. A ball is dropped from a height of 10 m. If the energy of the ball reduces by 40% after striking the ground, how much high can the ball bounce back? ($g = 10\ m\ s^{-2}$)

31. If an electric iron of 1200 W is used for 30 minutes everyday, find electric energy consumed in the month of April.

LONG ANSWER QUESTIONS

32. A light and a heavy object have the same momentum. Find out the ratio of their kinetic energies. Which one has a larger kinetic energy?

33. An automobile engine propels a 1000 kg car (A) along a levelled road at a speed of 36 kmh^{-1}. Find the power if the opposing frictional force is 100 N. Now, suppose after travelling a distance of 200 m, this car collides with another stationary car (B) of same mass and comes to rest. Let its engine also stop at the same time. Now car (B) starts moving on the same level road without getting its engine started. Find the speed of the car (B) just after the collision.

34. A girl having mass of 35 kg sits on a trolley of mass 5 kg. The trolley is given an initial velocity of 4 m s–1 by applying a force. The trolley comes to rest after traversing a distance of 16 m.
(a) How much work is done on the trolley?
(b) How much work is done by the girl?

35. Four men lift a 250 kg box to a height of 1 m and hold it without raising or lowering it.
(a) How much work is done by the men in lifting the box?
(b) How much work do they do in just holding it?
(c) Why do they get tired while holding it? ($g = 10\ m\ s^{-2}$)

36. What is power? How do you differentiate kilowatt from kilowatt hour? The Jog Falls in Karnataka state are nearly 20 m high. 2000 tonnes of water falls from it in a minute. Calculate the equivalent power if all this energy can be utilized? ($g = 10\ m\ s^{-2}$)

37. How is the power related to the speed at which a body can be lifted? How many kilograms will a man working at the power of 100 W, be able to lift at constant speed of 1 m s–1 vertically? ($g = 10\ m\ s^{-2}$)

38. Define watt. Express kilowatt in terms of joule per second. A 150 kg car engine develops 500 W for each kg. What force does it exert in moving the car at a speed of 20 m s–1?

39. (a) Explain by an example what is meant by potential energy. Write down the expression for gravitational potential energy of a body of mass m placed at a height h above the surface of the earth.
(b) What is the difference between potential energy and kinetic energy ?
(c) A ball of mass 0.5 kg slows down from a speed of 5 m/s to that of 3 m/s. Calculate the change in kinetic energy of the ball. State your answer giving proper units.

40. Compare the power at which each of the following is moving upwards against the force of gravity? (given $g = 10\ m\ s^{-2}$)
(i) a butterfly of mass 1.0 g that flies upward at a rate of 0.5 $m\ s^{-1}$.
(ii) a 250 g squirrel climbing up on a tree at a rate of 0.5 $m\ s^{-1}$.

CHAPTER – 13

WHY DO WE FALL ILL

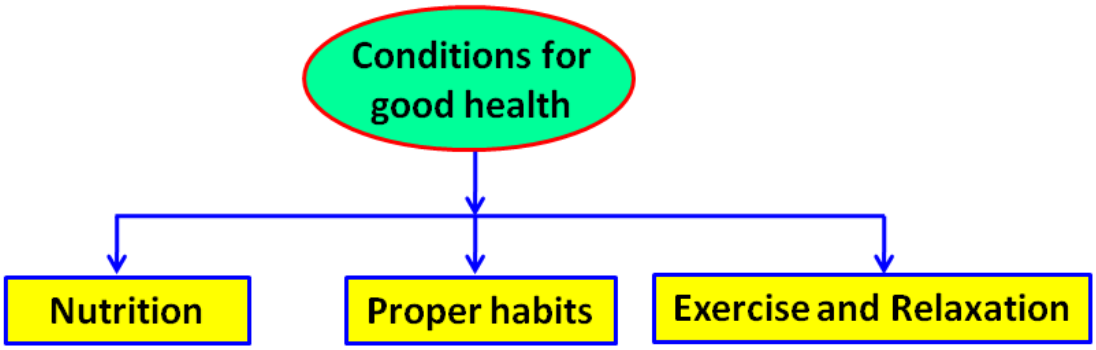
HEALTH AND ITS FAILURE

Good health is a very hard thing to measure, but it is one of life's most precious things. The World Health Organisation has defined health as a state of complete physical, mental and social well-being.
Community health can be defined as "All the personal health along with the environmental services for the importance of health of community".

Some of the health services are given below:
(i) Establishment of health care services like primary health centers, district hospitals, community health centers, medical colleges, all Indian institutes, regional hospitals etc.
(ii) Provision of safe drinking water and proper disposal of garbage.
(iii) Prevention of harmful insect breeding sites.
(iv) Management of different types of environmental pollution by Central and State Pollution Control Boards.
(v) Preventive vaccinations against number of diseases like tuberculosis, diphtheria, whooping cough, tetanus, measles, hepatitis, etc.
(vi) Provision of family planning advices and services.
(vii) Provision of medical care to school going children.
(viii) Prevention of food adulteration.
(ix) Health education.

CONDITIONS ESSENTIAL FOR GOOD HEALTH

There are several conditions which have to be fulfilled for good health. The important ones are
(i) Nutrition,
(ii) Proper habits, and
(iii) Exercise and relaxation.



(i) Nutrition
Nutrition can be defined as the procurement of substances necessary for growth, development, maintenance and activities of a living organism.
We obtain food from various plant and animal sources. In order to keep healthy and energetic, we need to take food. It takes care of the daily energy need also. We consume energy even while sleeping. Energy requirement depends on individual, age and special need. Growing children, pregnant women and nursing mothers need more energy.
(ii) Proper Habits

Another important aspect of good health is to observe proper dietary habits that are consumption of balanced diet and at fixed time. Good personal and domestic hygiene is very essential. Take full care of the following aspects.

- Your food should be fresh and kept away from dust, flies, insect and microbes to avoid any infection and spoilage.
- Utensils should be kept clean.
- You should wash your face and hands with soap before eating or handling the food.
- Food should be cooked with good feelings and cheerful state.
- Smoking, chewing tobacco, drinking alcohol, taking addictive drugs are bad habits and should be avoided.
- They can have damaging effects on our body and mind.

(iii) Exercise and Relaxation

Regular exercise is necessary to keep our body fit. These exercises vary with age, physical condition and nature of work of the individual. In the case of sedentary worker, exercise is even more essential. Another aspect of health is regular sleep and relaxation. The duration of sleep also varies with age and nature of work. Infants sleep for long hours, which is necessary for them to grow. For children, an average of eight hours of sound sleep is sufficient. For adults six hours of sleep is enough. Relaxation improves the capacity to work. Relaxation may be defined as an activity or recreation, which provides a relief or diversion from work or effort. There are various ways of relaxation. Yoga and meditation relax the body and mind. Listening to music and reading magazines are also relaxing.

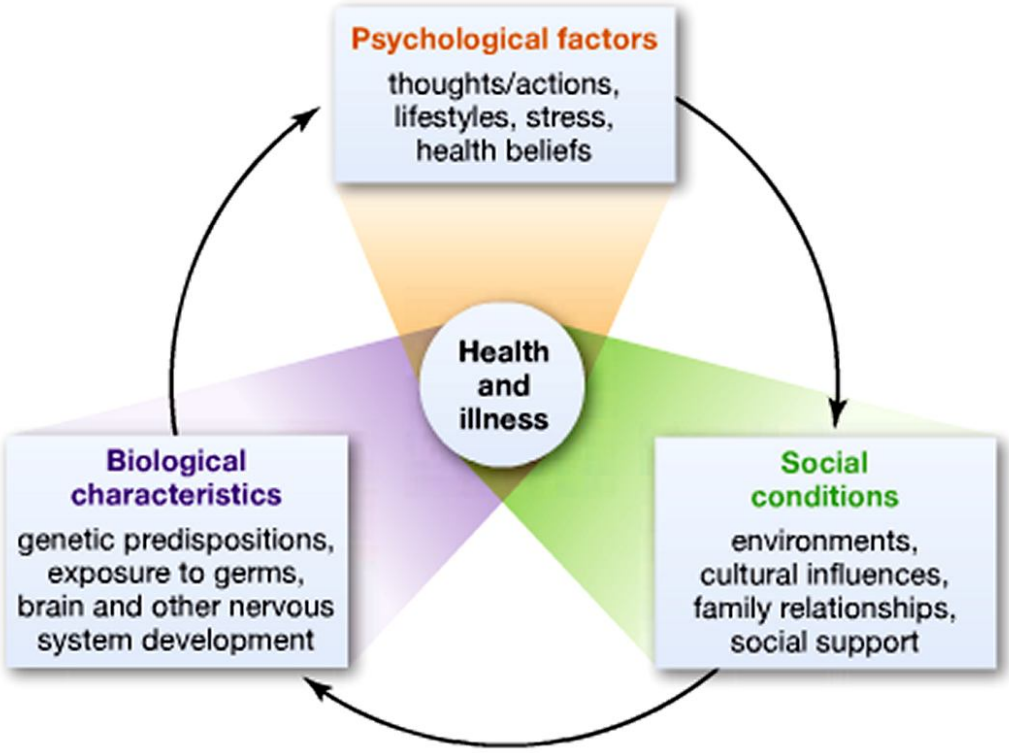
PERSONAL AND COMMUNITY ISSUES BOTH MATTER FOR HEALTH

Health is a state of physical, mental and social well being. The conditions necessary for good health are :-

i) Good physical and social environment.

ii) Good economic conditions.

iii) Social equality and harmony.



- Good physical and social environment includes clean surroundings, good sanitation, proper garbage disposal and clean drinking water.

- Good economic conditions includes job opportunities for all for earning to have nutritious food and to lead a healthy life.
- Social equality and harmony are necessary for a healthy and peaceful life.

DISTINCTIONS BETWEEN 'HEALTHY' AND 'DISEASE-FREE'

Healthy	Disease free
It is a state of physical, mental and social well being.	It is a state of absence from diseases.
It refers to the individual, physical and social environment.	It refers only to the individual.
The individual has good health.	The individual may have good health or poor health.

DISEASE AND ITS CAUSES

A person may be regarded as suffering from a disease when his body does not function properly. Minor and major disorders of the body may lead to diseases. Infectious diseases are caused by germs. One of the greatest achievements in the history of mankind is the demonstration by Pasteur, Koch and others of germs or microbes that cause diseases. Microbes are the microscopic organisms such as virus, bacteria, some fungi and protozoans that are responsible for causing diseases in human beings. Cholera, tetanus, typhoid, diphtheria and pneumonia are some common diseases caused by bacteria. Polio, common cold, influenza, measles, chicken pox and AIDS are diseases caused by virus. Amoebic dysentery and malaria are caused by protozoans.

Name of the disease	Medium
Tuberculosis, pneumonia, diphtheria, influenza, measles and common cold	Air
Cholera, typhoid, dysentery and diarrhoea	Food, water
Leprosy, ringworm and scabies	Skin contact
Malaria, filarial and plaque	Insects

ACUTE AND CHRONIC DISEASES

When a person is affected by a disease either the normal functioning or the appearance of one or more systems of the body changes for the worse. These changes give rise to signs of the disease called symptoms. On the basis of the symptoms the physicians look for the signs of a particular disease and conduct tests to confirm the disease.

Types of diseases :- Diseases are of different types. They are :- i) Acute diseases :- are diseases which last only for a short period of time and does not have long term effect on health. Eg:- cold, cough, typhoid, cholera etc. ii) Chronic disease :- are diseases which lasts for a long time and has long term drastic effect on health. Eg :- diabetes, tuberculosis, elephantiasis, arthritis, cancer etc.

Difference between Acute Disease and Chronic Disease

Acute Disease	Chronic Disease
They are short duration disease.	They are long lasting disease.
Patient recovers completely after the cure.	Patient does not recover completely.
There is no loss of weight or feeling of tiredness afterward.	There is often loss of weight of feeling of tiredness.
There is short duration loss of work and efficiency.	There is a prolonged loss of work and efficiency.

CHRONIC DISEASES AND POOR HEALTH

Chronic disease is a disease that persists for a long time. Chronic diseases are the major cause of death and disability worldwide.
The total number of people dying from chronic diseases is double that of all infectious diseases (including HIV/AIDS, tuberculosis and malaria), maternal and parental conditions, and nutritional deficiencies combined. 80% of chronic disease deaths occur in low and middle income countries and half are in women. Without action to address the causes, deaths from chronic disease will increase by 17% between 2005 and 2015.

Chronic diseases

- Cardiovascular diseases, mainly heart disease and
- Stroke;
- Cancer;
- others, such as mental disorders, vision and hearing
- impairment, oral diseases, bone and joint disorders,
- chronic respiratory diseases;
- diabetes;
- genetic disorders.

HEART DISEASE

There are many forms of heart disease. Coronary heart disease, also known as coronary artery disease or ischaemic heart disease, is the leading cause of death globally. It is caused by disease of the blood vessels (atherosclerosis) of the heart.

STROKE

Stroke is a disease of the brain caused by interference to the blood supply. Stroke and heart disease are the main cardiovascular diseases.

CANCER

Cancer describes a range of diseases in which abnormal cells proliferate and spread out of control. Other terms used are tumours and neoplasms. There are many types of cancer and all organs of the body can become cancerous.

CHRONIC RESPIRATORY DISEASES

Diseases of the lung take many forms. Chronic obstructive respiratory disease and asthma are the most common forms.
Chronic obstructive respiratory disease is caused by irreversible obstruction of the larger airways in the lung; asthma is caused by reversible obstruction of the smaller airways in the lung.

DIABETES

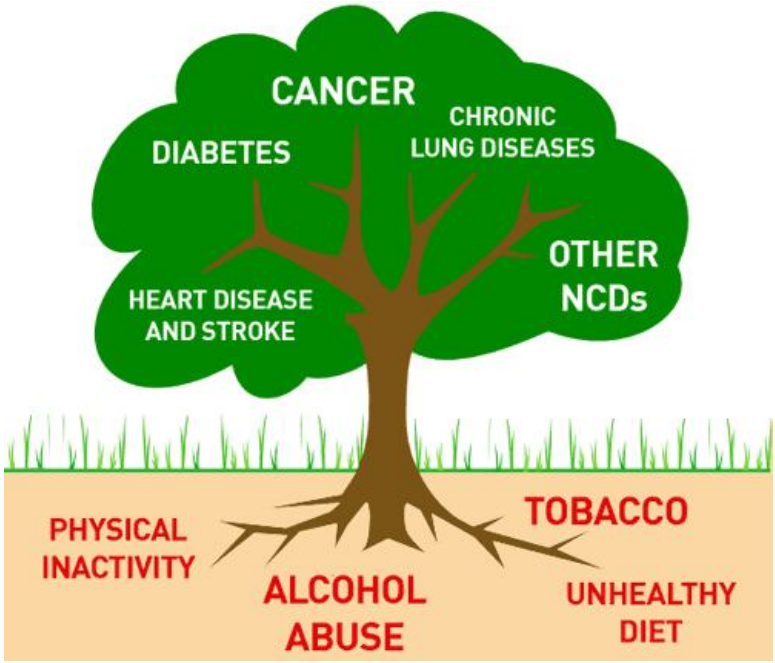
Diabetes is characterized by raised blood glucose (sugar) levels. This results from a lack of the hormone insulin, which controls blood glucose levels, and/or an inability of the body's tissues to respond properly to insulin. The most common type of diabetes is type 2, which accounts for about 90% of all diabetes and is largely the result of excessive weight and physical inactivity. The usual childhood form of diabetes (type 1 diabetes) is caused by an absolute lack of insulin. Without insulin, type 1 diabetes is rapidly fatal.

WHAT CAUSES CHRONIC DISEASES?

The causes (risk factors) of chronic diseases are well established and well known; a small set of common risk factors are responsible for most of the main chronic diseases. These risk factors are modifiable and the same in men and women:

- unhealthy diet;
- physical inactivity;
- tobacco use.

These causes are expressed through the intermediate risk factors of raised blood pressure, raised glucose levels, abnormal blood lipids, overweight and obesity. The major modifiable risk factors, in conjunction with the non-modifiable risk factors of age and heredity, explain the majority of new events of heart disease, stroke, chronic respiratory diseases and some important cancers. The relationship between the major modifiable risk factors and the main chronic diseases is similar in all regions of the world.

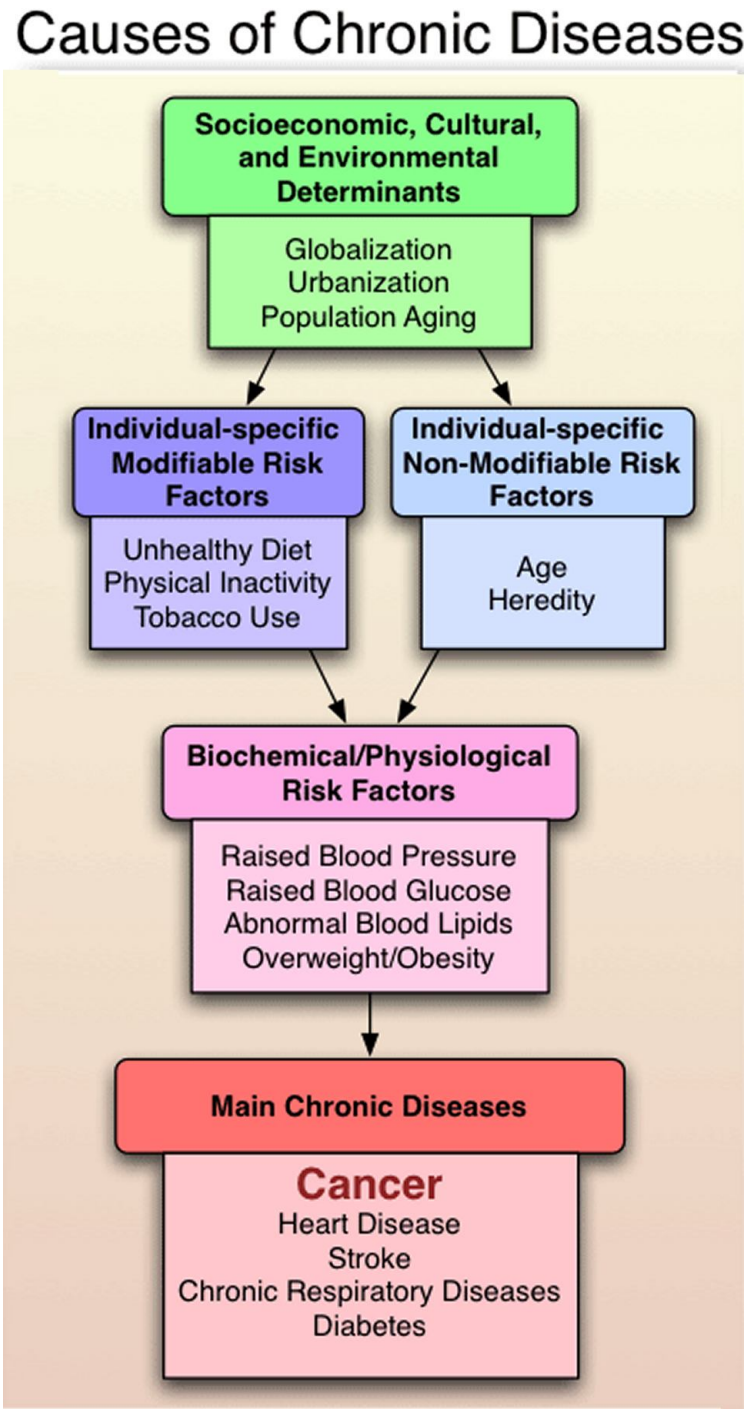


OTHER RISK FACTORS

Many more risk factors for chronic diseases have been identified, but they account for a smaller proportion of disease. Harmful alcohol use is an important contributor to the global burden of disease but its relationship to chronic disease is more complex. Other risk factors for chronic disease include infectious agents that are responsible for cervical and liver cancers, and some environmental factors, such as air pollution, which contribute to a range of chronic diseases including asthma and other chronic respiratory diseases.

PSYCHOSOCIAL AND GENETIC FACTORS ALSO PLAY A ROLE.

- **Childhood risk**
  There is now extensive evidence from many countries that conditions before birth and in early childhood influence health in adult life. For example, low birth weight is now known to be associated with increased rates of high blood pressure, heart disease, stroke and diabetes.
- **Risk accumulation**
  Ageing is an important marker of the accumulation of modifiable risks for chronic disease: the impact of risk factors increases over the life course.
- **Underlying determinants**
  The underlying determinants of chronic diseases are a reflection of the major forces driving social, economic and cultural change – globalization, urbanization, population ageing, and the general policy environment.
- **Poverty**
  Chronic diseases and poverty are interconnected in a vicious circle. At the same time, poverty and worsening of already existing poverty are caused by chronic diseases. The poor are more vulnerable for several reasons, including greater exposure to risks and decreased access to health services.
- **Psychosocial stress also plays a role.**



INFECTIOUS AND NON-INFECTIOUS CAUSES

Infectious diseases (Communicable diseases) :- are diseases which spread from an infected person to a healthy person through air, water, food, vectors, physical contact or sexual contact. Eg :- common cold, chicken pox, mumps, measles, typhoid, cholera, tuberculosis, malaria, AIDS etc.

Non-infectious diseases (Non-communicable diseases) :- are diseases which are not spread from an infected person to a healthy person. Eg :- beri beri, rickets, scurvy, night blindness, diabetes, cancer, high blood pressure etc. 5) Causes of diseases :- Diseases are caused by :- i) Pathogens like virus, bacteria, fungi, protozoans or worms. ii) Poor health and under

nourishment. iii) Malfunctioning of body parts. iv) Environmental pollution. v) Genetic disorders.

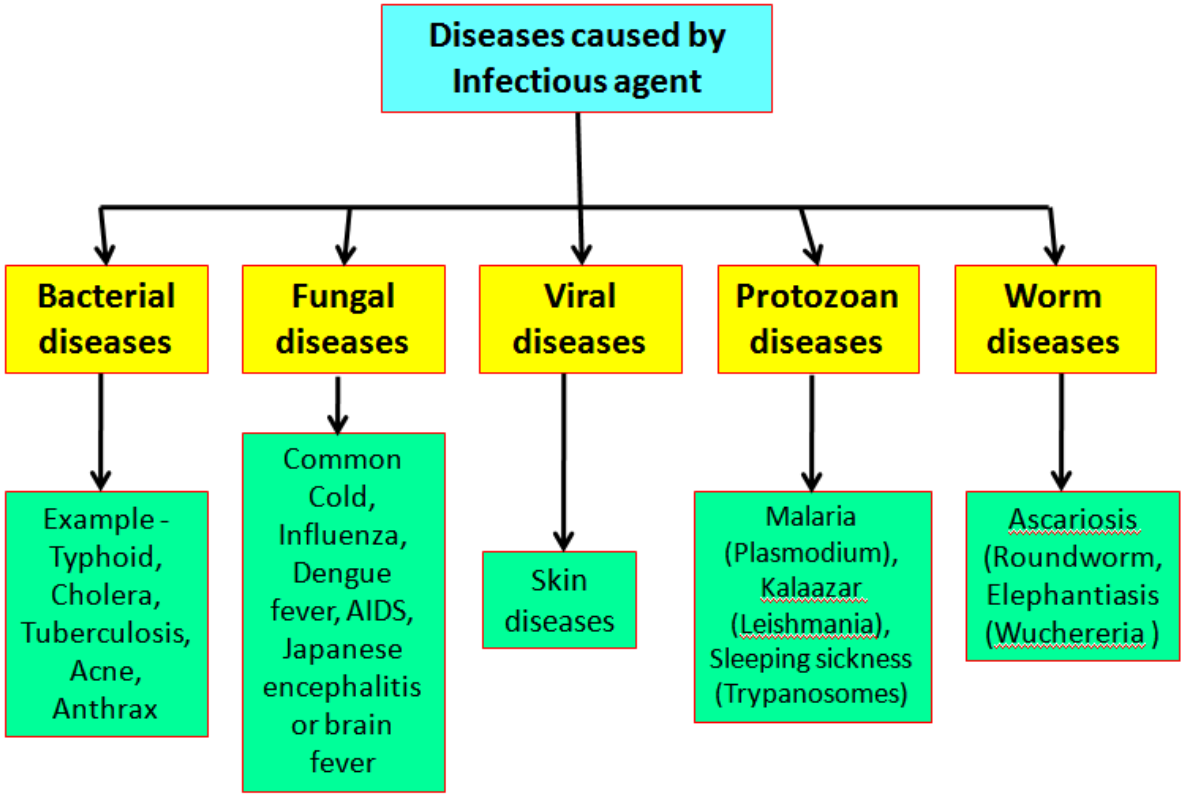
INFECTIOUS AGENTS

Infectious diseases are caused by microorganisms such as viruses, bacteria, fungi or parasites and can spread between individuals.

Microorganisms that cause disease are collectively called pathogens.
Pathogens cause disease either by disrupting the bodies normal processes and/or stimulating the immune system to produce a defensive response, resulting in high fever, inflammation and other symptoms.
Infectious diseases can be spread from one person to another, for example through contact with bodily fluids, by aerosols (through coughing and sneezing), or via a vector, for example a mosquito.

Infectious diseases can be caused by:

- **Bacteria.** These one-cell organisms are responsible for illnesses such as strep throat, urinary tract infections and tuberculosis.
- **Viruses.** Even smaller than bacteria, viruses cause a multitude of diseases — ranging from the common cold to AIDS.
- **Fungi.** Many skin diseases, such as ringworm and athlete's foot, are caused by fungi. Other types of fungi can infect your lungs or nervous system.
- **Parasites.** Malaria is caused by a tiny parasite that is transmitted by a mosquito bite. Other parasites may be transmitted to humans from animal feces.

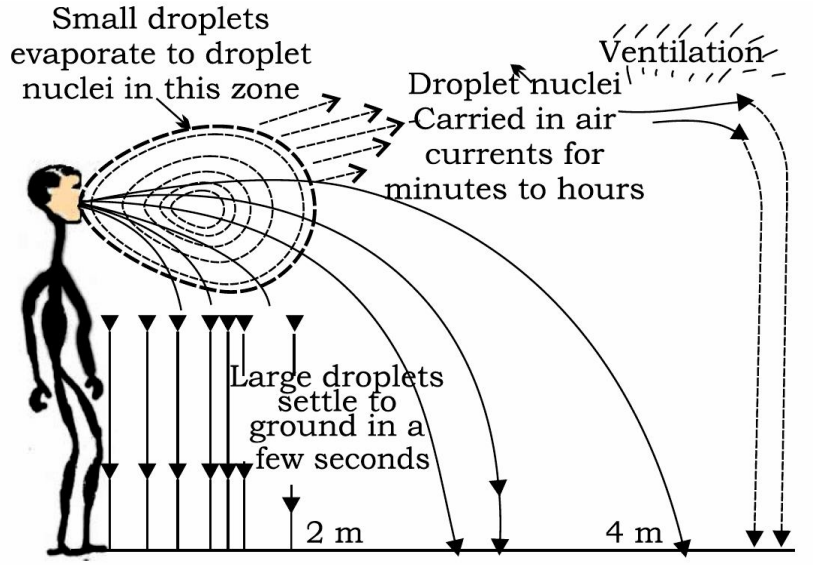


MEANS OF SPREAD

Infectious diseases spread from an infected person to a healthy person through air, water, food, vectors, physical contact and sexual contact.

i) Through air :- Common cold, Tuberculosis, Pneumonia etc.
ii) Through water :- Cholera, Amoebic dysentry etc.
iii) Through vectors :- Mosquitoes :- Malaria, Dengue, Yellow fever etc. Flies :- Typhoid, Tuberculosis, Diarrhoea, Dysentry etc.
iv) Through sexual contact :- Syphilis, AIDS. AIDS virus can also spread though blood transfusion and from the mother to her child during pregnancy and through breast feeding.

The below figure shows how Air-transmitted diseases are easier to catch the closer we are to the infected person. However, in closed areas, the droplet nuclei recirculate and pose a risk to everybody. Overcrowded and poorly ventilated housing is therefore a major factor in the spread of airborne diseases.



Disease can also be spread through water. This occurs if the excreta from someone suffering from an infectious gut gets mixed with water. Eg cholera, gets mixed with the drinking water used by people living near by. The cholera causing microbes will enter new hosts through the water they drink and cause disease in them. Such diseases are much more likely to spread in the absence of safe supplies of drinking water.

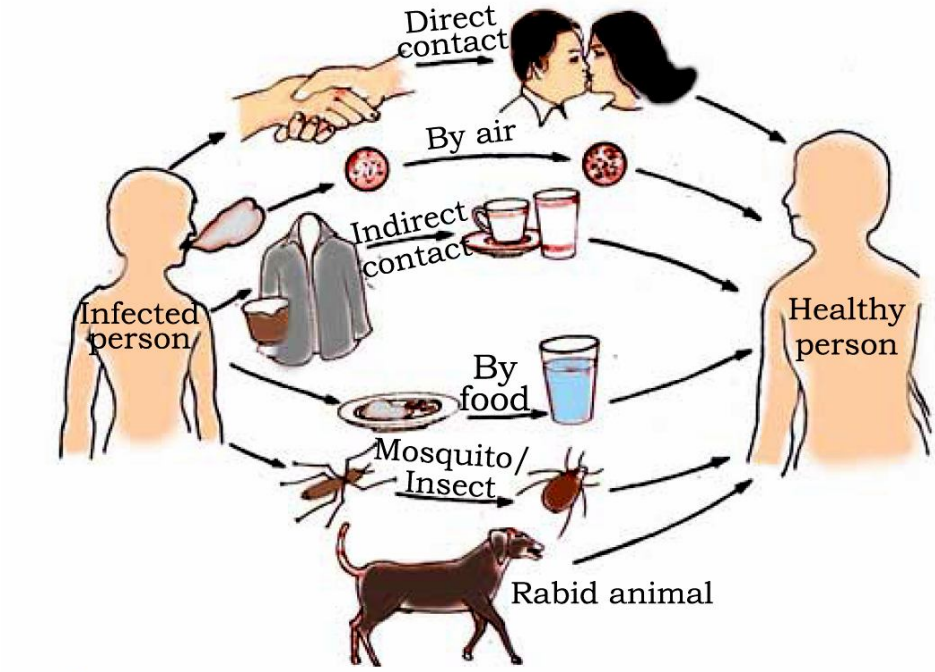


Fig. *Common methods of transmission of diseases.*

The sexual act is one of the closest physical contacts two people can have with each other. Not surprisingly, there are microbial diseases such as syphills or AIDS that are transmitted by sexual contact from one partner to the other. However, such sexually transmitted diseases are not spread by casual physical contact. Casual physical contacts include handshakes or hugs or sports, like wrestling, or by any of the other ways in which we touch each other socially. Other than the sexual contact, the AIDS virus can also spread through blood to blood contact with infected people or from an infected mother to her baby during pregnancy or through breast feeding.

ORGAN-SPECIFIC AND TISSUESPECIFIC MANIFESTATIONS

Disease causing microbes enter the body by different means and goes to different organs and tissues.

- Microbes which enters through the nose are likely to go to the lungs. (Bacteria which cause tuberculosis of lungs).
- Microbes which enter through the mouth are likely to stay in the gut (Bacteria which causes Typhoid) or liver (Bacteria which causes Jaundice).
- Virus which causes AIDS enter the body through sexual organs during sexual contact and spreads through the lymph to all parts of the body and damages the immune system.
- Malaria-causing microbes, entering through a mosquito bite, will go to the liver, and then to the red blood cells.
- The virus causing Japanese encephalitis, or brain fever, will similarly enter through a mosquito bite goes and infects the brain.

PRINCIPLES OF TREATMENT

The treatment of infectious diseases consists of two steps. They are to reduce the effects of the disease (symptoms) and to kill the microbes which caused the disease.

i) To reduce the effects of the disease :- This can be done by taking medicines to bring down the effects of the disease like fever, pain or loose motions etc. and by taking bed rest to conserve our energy.

ii) To kill the microbes :- This can be done by taking suitable antibiotics and drugs which kills the microbes and the disease is cured.

PRINCIPLES OF PREVENTION

There are two ways of prevention of infectious diseases. They are general ways and specific ways.

i) General ways of prevention :- Public hygiene is most important for prevention of infectious diseases. Proper and sufficient food for every one will make people healthy to resist infection. Air borne diseases can be prevented by living in conditions that are not crowded. Water borne diseases can be prevented by providing safe drinking water. Vector borne diseases can be prevented by providing clean environment.

ii) Specific ways of prevention :- The specific ways to prevent infectious disease is immunisation by taking vaccines. Vaccines provide immunity from infectious diseases like tetanus, diphtheria, whooping cough, measles, polio etc. Our body has an immune system which fights microbial infection. When this system first sees an infectious microbe, it kills the microbe and remembers it. So if the microbe enters the body the next time, it responds more vigorously. Vaccines mimic the infectious microbe and strengthens our immune system and protects the body from infectious diseases.

IMMUNISATION

Immunisation gives a very good level of protection against many serious diseases.

It uses your body's natural defence mechanism, the immune response, to build resistance to specific infection.

There are three reasons why we immunise children.

- **First,** immunisation prevents children from becoming ill with unpleasant and serious infectious diseases, which have a risk of complications and long-term side effects.
- **Second,** we immunise to try and help protect all children in the population. The more people who are immunised, the less of the infectious disease there is around so the less chance there is of anyone catching it. When levels of immunisation against an infectious disease are really, really high - then something happens called 'herd immunity' where the risk of the disease occurring is so low that even those who cannot be immunised are unlikely to be affected.
- **Third,** we immunise to try and wipe out as many infectious diseases as we can everywhere in the world.

National Immunization Schedule

For Infants	Vaccine & Dose	Route
At Birth	BCG 0.1ml + OPV 2drops(0 dose)	Intradermal
6 weeks	BCG 0.1ml [if not at birth]	Intradermal
	DPT-1 0.5ml + OPV-1 2drops	I/M + Oral
10 weeks	DPT-2 + OPV-2	I/M + Oral
14 weeks	DPT-3 + OPV-3	I/M + Oral
9-12 months	Measles 0.5ml + Vit. A 2ml	Deep S/C + Oral
At 18 months	DPT + OPV[Boosters-1]	I/M + Oral
At 24, 30, 36 months	Vitamin A 2ml	Oral
At 5-6 years	DT[Booster-2]	I/M
At 10 and 16 years	Tetanus Toxoid	I/M
For Pregnant Women	**Vaccine & Dose**	**Route**
Early in Pregnancy	TT-1 or Booster	I/M
One month after TT-1	TT-2	I/M

SUPPLEMENTARY NOTES

CAUSES OF INFECTIOUS DISEASES (INFECTIOUS AGENTS)

VIRUSES

Viral diseases are extremely widespread infections caused by viruses, a type of microorganism. There are many types of viruses that cause a wide variety of viral diseases. The most common type of viral disease is the common cold, which is caused by a viral infection of the upper respiratory tract (nose and throat). Other common viral diseases include:

- Chickenpox
- Flu (influenza)

- Herpes
- Human immunodeficiency virus (HIV/AIDS)
- Human papillomavirus (HPV)
- Infectious mononucleosis
- Mumps, measles and rubella
- Shingles
- Viral gastroenteritis (stomach flu)
- Viral hepatitis
- Viral meningitis
- Viral pneumonia

Viral diseases are contagious and spread from person to person when a virus enters the body and begins to multiply. Common ways that viruses spread from person to person include:

- Breathing in air-borne droplets contaminated with a virus
- Eating food or drinking water contaminated with a virus
- Having sexual contact with a person who is infected with a sexually transmitted virus
- Indirect transmission from person to person by a virus host, such as a mosquito, tick, or field mouse
- Touching surfaces or body fluids contaminated with a virus

Viral diseases result in a wide variety of symptoms that vary in character and severity depending on the type of viral infection and other factors, including the person's age and overall health. Common symptoms of viral diseases include flu-like symptoms and malaise.
Viral diseases are not treatable with antibiotics, which can only cure bacterial diseases and infections. However, the most common viral diseases, the common cold and the flu, are self-limiting in generally healthy people. This means that the viral infection causes illness for a period of time, then it resolves and symptoms disappear as your immune system attacks the virus and your body recovers.

In some cases, viral diseases can lead to serious, possibly life-threatening complications, such as dehydration, bacterial pneumonia, and other secondary bacterial infections. People at risk for complications include those who have a chronic disease or a suppressed or compromised immune system, and the very young and very old. In addition, certain types of sexually transmitted viral infections, such as HIV/AIDS and HPV, can lead to serious complications and death. Seek prompt medical care if you think you have a viral disease, especially if you are at risk for complications, or if you believe you have been exposed to a sexually transmitted disease.
Seek immediate medical care if you, or someone you are with, have serious symptoms of an illness or a viral disease, such as shortness of breath, chest pain, passing out (fainting), or a change in alertness or consciousness.

SYMPTOMS OF VIRAL DISEASES

Symptoms of viral diseases vary depending on the specific type of virus causing infection, the area of the body that is infected, the age and health history of the patient, and other factors. The symptoms of viral diseases can affect almost any area of the body or body system. Symptoms of viral diseases can include:

- Flu-like symptoms (fatigue, fever, sore throat, headache, cough, aches and pains)
- Gastrointestinal disturbances, such as diarrhea, nausea and vomiting
- Irritability
- Malaise (general ill feeling)
- Rash
- Sneezing
- Stuffy nose, nasal congestion, runny nose, or postnasal drip

- Swollen lymph nodes
- Swollen tonsils
- Unexplained weight loss

In infants, signs of a viral disease can also include:

- Bulging of the soft spot on the top of the head
- Difficulty with feeding
- Excessive crying or fussiness
- Excessive sleepiness

Serious symptoms that might indicate a life-threatening condition

In some cases, viral diseases can result in serious complications, such as dehydration or pneumonia. Seek immediate medical care (call 911) if you, or someone you are with, have any of the following symptoms:

- Change in alertness or level of consciousness
- Chest pain
- Deep, wet chest cough that produces yellow, green or brownish phlegm
- High fever (higher than 101 degrees Fahrenheit)
- Lethargy or unresponsiveness
- Seizure
- Shortness of breath, wheezing, or difficulty breathing
- Stiff neck
- Yellowing of the skin and whites of the eyes (jaundice)

WHAT CAUSES VIRAL DISEASES?

Viral infections occur when a virus enters the body and invades the inside of the body's cells in order to reproduce. If the body's immune system is unable to fight off the virus, it multiplies and spreads to other cells, repeating the process and leading to a widespread infection.

Types of viruses

There are many types of viruses that cause a wide variety of viral infections or viral diseases. In fact, there are more than 200 different viruses that can cause a cold or an upper respiratory infection. Other common viruses include the following:

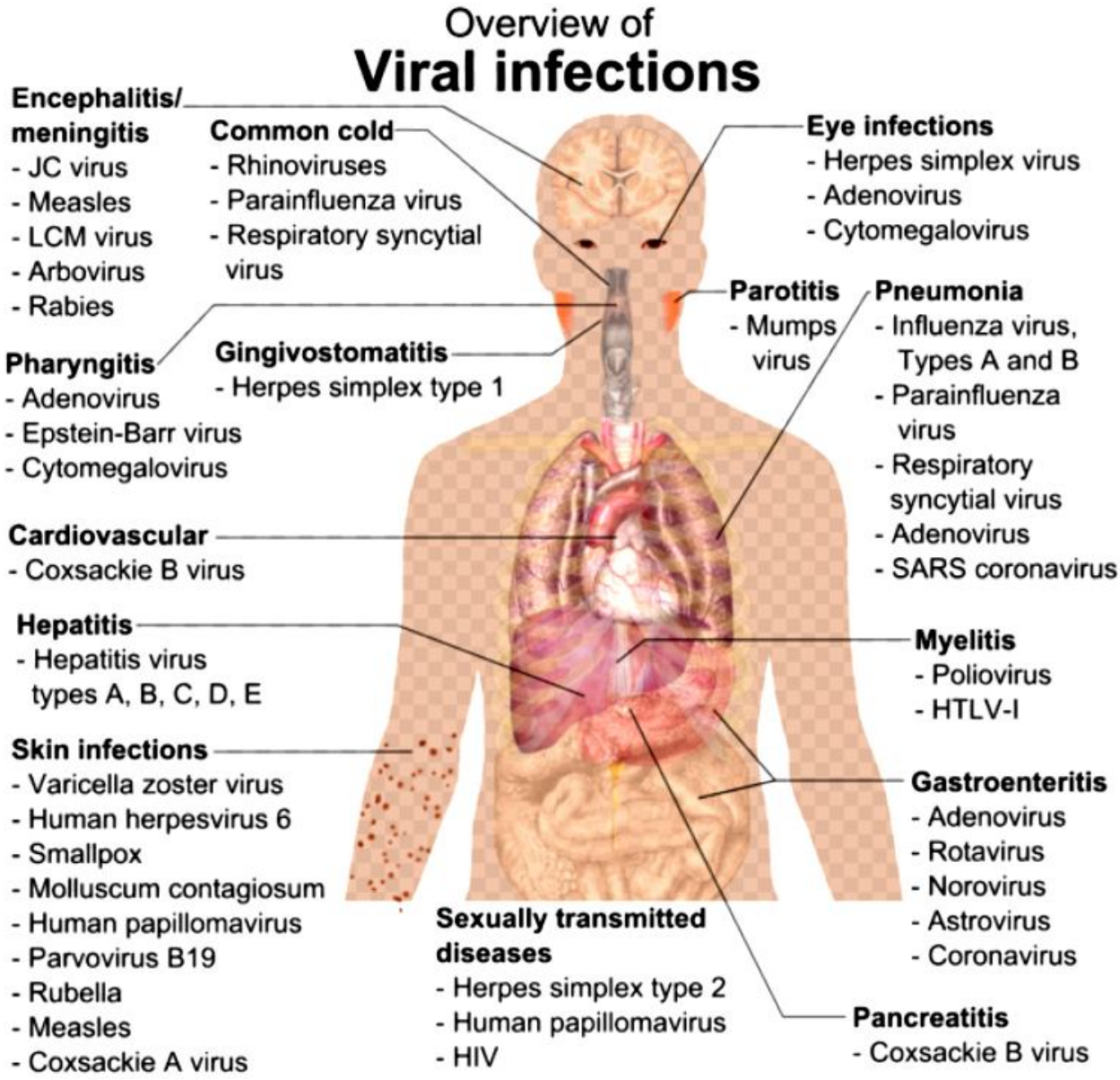
- Epstein-Barr virus causes infectious mononucleosis (cytomegalovirus causes a very similar disease in some people).
- Human immunodeficiency virus (HIV) causes AIDS.
- Human papillomaviruses (HPV) cause HPV infection, cervical dysplasia, genital warts, and cervical cancer.
- Influenza viruses, such as H1N1, cause influenza (flu).
- Respiratory syncytial virus (RSV) causes lower respiratory tract infections in young children.
- Rhinoviruses cause the common cold.
- Rotavirus, enteroviruses and noroviruses cause viral gastroenteritis.
- Varicella zoster virus causes shingles and chickenpox.
- West Nile virus causes West Nile fever.

Various ways to become infected with a virus

Our body infected with a virus in a variety of ways including:

- Being bitten by an animal infected with a virus
- Being bitten by an insect infected with a virus, such as with West Nile virus
- Breathing in air-borne droplets contaminated with a virus
- Eating food or drinking water contaminated with a virus
- Having sexual contact with a person who is infected with a sexually transmitted virus

- Sharing needles for tattooing or drug use with an infected person
- Touching infected feces or body fluids and not washing your hands before eating or touching your mouth, eyes or nose
- Touching surfaces contaminated with a virus
- Transmission of a virus from an infected mother to her baby during pregnancy or delivery



What are the risk factors for contracting viral diseases?

Viral diseases can occur in any age group or population. Everybody contracts viral diseases during their life, although in some cases, the virus does not cause obvious symptoms. Risk factors for catching a viral disease or developing complications of a viral disease include:

- Advanced age
- Compromised immune system due to an immunodeficiency disorder, HIV/AIDS, cancer or cancer treatment, kidney disease, or other condition
- History of chronic disease, such as asthma, COPD, diabetes, tuberculosis, or heart disease
- Malnourishment
- Not getting enough rest and having high levels of stress

- Not washing your hands frequently, especially before eating or after using the restroom, or after touching common surfaces
- Sharing needles to inject drugs or for tattooing
- Unprotected sex including vaginal, oral and anal sex with a partner who has had one or more other sexual partners
- Young age including infancy and elementary-school-age children

Reducing your risk of viral diseases

We can lower your risk of catching or spreading a viral disease by:

- Abstaining from sexual activity, or only engaging in sexual activities within a mutually monogamous relationship in which neither partner is infected with a sexually transmitted disease
- Avoiding contact of your hands with your eyes, nose and mouth, which can transmit a virus into the body
- Avoiding contact with a person who has a viral disease
- Covering your mouth and nose with your elbow (not your hand) or a tissue when sneezing or coughing
- Eating a well-balanced diet that includes sufficient amounts of fruits and vegetables
- Sufficient rest
- Using a new condom for each sex act
- Using a sterile, unused needle for each act of tattooing or injectable drug use
- Using appropriate antibacterial cleaners to clean your hands and surfaces
- Vaccination as recommended by your health care provider for viral diseases, such as chickenpox, shingles, influenza, HPV, hepatitis B, hepatitis A, measles, and mumps
- Washing your hands with soap and water for at least 15 seconds after contact with a person who has a viral disease, before eating, or after using the restroom or touching feces, body fluids, surfaces, or foods that are potentially contaminated with viruses

How are viral diseases treated?

Treatment of viral infections varies depending on the specific virus and other factors. General treatment measures are aimed at relieving your symptoms so that you can get the rest you need to keep up your strength and recover without developing complications.

General treatments for viral infections include:

- Acetaminophen (Tylenol) or ibuprofen (Motrin, Advil) for fever, body aches, and pain
- Drinking extra fluids
- Getting extra rest and sleep
- Maintaining good nutrition

Depending on the type of viral infection and the presence of complications, a wide variety of other treatments may be needed. For example, a human papillomavirus (HPV) infection that leads to cervical dysplasia can be treated by surgical removal of the abnormal cells on a woman's cervix.

In general, it is recommended that children younger than age six not use cold or cough medications because of the risk for serious side effects. In addition, people with a viral disease should not use aspirin or products that contain aspirin because of the risk of developing a rare but life-threatening condition called Reye syndrome. Reye syndrome has been linked to taking aspirin during a viral illness, such as a cold or the flu.

Prescription medications used to treat viral diseases

In some cases, certain medications may be prescribed to treat viral diseases:

- Antiretroviral medications, which can help people with HIV/AIDS lead longer lives. Antiretroviral medications hinder the ability of HIV to reproduce, which slows the spread of HIV in the body.

- Antiviral drugs, which minimize the severity and length of some viral infections, such as the flu and shingles, especially in people who are at a high risk for serious complications. For example, the drugs oseltamivir (brand name Tamiflu) and zanamivir (brand name Relenza) may be prescribed for some cases of flu. These drugs are not appropriate for all people with the flu.

Antibiotics, which are not prescribed for viral diseases because they are ineffective in the treatment of viral infections, may be prescribed if a person with a viral disease develops a secondary bacterial infection, such as bacterial pneumonia, bacterial bronchitis, or encephalitis.

Complementary treatments

Complementary and traditional treatments will not cure a viral disease but may help to increase comfort, promote rest, and minimize symptoms of viral diseases. Some possible treatments include:

- Chicken soup to help break up congestion and provide easy-to-digest nutrients and extra fluids to help keep up strength
- Supplements or products that contain vitamin C, echinacea, or zinc
- Using a vaporizer
- Using mentholated ointments on the chest

What are the possible complications of viral diseases?

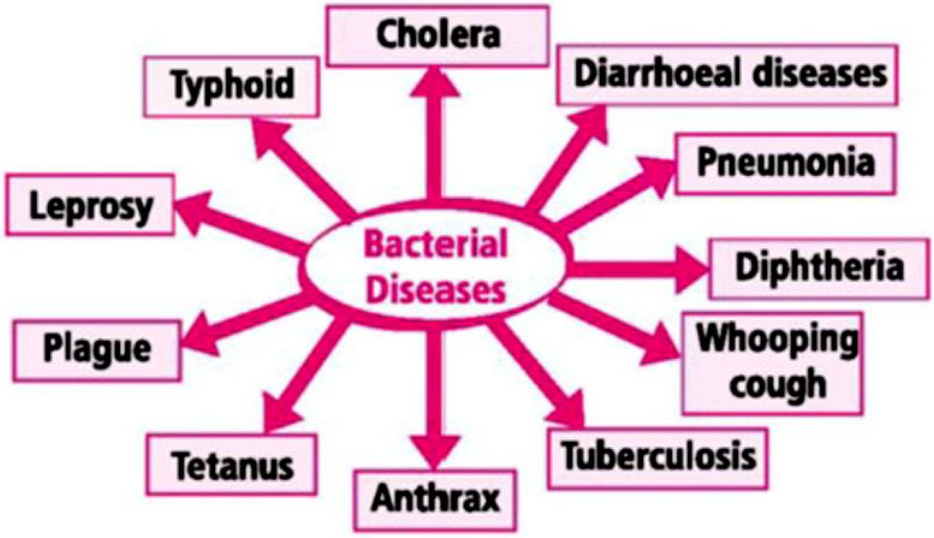
In some people, viral diseases can break down the body's defenses and lead to more serious infections and life-threatening complications. Therefore, it is important to visit your health care provider when you have symptoms of a viral infection. Once the underlying infection has been determined, following the treatment plan outlined by your health care provider can help reduce any potential complications including:

- Acute bronchitis
- Cervical cancer (from human papillomavirus infection)
- Dehydration
- Frequent life-threatening, opportunistic infections
- Otitis media (ear infection)
- Pneumonia
- Secondary bacterial infection
- Seizures
- Shock and coma
- Sinusitis
- Worsening of asthma

BACTERIA

Bacteria are single-celled microorganisms.
They come in many shapes including ball-, rod- and spiral-shaped.
Most bacteria are not harmful and some are actually beneficial. Less than one per cent of bacteria will actually make you ill.
Infectious bacteria can grow, divide and spread in the body, leading to infectious disease.
Some infectious bacteria give off toxins which can make some diseases more severe.
Bacteria are spread in many ways including:

- Spread by aerosols (through coughing and sneezing). For example, Streptococcus.
- Spread by surface and skin contact. For example, Staphylococcus aureus, including MRSA.
- Spread through body fluids, such as blood and saliva. For example, meningococcal disease (meningitis).



Antibiotics are usually given to treat severe bacterial infections.
Antibiotic resistance in bacteria is a significant problem.

TYPHOID (ENTERIC FEVER)

• Typhoid is a common bacterial disease caused by a rodlike bacterium. Salmonella typhi, which is commonly found in the intestine of man.
• Certain humans function as carriers without suffering from it. Mary Mallon, called Typhoid Mary was such a case. She was a cook and typhoid carrier, who continued to spread the disease for several years through her food preparation.

Mode of transmission of Typhoid

• Incubation period varies from 1-3 weeks, average 2 weeks.
• Typhoid spreads through food and water contaminated with faeces of the patient. House flies may carry the pathogens from the faeces to the food, milk and water.

Symptoms of Typhoid

• This disease is characterised by the inflammation of ileum and colon, liver and spleen also become enlarged, abdominal pain, pea-soup diarrhoea which may become haemorrhagic, constant fever, extreme weakness, vomiting, rash of rose coloured spots called rose spots on the upper abdomen and sore throat.
• Typhoid is diagnosed by Widal Test.

Prevention and treatment Typhoid

• Any patient with typhoid requires the highest standards of nursing together with isolation and hygienic disposal of faeces.
• The two most important preventive measures are proper sewage treatment and purification of water supplies.
• Contamination of food can be reduced by personal hygiene and control of flies.
• TAB vaccine provides immunity for about 3 years.
• Antibiotics like ampicillin and chloramphenicol are used to treat typhoid.

CHOLERA

• Cholera commonly called haiza is a water-borne disease caused by the bacterium, Vibrio cholerae.
• Robert Koch discovered this disease.

Mode of transmission of Cholera
• Incubation period varies from a few hours to 2-3 days.
• It spreads through contaminated food and drinks.
• The causative bacterium secretes cholera toxin, enterotoxin which induces excessive secretion of an isotonic electrolyte solution by the intestinal mucosa. This solution is lost in stool.

Symptoms of Cholera
• Cholera is mainly characterized by sudden onset of profuse, effortless, rice-water like stools, vomiting and rapid dehydration, loss of minerals and muscular cramps.

Prevention and treatment of Cholera
• Proper sanitation and hygienic conditions are the best methods of prevention.
• Cholera vaccine is effective for six months only.
• Fluid and salt lost is restored by Oral Rehydration Solution (ORS). It is water with a small amount of sugar and salt.
• Antibiotics like tetracycline and chloramphenicol are used to treat cholera.

DIARRHOEAL DISEASES

• Diarrhoeal diseases are group of diseases caused by different bacteria such as Shigella dysenteriae, Escherichia coli, Campylobacter, Salmonella and Clostridium.

Mode of transmission of Diarrhoeal diseases
• Incubation period is variable.
• Epidemics are common in overcrowded insanitary conditions.
• It spreads through food poisoning, contaminated food, water or drinks, clothes, utensils and bed sheets.

Symptoms of Diarrhoeal diseases
• This is characterised by mild diarrhoea i.e., loose stools if infected by E. coli, frequent stools with blood and mucus and abdominal cramps if infected by Shigella. Other symptoms are dehydration, diminished appetite, fever, low B.P., increase in pulse rate etc.

Prevention and treatment of Diarrhoeal diseases
• One should avoid contaminated food and water.
• ORS is given repeatedly to check dehydration and loss of minerals.

PNEUMONIA

• Pneumonia is a serious disease of lungs characterised by accumulation of mucus/fluid in alveoli and bronchioles to that extent that breathing becomes difficult.
• It is caused by Streptococcus pneumoniae or Diplococcus pneumoniae, and Haemophilus influenzae.

Mode of transmission of Pneumonia
• Incubation period is of 1-3 days.
• A healthy person acquires the infection by inhaling the droplets/aerosols released by an infected person or even by sharing glasses and utensils with an infected person.

Symptoms
• The onset of pneumonia is usually sudden with a single shaking chill, followed by fever, pain with breathing on the side of lung involved, increased pulse and respiratory rates and cough.
• In severe cases the lips and finger nails turn grey to bluish in colour.

Prevention and treatment of Pneumonia

• The patients should be isolated and healthy persons should not share their belongings.
• Pneumococcal conjugate vaccine (PCV13) is available.
• Drugs against pneumonia are erythromycin, tetracycline and sulphonamide. If untreated, pneumonia leads to death.

DIPHTHERIA

• Diphtheria is an acute infectious disease in children mostly characterized by the development of a grey adherent false membrane over the upper respiratory tract or throat.
• It is caused by toxigenic strains of Corynebacterium diphtheriae (rod shaped, Gram +ve bacterium).

Mode of transmission of Diphtheria

• Incubation period is of 2- 5 days.
• Endotoxin produced by pathogen causes nasal diphtheria, pharyngeal diphtheria and laryngotracheal diphtheria.
• The germs are present in the discharges from the nose and throat of patients and also of healthy people who act as the "carriers".
• The patients and the carriers spread the disease through acts like kissing, talking, coughing and sneezing.

Symptoms of Diphtheria

• Symptoms are fever, sore throat, sometimes vomiting, headache, epithelial necrosis by endotoxin and oozing of semisolid material in the throat which develops into a grey false but tough membrane.
• The membrane chokes the air passage. Sometimes, bacterium infects the heart, nerve cells and adrenal glands.
• In severe cases, respiratory tract is blocked causing difficulty in breathing and even death due to choking.
• 'Schick test' tests the presence of antitoxin and the state of hypersensitivity to diphtheria toxin.

Prevention and treatment of Diphtheria

• One should avoid close contact with the patient.
• DPT (diphtheria, pertussis and tetanus) vaccine is available.
• Erythromycin is used to treat diphtheria.

WHOOPING COUGH (PERTUSSIS)

• Whooping cough is caused by Bordetella pertussis and is a common childhood disease affecting the respiratory system.

Mode of transmission

• It has an incubation period of 10 – 16 days.
• It spreads by droplet infection or by direct contact.

Symptoms of Whooping cough (Pertussis)

• It causes loss of appetite, fever, running nose, fatigue, sneezing and constant cough leaving the child breathless, tired and red in face.
• Later the voice becomes hoarse and the cough gives a whoop or a loud crowing sound while inhaling.
• The child usually vomits and there is frothy discharge from his mouth and nose.
• There may be other complications like vomiting, convulsions and pneumonia.

Prevention and treatment of Whooping cough (Pertussis)
• Immunisation of the disease is done in infants by DPT vaccination at six weeks, three months and five months.
• Erythromycin antibiotic is used for the treatment.

TUBERCULOSIS

• Tuberculosis (TB), also called Koch's disease is caused by rod-shaped, Gram +ve bacteria, Mycobacterium tuberculosis.
• The bacterium releases a toxin, tuberculin which destroys the organs it infects.
• It can affect almost any tissue or organ in the body like the lungs, lymph nodes, brain, bones and joints but disease of the lung is by far the most frequent.

Mode of transmission of Tuberculosis
• Incubation period is 3 to 6 weeks or may be years.
• It spreads through sneezing, coughing, contaminated food and water.

Symptoms of Tuberculosis
• Constant cough and in severe cases sputum with blood, pain in chest while coughing, loss of body weight, failure of appetite, slight rise of temperature in the evening are the symptoms of lung T. B.
• Sputum, tuberculin, X-ray and gastric analysis are carried out to diagnose tuberculosis.
• Tuberculin test is also called Mantoux test.

Prevention and treatment of Tuberculosis
• BCG (Bacillus Calmette Guerin) vaccine for TB was obtained from bovine bacillus by Calmette and Guerin in 1921.
• Before giving vaccination to any individual it is important to check if they are already suffering from TB or have recovered from it.
• The test is to puncture the skin with a special instrument which has a ring of six short needles (the Heaf test). This introduces tuberculin, purified from dead tubercle bacilli.
• In the absence of past or present TB the skin shows no reaction, but if an individual has the disease or has recovered, then the skin swells and reddens at the injection site. This indicates a substantial immunity and no vaccine is offered.
• Some of the anti-tuberculosis drugs are streptomycin, rifampicin, isoniazid, thiatazone, PAS (Para amino salicydic acid) etc.
• Direct observation treatment (DOT) is a programme under WHO for treatment of TB across the world.

ANTHRAX (BIOWAR DISEASE)

• Anthrax is an acute infectious disease caused by airborne, spore-forming, rod-like, non-motile bacterium, Bacillus anthracis.
• Bacillus anthracis can be easily grown in the laboratory. Anthrax spores can be produced in a dry form which can be stored as particles.
• These particles can be used in biological warfare. Spores are infective in dry form, not in wet form.
• It most commonly occurs in wild and domestic vertebrates (cattle, sheep, goats, camels, antelopes, and other herbivores), but it can also occur in humans when they are exposed to infected animals or tissues from infected animals.

Mode of transmission of Anthrax (Biowar disease)
• Infected animals shed, a large number of bacilli (bacteria) in the discharges from the mouth, nose and rectum which sporulate in the soil. These spores are source of infection.

• It requires thousands of spores to cause human infection. Anthrax does not spread from human to human.

Types of Anthrax of Anthrax (Biowar disease)

• Anthrax infection can occur in three different forms: cutaneous (skin), gastrointestinal (by ingestion) and pulmonary (by inhalation).

(i) Cutaneous anthrax occurs when bacteria enter through skin cuts and wounds. A skin lesion begins as a papule and soon becomes a vesicle and breaks, discharging bloody serum. This vesicle, in about 36 hours, becomes a bluish-black necrotic mass (dead tissue). It consists of minute particles rich in spores.

(ii) Gastrointestinal anthrax is caused by taking under- cooked meat of infected animals. Patient experiences chill, high fever, body aches, nausea, vomiting, bloody diarrhoea, loss of appetite, and frequent haemorrhages from the mucous membranes and in the skin.

(iii) Pulmonary anthrax is acquired by inhaling dust containing B. anthracis. Pulmonary anthrax is often called wool-sorter's disease.

Symptoms of Anthrax (Biowar disease)

• Initial symptoms resemble those of common cold. Later there is difficulty in breathing, cough, fever, fast pulse and cardiovascular collapse.

• If left untreated, anthrax in all forms can lead to septicemia and death.

• Death is apparently due to oxygen depletion, secondary shock, increased vascular permeability, respiratory failure and cardiac failure.

Prevention and treatment of Anthrax (Biowar disease)

• The only known effective prevention against anthrax is the anthrax vaccine. The vaccine was developed from an attenuated strain B. anthracis.

• A suitable antibiotic like ciprofloxacin is quite effective, particularly if used in the initial stages of disease. But in cattle, ciprofloxacin may be effective only in chronic area.

• Antibiotics should be given to unvaccinated individuals exposed to pulmonary anthrax. Penicillin, tetracycline and fluoroquinolones are effective if administered before the onset of lymphatic spread or septicemia.

TETANUS (LOCK JAW)

• Lock jaw disease is caused by the spores of Clostridium tetani that enter through wounds.

Mode of transmission

• Incubation period is of 3-25 days during which the bacterium secretes a powerful exotoxin tenanospasmin into the tissue, and blood carries it to the central nervous system and brings about tetanus of muscles.

• Its infection is acquired by contamination of wounds with tetanus spores as these infected spores are abundant in the soil manured with animal dung.

• Spores may survive for 60 or more years in contaminated soil.

Symptoms of Tetanus (Lock jaw)

• Symptoms include painful muscular spasms especially of neck and jaw.

• Lock jaw condition occurs when the patient cannot open the mouth. Convulsions and paralysis of muscles, difficulty in chewing and swallowing, fever and headache are the other symptoms.

Prevention and treatment

• All wounds should be treated carefully and cleaned with iodine solution.

• Immunisation of infants by DPT should be done.

• ATS {antitetanus serum) injection within 24 hours of injury provides passive immunity while TT (tetanus toxoid) gives active immunity.

PLAGUE (BLACK DEATH)

• Plague is caused by a rod-shaped non-motile bacterium called Pasteurella/Yersinia pestis and is transmitted by the bite of infected rat flea, Xenopsylla cheopis.
• The first authenticated plague epidemics in India in modern times occurred in 1895-96 and from 1898 onwards the disease was appreciably manifest, reaching a peak in the year 1907.
• Pasteurella pestis endoparasite of gut of rat flea (which is an ectoparasite of rat and mouse).
• Head louse (Pediculus) and bedbug (Cimex) may also transmit the germs from man to man.

Prevention and treatment of Plague (Black death)

• Plague is confirmed by Wayson stain test.
• Anti-plague vaccine, spray of insecticides, killing of rats, nose caps and high cots (rat flea can jump upto 45 cm) are some preventive measures.
• Streptomycin or oral tetracycline is effective against plague.

LEPROSY (HANSEN'S DISEASE)

• Leprosy is a contagious chronic bacterial disease caused by Mycobacterium leprae which is characterised by the chronic infection of the skin and other tissues.

Mode of transmission of Leprosy (Hansen's disease)

• The incubation period is very long and averages upto 2-5 years.
• Infection occurs by prolonged contact with leprosy patients.
• The bacilli leave the body in nasal discharge, from the throat during coughing, sneezing and even speaking and through broken skin lesions.

Symptoms of Leprosy (Hansen's disease)

These include appearance of light coloured patches on the skin, thickening of the nerves, partial or total loss of sensation in the affected parts of the body.
• These are accompanied by fever, pain, ulcers and skin eruptions. Deformities of toes and fingers may also develop.
Lepromin test is used to evaluate leprosy using an intradermal injection of a lepromin. This test classifies the type of leprosy based on reaction.
• Tuberculoid leprosy gives positive test with lepromin while lepromatous leprosy is negative to lepromin test.

Prevention and treatment of Leprosy (Hansen's disease)

• No vaccine is available.
• Leprosy is treated with drugs like rifampicin, dapsone, and clofazimine.

FUNGI

Fungi are microorganisms characterised by cell walls made from a substance called chitin.
Most fungi are harmless to humans and some are edible.
Other fungi can be infectious and may lead to life-threatening diseases.
Fungi reproduce by releasing spores that can be picked up by direct contact or even inhaled.
Fungal infections often affect the lungs, skin or nails. Some infections may also penetrate the body to affect organs and cause whole-body infections.
Examples of fungal infections include:

- Athlete's foot: itching, scaling or cracking of the skin
- Ringworm: reddish, itchy, scaly rash usually on the skin and scalp
- Thrush: caused by the fungus Candida albicans which can infect the mouth, vagina, stomach and urinary tract.

Fungi that commonly cause skin diseases are called dermatophytes. “Dermatophytes” doesn't refer to a particular group of fungi, but rather to the fact that they attack the dermis, or skin. Fungal infections of the skin can be treated with topical creams as well as prescription drugs.

Athlete's Foot

The best-known fungal skin infection is athlete's foot. It infects approximately 10 percent of the United States population. It is most common among adolescents and adults; however, it may affect people of any age.

Athlete's foot can grow on the feet in different forms, including the following:
Interdigital: Infection occurs between the toes, with scaling, fissuring, or softened skin.
Moccasin: The fungi grows as a thick scaling over the entire sole of the foot (like a moccasin) and causes discomfort.
Vesicular: The fungi appear as small, itchy blisters near the instep.
Ulcerative: The infection involves peeling, oozing discharge, and a strong odor that usually starts as red, itchy swelling between the toes.

A good way to combat athlete's foot is to keep feet clean and dry. Topical powders or creams may also help to control infection. Unfortunately, athlete's foot is tough to eliminate and often comes back.

Summary of Human Fungal Diseases

Disease	Symptoms	Fungus	Route of transmission
Athlete's foot	fluid-filled blisters, scaly skin, itching	*Trichophyton* species (Ascomycete) or *Epidermophyton* species	contact with skin lesions or contaminated floors
Ringworm	ring-shaped skin lesions	*Microsporum*, *Trichophyton* (Ascomycetes)	contact with skin lesions, contaminated floors, or contaminated objects
Vaginal yeast infection	burning sensation, itching, discharge	*Candida*	contact with fecal material, diabetes; antibiotic treatments increase susceptibility
Tinea cruris (jock itch)	intense itching, ring-shaped lesions	*Microsporum*, *Trichophyton* (Ascomycetes)	contact with skin lesions, contaminated floors, or contaminated objects
Histoplasmosis	fever, chills, headache, body aches, chest pains, nonproductive cough	*Histoplasma capsulatum* (Ascomycete)	inhalation of airborne conidia

Scalp Itch

Scalp itch is a fungal infection of the scalp and hair. It usually occurs in young children, but may appear in all age groups. It is contagious and may be spread from child to child in a school or day care setting.

An antifungal drug called riseofulvin cures scalp itch in one to three months.

Nail Fungus

Nail fungus is most common in adolescents and adults, especially among people who have frequent manicures. These infections can manifest themselves in a variety of patterns. Sometimes a portion of the nail becomes thick and brittle. Other times, the fungi attack the cuticle and the growth spreads out from there. This cuticle-based infection is common in AIDS patients.

PARASITES

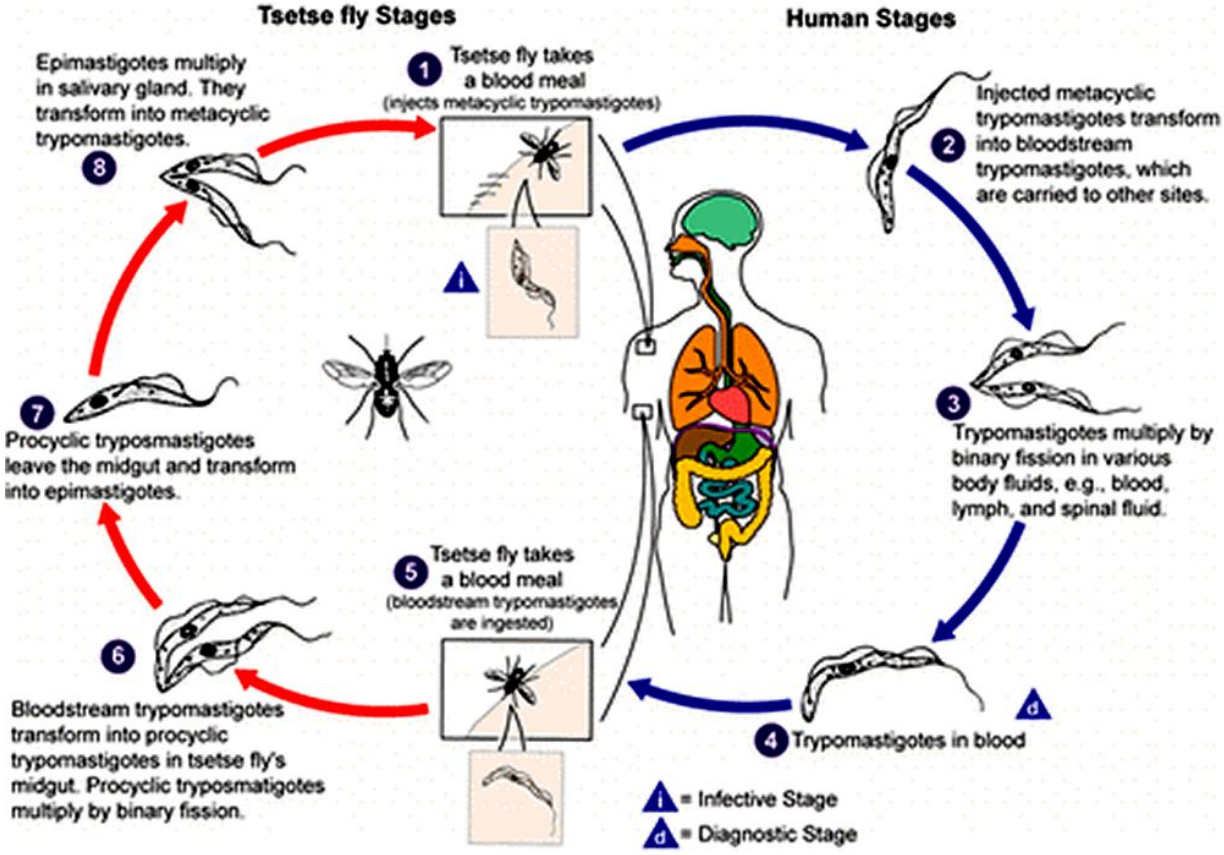
A parasite is an organism that lives off another organism, typically attaching itself to feed from the victim's blood, bowels, or other various bodily fluids. Parasitic diseases are more common than most people realize, and can strike anyone regardless of race, age, or social status. A certain amount of parasites are normally found on the skin and bedding of every human being. Dust mites, and other tiny, harmless mites, are commonly found in all household. Harmful parasites, however, can cause a great deal of damage to the human body if not properly treated.

PARASITIC DISEASES SYMPTOMS

Parasites such as roundworms feed off the human waste in the intestines. Symptoms of various worm infestation include itching, usually of the anus or vaginal area, weight loss, increased appetite, abdominal pain, bowel obstructions, vomiting, disturbed sleep, worms present in the stools or vomit, diarrhea, anemia, symptoms of pneumonia, food poisoning symptoms, aching muscles or joints, or a generally feeling of illness. These symptoms can range from barely noticeable to very severe.

PARASITIC DISEASES CAUSES

Parasitic disease is typically caused by the parasite's entry into the body via the skin or mouth. It is not unusual to pick up parasitic infections from soil, typically by either walking barefoot and allowing entry through the feet, or by placing the hands in the dirt and eventually placing the fingers in the mouth. Often people carry a parasite without ever knowing it.



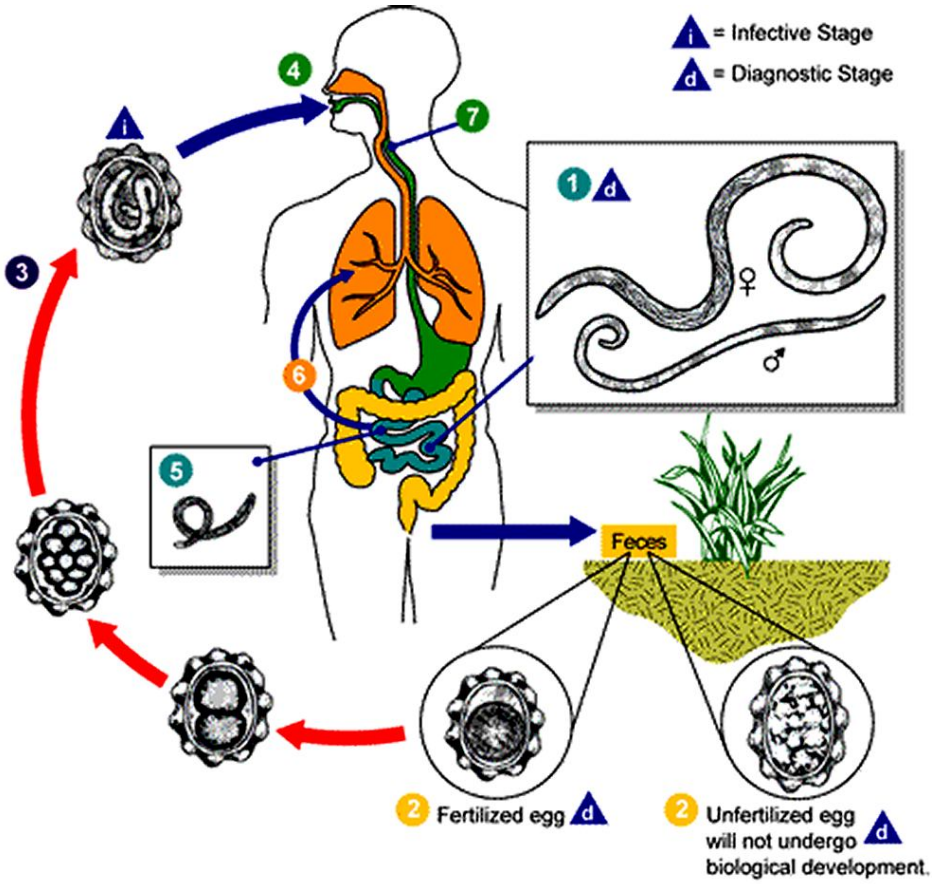
Parasites such as lice are caused through human contact with a person who is infected with lice. Ticks can be picked up through walking outdoors, close contact with a dog or cat, or being brought in from outside in various packages. Mosquitoes are parasites which simply attack humans for their blood and leave as quickly as they came.

PARASITIC DISEASES RISK FACTOR

Risk factors for parasites include children who play outdoors in the dirt, close contact with pets, farming, gardening, outdoor activities that include walking near wooded areas, digging in the dirt, walking outside barefoot, being in close or sexual contact with someone who has specific parasites, or sometimes simply the act of walking from the car to the house. Parasites exist in the world and can not be avoided simply by avoiding being outdoors. Parasites can be found in foods, especially undercooked or exotic foods.

Physicians typically do not screen for parasites without cause. Blood tests or fecal samples can determine parasites, but not all parasites. Pinworms require a nightly anal test, typically for three nights, where a sticky slide is placed on either side of the anus to pick up any eggs that have been laid. Analyzing the slide under a microscope can determine the presence of pinworm.

The majority of parasitic diseases are not dangerous. However, extreme cases may cause weight loss, dehydration from chronic diarrhea, symptoms which mimic pneumonia, anemia, fatigue, Lyme disease from ticks, Malaria from mosquitoes, or a host of uncomfortable bowel syndromes.



PARASITIC DISEASES TREATMENT

Treatment of parasitic disease is typically nothing. Most often there are no symptoms, or symptoms are so mild that there is no concern, and thus physicians are not told to consider the symptoms as a possible parasitic disease. Unless there are serious symptoms or the infestation is large enough to cause health problems, most parasitic diseases will clear up on their own.

For serious symptomatic cases, medication can be administered to kill the parasite or to relieve the symptoms caused by the parasite. Pinworm discomfort can be handled with an anti itch cream, while Lyme disease can only be treated by treating the symptoms. Medication such as mebendazole, pyrantel pamoate, and albendazole are effective medications in killing worm infestations.

When dealing an infestation of worms or other parasites, self care can be as simple as keeping clean. Frequent bathing, cleaning clothes and bed clothes, wearing clean underclothing to bed, and checking for parasites are the best ways to deal with a parasitic disease. Washing hands frequently, especially after outdoor activities can help reduce the chances of a parasitic disease.

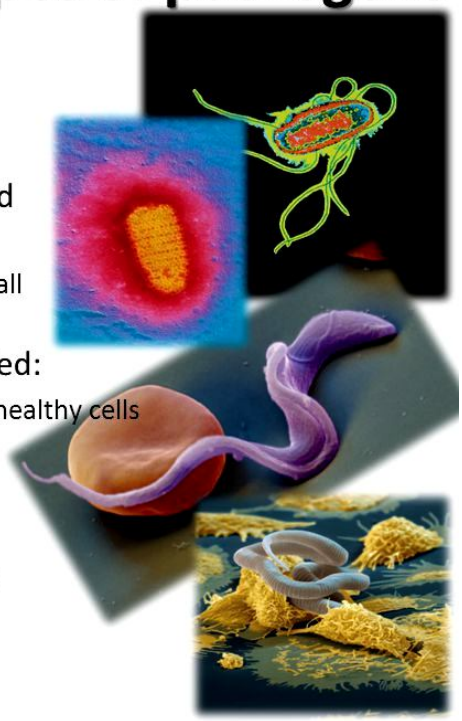
PARASITIC DISEASES PREVENTION

Coping with a parasitic disease can be stressful, more so when the patient believes that parasites come from being dirty. Parasites can be contracted regardless of the cleanliness of the home. While hand washing and overall cleanliness are positive ways to prevent parasitic infections and diseases, they in now way guarantee that parasites won't infect a family member.

There are different types of pathogens

- **Bacteria** are single-celled organisms:
  - Cause illness by destroying cells, release toxic chemicals
  - Ex: Food poisoning, MRSA
- **Viruses** are genetic material surrounded by a protein coat:
  - Force host cells to make more viruses, small
  - Ex: Flu, Cold, HIV
- **Fungi** can be multicellular or single-celled:
  - Take nutrients from host cells by piercing healthy cells
  - Occur in warm and damp places
  - Ex: Athlete's foot
- **Protozoa** are single-celled organisms.
  - Use host cells to complete their life cycles
  - Take nutrients from host cell
  - Ex: Malaria

Review: Parasite



Means of spread of infectious diseases :-

Infectious diseases spread from an infected person to a healthy person through air, water, food, vectors, physical contact and sexual contact.

i) Through air :- Common cold, Tuberculosis, Pneumonia etc.

ii) Through water :- Cholera, Amoebic dysentry etc.

iii) Through vectors :-

Mosquitoes :- Malaria, Dengue, Yellow fever etc.

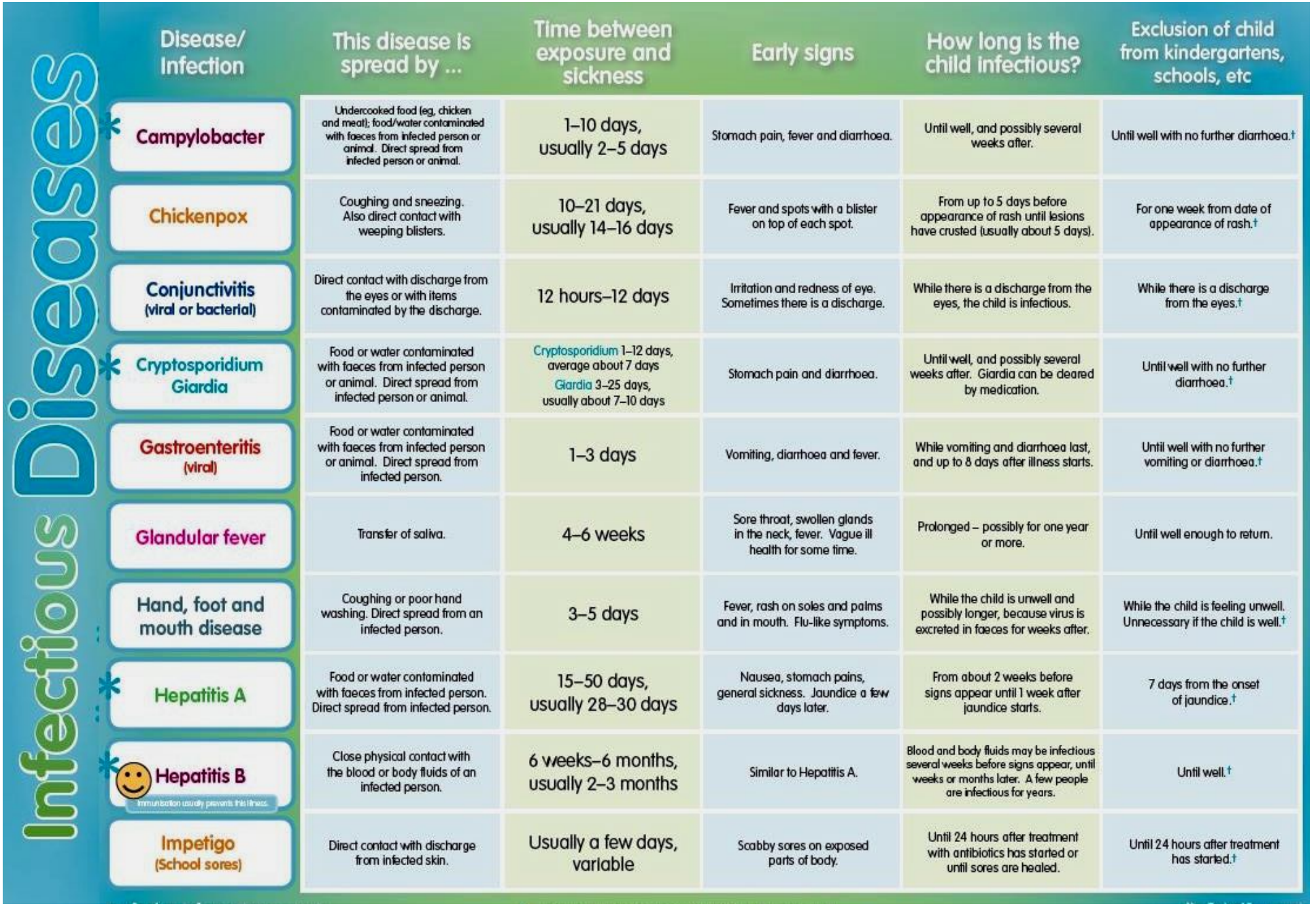
Flies :- Typhoid, Tuberculosis, Diarrhoea, Dysentry etc.

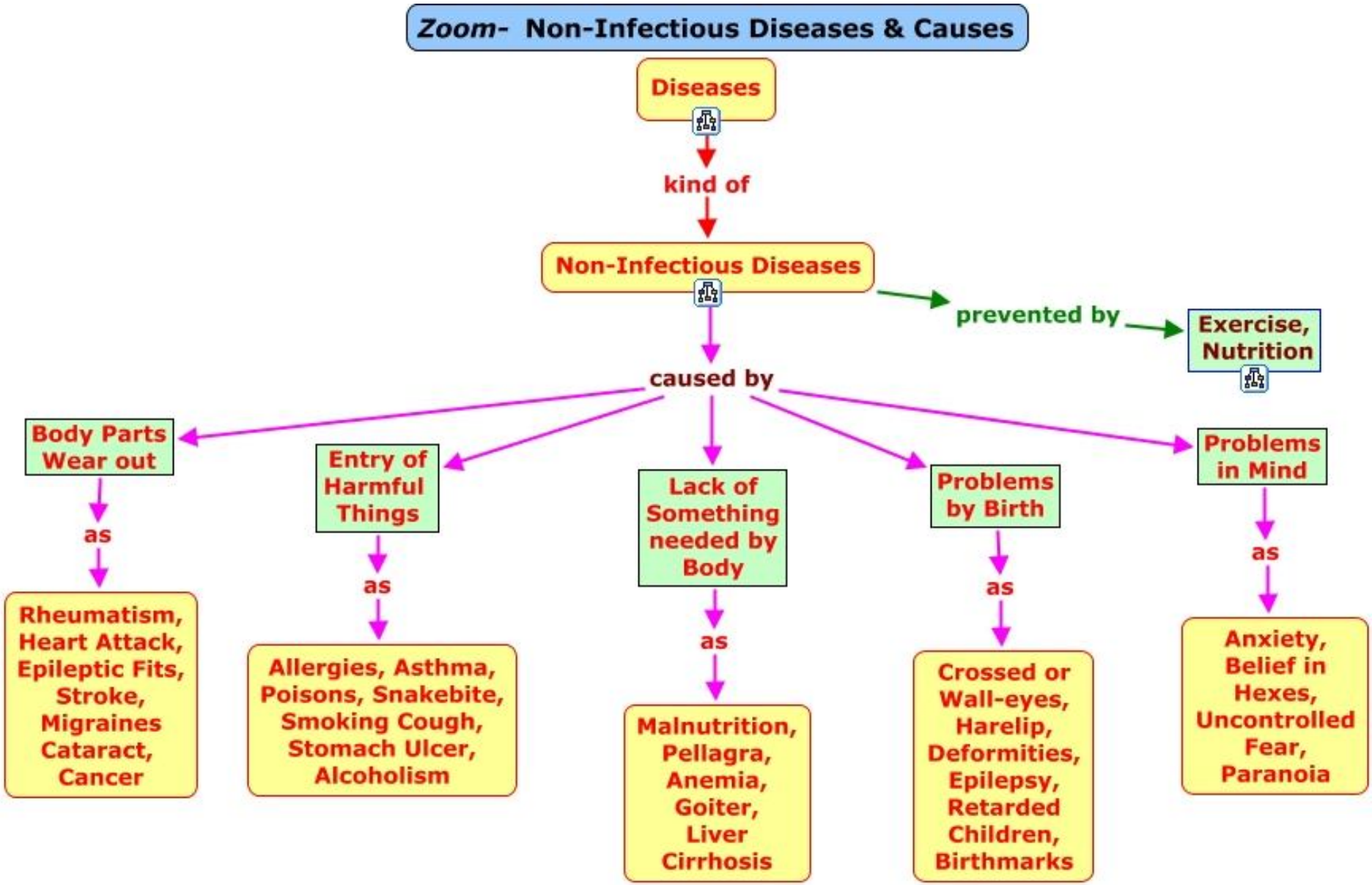
iv) Through sexual contact :- Syphilis, AIDS.

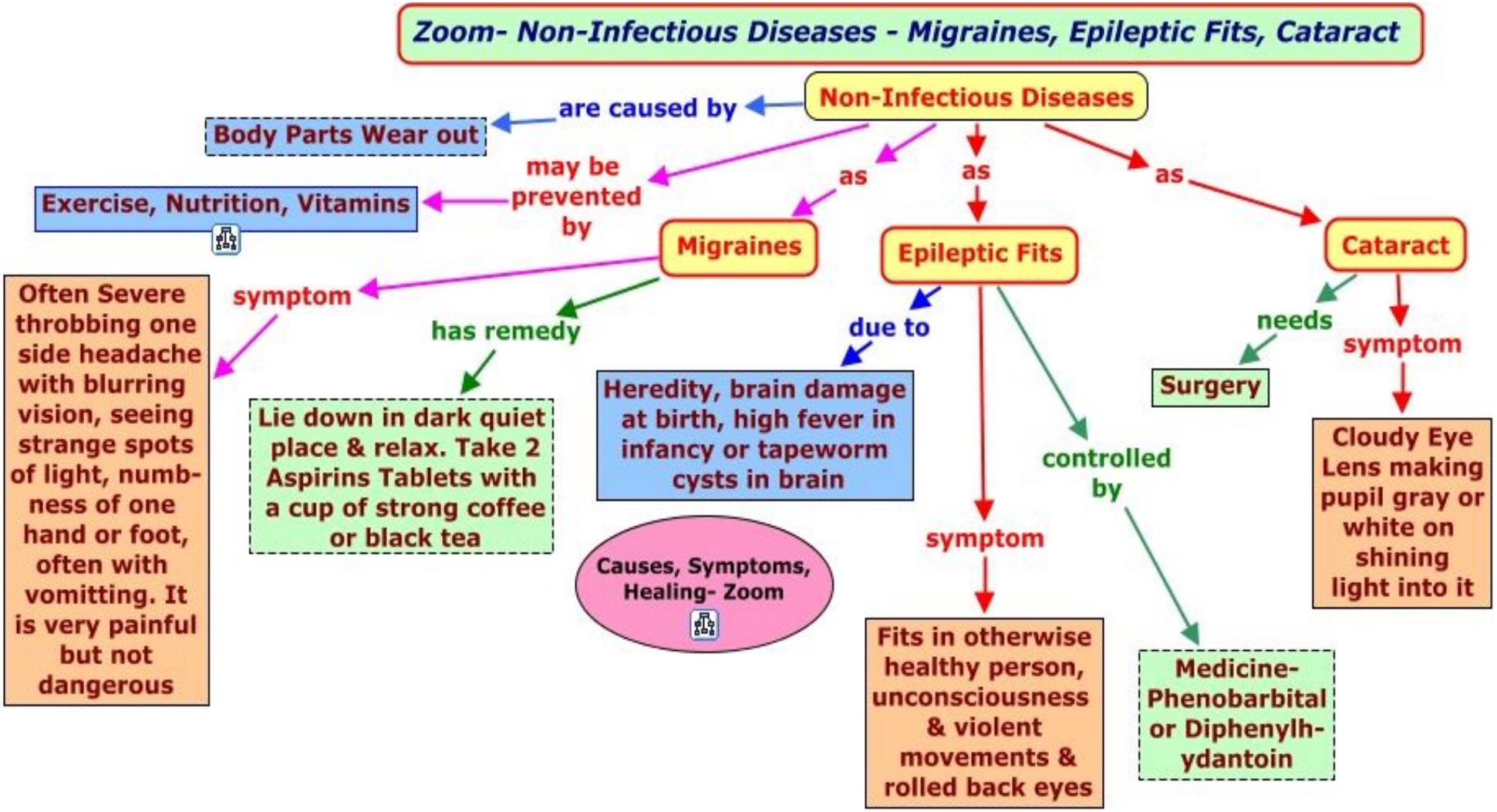
AIDS virus can also spread though blood transfusion and from the mother to her child during pregnancy and through breast feeding.

Infectious Diseases

Disease/ Infection	This disease is spread by …	Time between exposure and sickness	Early signs	How long is the child infectious?	Exclusion of child from kindergartens, schools, etc
Influenza	Coughing and sneezing and direct contact with respiratory droplets.	1–4 days	Sudden onset of fever with cough, sore throat, muscular aches and headache.	From 1 day before, up to 7 days after illness onset.	Restrict contact activities until well.†
* Measles (Immunisation usually prevents this illness.)	Coughing and sneezing. Also direct contact with the nose/throat secretions of an infected person.	7–18 days, usually 10 days to onset and 14 days to rash	Running nose and eyes, cough, fever and a rash.	From the first day of illness until 4 days after the rash begins.	At least 4 days from onset of rash.
* Meningitis (Meningococcal)	Close physical contact, such as kissing. Sleeping in the same room.	2–10 days, usually 3–4 days	Generally unwell, fever, headache, vomiting, sometimes a rash. **Urgent treatment is required!**	For 24 hours after antibiotics are started.	Until well enough to return.
* Mumps (Immunisation usually prevents this illness.)	Contact with infected saliva, eg, coughing, sneezing, kissing and sharing food and drink.	12–25 days, usually 16–18 days	Pain in jaw, then swelling in front of ear and fever.	For one week before swelling appears until 9 days after.	Until 9 days after swelling develops, or until child is well, whichever is sooner.
Ringworm	Contact with infected person's skin, clothes or personal items. Also through contaminated floors and shower stalls.	10–14 days	Flat spreading ring-shaped lesions.	While lesions are present, and while fungus persists on contaminated material.	Restrict contact activities, eg, gym and swimming, until lesions clear.
* Rubella (Immunisation usually prevents this illness.)	Coughing and sneezing. Also direct contact with the nose/ throat secretions of an infected person.	14–23 days, usually 16–18 days	Fever, swollen neck glands and a rash on the face, scalp and body. Rubella during early pregnancy can cause abnormalities in the baby.	From 7 days before rash starts until at least 4 days after it has appeared.	7 days from appearance of rash.
* Salmonella	Undercooked food (eg, chicken and meat); food/water contaminated with faeces from infected person or animal; direct spread from infected person or animal.	6–72 hours, usually 12–36 hours	Stomach pain, nausea, fever and diarrhoea.	Until well, and possibly weeks or months after.	Until well with no further diarrhoea.†
Scabies	Direct skin contact with the infected person, and sharing sheets and clothes.	Days–weeks	Itchy rash in places such as forearm, around waist, between fingers and buttocks and under armpits.	Until 24 hours after treatment is started.	24 hours after treatment is started.
Slapped cheek (Human parvovirus infection)	Coughing and sneezing. The virus may be passed from mother to child during pregnancy.	4–20 days	Red cheeks and lace-like rash on body.	For variable time up to appearance of rash.	Unnecessary unless child is unwell.
Streptococcal sore throat	Usually contact with the secretions of a strep sore throat. Sometimes through contaminated food.	1–3 days	Headache, vomiting, sore throat.	For 24 hours after antibiotics are started.	Until 24 hours after antibiotics started.
* Whooping cough (Pertussis) (Immunisation usually prevents this illness.)	Coughing. Adults and older children may pass on the infection to babies.	5–21 days, usually 7–10 days	Running nose, persistent cough followed by "whoop", vomiting or breathlessness.	From runny nose stage and for 3 weeks after onset of cough if not treated with antibiotics, or until 5 days of antibiotic treatment.	21 days from onset of coughing, or after 5 days of antibiotics.


Infectious Diseases
Disease/ Infection
This disease is spread by ...
Time between exposure and sickness
Early signs
How long is the child infectious?
Exclusion of child from kindergartens, schools, etc
* Campylobacter
Undercooked food (eg, chicken and meat); food/water contaminated with faeces from infected person or animal. Direct spread from infected person or animal.
1–10 days, usually 2–5 days
Stomach pain, fever and diarrhoea.
Until well, and possibly several weeks after.
Until well with no further diarrhoea.†
Chickenpox
Coughing and sneezing. Also direct contact with weeping blisters.
10–21 days, usually 14–16 days
Fever and spots with a blister on top of each spot.
From up to 5 days before appearance of rash until lesions have crusted (usually about 5 days).
For one week from date of appearance of rash.†
Conjunctivitis (viral or bacterial)
Direct contact with discharge from the eyes or with items contaminated by the discharge.
12 hours–12 days
Irritation and redness of eye. Sometimes there is a discharge.
While there is a discharge from the eyes, the child is infectious.
While there is a discharge from the eyes.†
* Cryptosporidium Giardia
Food or water contaminated with faeces from infected person or animal. Direct spread from infected person or animal.
Cryptosporidium 1–12 days, average about 7 days
Giardia 3–25 days, usually about 7–10 days
Stomach pain and diarrhoea.
Until well, and possibly several weeks after. Giardia can be cleared by medication.
Until well with no further diarrhoea.†
Gastroenteritis (viral)
Food or water contaminated with faeces from infected person or animal. Direct spread from infected person.
1–3 days
Vomiting, diarrhoea and fever.
While vomiting and diarrhoea last, and up to 8 days after illness starts.
Until well with no further vomiting or diarrhoea.†
Glandular fever
Transfer of saliva.
4–6 weeks
Sore throat, swollen glands in the neck, fever. Vague ill health for some time.
Prolonged – possibly for one year or more.
Until well enough to return.
Hand, foot and mouth disease
Coughing or poor hand washing. Direct spread from an infected person.
3–5 days
Fever, rash on soles and palms and in mouth. Flu-like symptoms.
While the child is unwell and possibly longer, because virus is excreted in faeces for weeks after.
While the child is feeling unwell. Unnecessary if the child is well.†
* Hepatitis A
Food or water contaminated with faeces from infected person. Direct spread from infected person.
15–50 days, usually 28–30 days
Nausea, stomach pains, general sickness. Jaundice a few days later.
From about 2 weeks before signs appear until 1 week after jaundice starts.
7 days from the onset of jaundice.†
* Hepatitis B
Immunisation usually prevents this illness.
Close physical contact with the blood or body fluids of an infected person.
6 weeks–6 months, usually 2–3 months
Similar to Hepatitis A.
Blood and body fluids may be infectious several weeks before signs appear, until weeks or months later. A few people are infectious for years.
Until well.†
Impetigo (School sores)
Direct contact with discharge from infected skin.
Usually a few days, variable
Scabby sores on exposed parts of body.
Until 24 hours after treatment with antibiotics has started or until sores are healed.
Until 24 hours after treatment has started.†


Zoom- Non-Infectious Diseases & Causes
Diseases
kind of
Non-Infectious Diseases
prevented by
Exercise, Nutrition
caused by
Body Parts Wear out
as
Rheumatism, Heart Attack, Epileptic Fits, Stroke, Migraines Cataract, Cancer
Entry of Harmful Things
as
Allergies, Asthma, Poisons, Snakebite, Smoking Cough, Stomach Ulcer, Alcoholism
Lack of Something needed by Body
as
Malnutrition, Pellagra, Anemia, Goiter, Liver Cirrhosis
Problems by Birth
as
Crossed or Wall-eyes, Harelip, Deformities, Epilepsy, Retarded Children, Birthmarks
Problems in Mind
as
Anxiety, Belief in Hexes, Uncontrolled Fear, Paranoia


Zoom- Non-Infectious Diseases - Migraines, Epileptic Fits, Cataract
Non-Infectious Diseases
are caused by
Body Parts Wear out
may be prevented by
Exercise, Nutrition, Vitamins
as
Migraines
as
Epileptic Fits
as
Cataract
symptom
Often Severe throbbing one side headache with blurring vision, seeing strange spots of light, numb-ness of one hand or foot, often with vomitting. It is very painful but not dangerous
has remedy
Lie down in dark quiet place & relax. Take 2 Aspirins Tablets with a cup of strong coffee or black tea
Causes, Symptoms, Healing- Zoom
due to
Heredity, brain damage at birth, high fever in infancy or tapeworm cysts in brain
symptom
Fits in otherwise healthy person, unconsciousness & violent movements & rolled back eyes
controlled by
Medicine- Phenobarbital or Diphenylh-ydantoin
needs
Surgery
symptom
Cloudy Eye Lens making pupil gray or white on shining light into it

INTEXT QUESTIONS PAGE NO. 178

Q1. State any two conditions essential for good health.
Answer:
Good health of a person depends on
(i) social environment.
(ii) public cleanliness.
(iii) good economic conditions and earnings.
(iv) social equality and harmony.

Q2. State any two conditions essential for being free of disease.
Answer:
The conditions essential for being free of diseases
(i) Taking good food (balanced diet)
(ii) Maintaining personal and public hygiene.

Q3. Are the answers to the above questions necessarily the same or different? Why?
Answer:
The answers are not same all the time. Because the meaning of health varies from person to person. For example, good health for a dancer may be being able to stretch his body into difficult but graceful positions. On the other hand, good health for a musician may mean having enough breathing capacity in his/her lungs to control his/her voice.
There is one similarity in both the cases. If the conditions essential for good health are maintained, then there are no chances of getting a disease.

INTEXT QUESTIONS PAGE NO. 180

Q1. List any three reasons why you would think that you are sick and ought to see a doctor. If only one of these symptoms were present, would you still go to the doctor? Why or why not?
Answer:
When there is a disease, its symptoms and signs appear. These symptoms may be headache, cough, loose-motions, wound with pus, etc. These symptoms indicate disease but do not tell what the disease is. So, it is advisable to go to the doctor to diagnose any signs of a disease on the basis of these symptoms. The doctor will get laboratory tests done, if required for the confirmation of a particular disease.

Q2. In which of the following case do you think the long-term effects on your health are likely to be most unpleasant?
If you get jaundice,
If you get lice,
If you get acne.
Why?
Answer:
Lice and acne will not cause long lasting effects on our body. But in case of jaundice, there will be severe long lasting effects. For example:
(i) High temperature, headache and joint pains.
(ii) Feeling of nausea and vomiting.
(iii) Initiating rashes.
The patient will suffer from poor health and will recover by taking complete bed rest for sometime.

INTEXT QUESTIONS PAGE NO. 187

Q1. Why are we normally advised to take bland and nourishing food when we are sick?
Answer:
In case of illness, the normal functions of the body get disturbed. So, a nourishing food is required which is easily digestable and contains all the nutrients. Therefore, bland and nourishing food is advised to take during sickness.

Q2. What are the different means by which infectious diseases are spread?
Answer:
Infectious diseases spread by different means. These are:
(i) **Through air** An infected person when sneezes or coughs releases droplets containing germs. These droplets infect another healthy person through air and microbes enter a new body. Examples of such diseases are common cold, pneumonia and tuberculosis.
(ii) **Through water** If the water source is polluted by the excreta of infectious persons having gut diseases and this water is used by other people they will be infected by diseases. For example, cholera, amoebiasis, hepatitis spread through water.
(iii) **Through sexual contact** Some diseases like AIDS and syphilis, etc., are transmitted by sexual contact. Other than this, AIDS virus also spread through blood, infected syringes, infected mother to her baby during pregnancy and through breast feeding.
(iv) **Through vectors** There are some animals which act as intermediaries or vectors for a particular diseases. The vectors carry diseases from infected person to the healthy person. For example, mosquito spread malaria causing organism in humans, while sucking their blood.

Q3. What precautions can you take in your school to reduce the incidence of infectious diseases?
Answer:
To prevent the incidence of infectious diseases in school following precautions can be taken:
(i) Avoid contact of students suffering from air borne diseases like common cold, cough, eye, flu, etc.
(ii) By checking the availability of clean drinking water in school.
(iii) Clean surroundings in school will not allow the growth and multiplication of vectors.
(iv) Starting childhood immunisation programme in schools.

Q4. What is immunisation?
Answer:
Immunisation is a process of administration (injecting) of vaccine into a healthy person in order to develop immunity against a disease. Immunity means the ability of a body to recognise, destroy and eliminate external disease causing agents. This immunisation through administering vaccine is called vaccination. Vaccine contains disease-causing organisms in a diluted or weakened form or in living or dead form. It prevents further infection by microbes from causing the disease. The diseases like small pox, rabies, diphtheria chicken pox, polio, hepatitis are controlled by vaccination. Small pox is eliminated from the world through a world wide vaccination programme.

Q5. What are the immunisation programmes available at nearest health centre in locality? Which of these diseases are the major health problems in your area?
Answer:
The following immunisation programme is available at the nearest health centre in our locality
(i) Immunisation for infants—DPT, BCG, polio, measles and MMR.
(ii) For children—Typhoid, TT, DT, small pox and TAB.
(iii) For pregnant woman— TT and hepatitis-B.

The diseases like typhoid, polio, measles, tetanus are the major health problems in our locality. To prevent these diseases, our government have initiated expanded immunisation programme all over the country.

EXERCISE QUESTIONS PAGE NO. 188

Q1. How many times did you fall ill in the last one years? What were the illnesses?
(a) Think of one change you could make in your habits in order to avoid any of/most of the above illnesses.
(b) Think of one change you would wish for in your surroundings in order to avoid any of/most of the above illnesses.
Answer: I fell ill twice in the last one year. The disease, I first suffered from was diarrhoea and secondary the dengue fever.
(a) The changes I brought in my habits after suffering from these disease to protect myself in near future are
(i) I will always drink clean, pure water and wash hands before eating anything.
(ii) I will live in clean surroundings where disease spreading vectors could not mulitply. For example, mosquitoes.
(b) Pure drinking water should be available always. The intake of impure water is the main cause of many infectious diseases.

Q2. A doctor/nurse/health-worker is exposed to more sick people than others in the community. Find out how she/he avoids getting sick herself/himself.
Answer: A doctor/nurse/health-worker take following precautions to avoid become sick themselves
(i) Wear masks while diagnosing mouth or chest infections.
(ii) Clean their hands and wear gloves even while doing minor surgeries.
(iii) Get immunisation done against all the infectious diseases.
(iv) Take balanced diet (rich in proteins especially) to strengthen their immune system.
(v) Dispose off blood samples, urine or stool, sputum, etc., carefully.

Q3. Conduct a survey in your neighbourhood to find out what the three most common diseases are. Suggest three steps that could be taken by your local authorities to bring down the incidence of these diseases.
Answer: I conducted a survey in my neighbourhood and found following three most common diseases.

Diseases	**Symptoms**	Steps could be Taken by Local Authorities to Bring Down the Incidence
Typhoid	Headache and fever which remains high in the second week and then declines	➢ Proper hygiene in surrounding areas of living. ➢ Safe disposal of excreta and other wastes. ➢ Providing TAB and typhoid oral vaccine.
Cholera	Painless watery diarrhoea, effortless vomiting	➢ Good sanitary condition in community. ➢ Provision of clean, purified drinking water. ➢ Providing standard cholera vaccination in the locality.
Dengue fever	High fever with headache, weakness and joint pains	➢ Maintenance of hygienic conditions in community . ➢ Preventing the mosquito breeding sites. ➢ Public awarness programme against mosquito borne diseases.

Q4. A baby is not able to tell her/his caretakers that she/he is sick. What would help us to find out (a) that the baby is sicks? (b) What is the sickness?

Answer:

(a) Symptoms to help in finding out that the baby is sick are:

(i) continuous crying

(ii) drooping of eyes

(iii) redness of eyes

(iv) high temperature of body.

(b) Signs which help to indicate the sickness in baby

(i) loose motions, stomach pain indicate diarrhoea.

(ii) high fever, headache, muscular pain, feeling of shivering and cold indicate malaria.

(iii) redness and persistent rubbing of eyes indicate eye flu.

(iv) pale skin, yellow urine, yellowing of eyes indicate jaundice.

(v) doctors suggest for laboratory tests, if there is fever with no other symptoms to find out the kind of sickness.

Q5. Under which of the following conditions is a person most likely to fall sick?

(a) When she is recovering from malaria.

(b) When she has recovered from malaria and is taking care of someone suffering from chicken pox.

(c) When she is on a four-day fast after recovering from malaria and is taking care of someone suffering from chicken pox. Why?

Answer:

In condition (c), a person is most likely to fall sick. The reasons are:

(a) Due to malaria, the body becomes weak and loss of body fluids occur. In this condition, it she takes four days fast, her recovery from malaria related weakness will not occur and she will become more weak.

(b) Her immune system is already weak due to malaria and if she takes care of someone suffering from chicken pox, there is high probability that she may also suffer this diseases.

Q6. Under which of the following conditions are you most likely to fall sick?

(a) When you are taking examinations.

(b) When you have travelled by bus and train for two days.

(c) When your friend is suffering from measles. Why?

Answer:

In condition (c), Charles of falling sick are maximum. Measles is an infectious viral disease of young children which spreads through nasal or throat discharge.In contact of a friend suffering from measles can cause you sick.

ASSIGNMENT QUESTIONS SET – 1
CHAPTER – 13
WHY DO WE FALL ILL

1. Which one of the following is an infectious disease?

(a) diptheria

(b) diabetes

(c) hypertension

(d) cancer

2. Elephantiasis disease can have

(a) short-term affect on our health

(b) no effect on our health

(c) long term affect on our health

(d) sometimes bad effect on our health

3. Ascaris worm lives in which part of human body?

(a) kidneys

(b) liver

(c) small intestine

(d) large intestine

4. Microbes which enter the body through nose most likely affect

(a) liver

(b) heart

(c) brain

(d) lungs

5. Which of the following is a viral infection?

(a) Dipteria

(b) Influenza

(c) Cholera

(d) Typhoid

6. HIV virus when active in body mainly attacks on

(a) lungs

(b) liver

(c) immunity

(d) nerves

7. An Organism which carries pathogens is termed as

(a) host

(b) vector

(c) parasite

(d) predator

8. Diseases which are always present in certain location are called?

(a) epidemic diseases

(b) endemic diseases

(c) acute diseases

(d) chronic diseases

9. DPT vaccines are administered to develop immunity against

(a) Tetanaus

(b) Diptheria

(c) Pertussis

(d) All of these

10. Anti-viral drugs are difficult to make because, viruses

(a) live outside the host cells

(b) live inside the host cells

(c) live in consumed food particles

(d) live in blood stream

11. BCG vaccine is used to develop immunity against

(a) jaundice

(b) polio

(c) influenza

(d) tuberculosis

12. Which of the following is a communicable disease?

(a) Rickets

(b) Scurvy

(c) Marasmus

(d) Cholera

13. The causative organism for malaria is a:

(a) bacteria

(b) protozoa

(c) virus

(d) fungi

14. Vaccination helps in controlling diseases because

(a) it develops resistance against the pathogen attack

(b) it kills the pathogens causing disease

(c) it blocks the food supplied to pathogens

(d) it does not allow pathogens to multiply in hosts

15. ORS is given in

(a) diarrhoea

(b) measeles

(c) typhoid

(d) tetanus

16. Which of the following is an example of nutritional deficiency disease?

(a) Hypertension

(b) Rickets

(c) Diabetes

(d) Gastroenteritis

17. Define Health? What do you interpret when we say a person is in good health?

18. State any two conditions essential for good health.

19. What are three dimensions of health? Are they interrelated?

20. Kidneys of a person do not filter urine properly. How does it affect physical, mental and social dimensions of that person?

21. State any two conditions essential for being free of disease.

22. Are the answers to the above questions (Q2 and Q5) and necessarily the same or different? Why?

23. What is a balanced diet?

24. A hefty boy of 12 years often picks fights with others. Do you think he is in good health? If so, then explain your answer.

25. How do you define 'disease'?

26. State and explain in brief the four major factors, which are the causes of disease.

27. Is there any difference between 'being healthy' and 'disease free'?

28. How do we identify a disease?

29. What is the difference between symptoms and signs of a disease?

30. List any three reasons why you would think that you are sick and ought to see a doctor. If only one of these symptoms were present, would you still go to the doctor? Why or why not?

31. Based on duration or persistence, how diseases are categorised?

32. Give examples of Acute diseases.

33. Give four examples of Chronic diseases.

34. Differentiate between Acute Diseases and Chronic Diseases.

35. What are congenital diseases? Give two examples of such disease.

36. Name a disease which was earlier considered to be chronic but now can be treated in short duration?

37. A baby is not able to tell her/his caretakers that she/he is sick. What would help us to find out (a) that the baby is sick? (b) what is the sickness?

38. What are acquired diseases?

39. Write few common signs and symptoms of a disease if brain is affected.

40. List any two differences between infectious and non-infectious diseases. Write any one example of each disease.

41. What are infectious agents? What are the different infectious agents?

42. What is 'germ theory of disease'? Who proposed it?

43. What are Koch's Postulates?

44. List the diseases caused by viruses?

45. Give three examples of bacterial diseases.

46. Give examples of fungal diseases.

47. List three diseases caused by protozoans.

48. Name the pathogen causes peptic ulcer.

49. List the diseases caused by worms?

50. Name the the protozoan pathogen that causes kala-azar.

51. Name the microbe which causes acne.

52. What is the scientific name of roundworm? Where do we find it commonly in human body? Name the disease caused by it.

53. Why is it important that we think of these categories of infectious agents?

54. How do antibiotics (say Penicillin) work on bacteria but not on human beings?

55. Define antibiotic? Explain how it is able to control bacterial infections but not viral infections.

56. Explain why antibiotics are more effective in curing bacterial diseases than viral diseases.

57. Why taking an antibiotic is not effective in the common cold?

58. Give two examples of bacterial antibiotics.

59. Give an example of fungal antibiotic.

60. Why are we normally advised to take bland and nourishing food when we are sick?

61. What are the different means by which infectious diseases are spread?

62. If a person has persistent cough and breathlessness, most likely which of the following organ is affected

63. What is the alternate name of brain fever? Which vector is responsible for this disease?

64. Name the vector which causes malaria.

65. Name the vector which causes dengue, chikengunia and yellow fever.

66. Name the vector that can cause sleeping sickness.

67. Name the diseases that can spread through housefly.

68. Name the vectors which can cause rabies.

69. A doctor/nurse/health-worker is exposed to more sick people than others in the community. Find out how she/he avoids getting sick herself/himself.

70. What precautions can you take in your school to reduce the incidence of infectious diseases?

71. What do you mean by immunity?

72. What is immunisation?

73. What is antigen?

74. What are antibodies?

75. What is colostrum? Why is mothers milk strongly advised to new borns?

76. What are the immunisation programmes available at the nearest health centre in your locality? Which of these diseases are the major health problems in your area?

77. What are epidemic and endemic diseases?

78. Which organ is affected if a person is suffering from jaundice?

79. What do you mean by Phagocytosis?

80. Why is it not necessary to give Hepatitis A vaccine to children?

81. What are the basic principles involved in medical treatment for diseases?

82. Why it is advisable to breast feed the baby for first few several weeks? Why Colostrum is good for infants?

83. How do Skin, Hairs, Saliva form the first line of defense against diseases?

ASSIGNMENT QUESTIONS SET – 2
CHAPTER – 13
WHY DO WE FALL ILL

1. What does the word health mean?

2. Name any two Symptoms of diseases……. (Cough& loose motions)

3. The disease which last for only a short period of time is called…….(Acute Disease)

4. State whether Tuberculosis is aChronic Disease or Acute Disease…… (Chronic Disease)

5. Mention the causal organism for Sleeping sickness …… (Trypanosoma)

6. Sleeping sickness is caused by……

7. Elephantiasis is caused by…….

8. Mention two Air born diseases1……..2…….

9. Mention two Sexually Transmitted Diseaes1……..2…….

10. Mention two Viral Diseaes1……..2…….

11. What is called vector. Give one example.

12. Give two examples of Chronic diseases.

13. Distinguish between Infectious and Non-infectious diseases.

14. Write a short notes on Small Pox.

15. What is immunity? Write short notes on it.

16. What is Vaccination? Give the details, how it works in human body.

17. Write three reasons for Cancers.

18. What are the basic five principles of treatment for diseases.

19. How Hygiene could help you to maintain good health and mention five situations to take care about health.

20. How does the health of an organism depend upon the surroundings?

21. What do we mean by “disease”?

22. What are symptoms?

23. How do you distinguish between acute and chronic diseases?

24. What are the various causes of diseases?

25. Name some common infectious diseases

26. Explain the effect of antibiotic penicillin on bacterial cells.

27. Why are human cells not affected by penicillin?

28. Why are antibiotics ineffective against viruses?

29. How do communicable or infectious diseases spread?

30. How does AIDS spread?

31. What are vectors? Name some vector transmitted diseases.

32. The disease-causing microbes enter the body through different means. Where do they go then?. Do all microbes go to the same tissue or organ, or do they go to different ones?

33. The signs and symptoms of a disease depend upon the tissue or organ targeted. Explain.

34. How does HIV damage our body?

35. How do we kill microbes?

36. What feature of our body protects us from catching infectious diseases?

37. Describe the principle behind vaccination.

38. Name some diseases for which vaccines are available.

39. Who were awarded nobel prize for discovery of treatment of peptic ulcer?

40. List some general principles of prevention.

41. State any two conditions essential for good health.

42. State any two conditions essential for being free of disease.

43. Are the answers to the above questions necessarily the same or different? Why?

44. List any three reasons why you would think that you are sick and ought to see a doctor. If only one of these symptoms were present, would you still go to the doctor? Why or why not?

45. In which of the following case do you think the long-term effects on your health are likely to be most unpleasant? a) if you get jaundice, b) if you get lice, c) if you get acne. Why?

46. Why we are normally advised to take bland and nourishing food when we are sick?

47. How are acute diseases different from chronic diseases?

48. What is the full form of AIDS? Name the causal organism.

49. State two conditions essential for keeping good health.

50. Define (a) health (b) disease.

51. Why are antibiotics not effective for viral disease?

52. Explain giving reasons –(a) Balanced diet is necessary for maintaining health body. (b) Health of an organism depends upon the surrounding environmental conditions.

53. Explain the Natural and acquired immunity?

54. What are the two ways to treat and infectious disease?

55. What do the sign and symptoms indicate if person is suffering from any disease? Based on the duration of diseases what are the difference between categories of diseases? Diffrentiate between them giving one example of each.

ASSIGNMENT QUESTIONS SET – 3
CHAPTER – 13
WHY DO WE FALL ILL

1. Which one of the following is not a viral disease?

(a) Dengue

(b) AIDS

(c) Typhoid

(d) Influenza

2. Which one of the following is not a bacterial disease?

(a) Cholera

(b) Tuberculosis

(c) Anthrax

(d) Influenza

3. Which one of the following disease is not transmitted by mosquito?

(a) Brain fever

(b) Malaria

(c) Typhoid

(d) Dengue

4. Which one of the following disease is caused by bacteria?

(a) Typhoid

(b) Anthrax

(c) Tuberculosis

(d) Malaria

5. Which one of the following diseases is caused by protozoans?

(a) Malaria (b) Influenza

(c) AIDS (d) Cholera

6. Which one of the following has a long term effect on the health of an individual?

(a) Common cold

(b) Chicken pox

(c) Chewing tobacco

(d) Stress

7. Which of the following can make you ill if you come in contact with an infected person?

(a) High blood pressure

(b) Genetic abnormalities

(c) Sneezing

(d) Blood cancer

8. AIDS cannot be transmitted by

(a) sexual contact

(b) hugs

(c) breast feeding

(d) blood transfusion

9. Making anti-viral drugs is more difficult than making anti-bacterial medicines because

(a) viruses make use of host machinery

(b) viruses are on the border line of living and non-living

(c) viruses have very few biochemical mechanisms of their own

(d) viruses have a protein coat

10. Which one of the following causes kala-azar?

(a) *Ascaris* (b) *Trypanosoma* (c) *Leishmania* (d) Bacteria

11. If you live in a overcrowded and poorly ventilated house, it is possible that you may suffer from which of the following diseases

(a) Cancer (b) AIDS (c) Air borne diseases (d) Cholera

12. Which disease is not transmitted by mosquitoes?

(a) Dengue (b) Malaria (c) Brain fever or encephalitis (d) Pneumonia

13. Which one of the following is not important for individual health?

(a) Living in clean space (b) Good economic condition

(c) Social equality and harmony (d) Living in a large and well furnished house

14. Choose the wrong statement

(a) High blood pressure is caused by excessive weight and lack of exercise.

(b) Cancers can be caused by genetic abnormalities

(c) Peptic ulcers are caused by eating acidic food

(d) Acne in not caused by staphylococci

15. We should not allow mosquitoes to breed in our surroundings because they

(a) multiply very fast and cause pollution

(b) are vectors for many diseases

(c) bite and cause skin diseases

(d) are not important insects

16. You are aware of Polio Eradication Programme in your city. Children are vaccinated because

(a) vaccination kills the polio causing microorganisms

(b) prevents the entry of polio causing organism

(c) it creates immunity in the body

(d) all the above

17. Viruses, which cause hepatitis, are transmitted through

(a) air (b) water (c) food (d) personal contact

18. Vectors can be defined as

(a) animals carry the infecting agents from sick person to another healthy person

(b) microorganisms which cause many diseases

(c) infected person

(d) diseased plants

19. Give two examples for each of the following

(a) Acute diseases (b) Chronic diseases

(c) Infectious diseases (d) Non-infectious diseases

20. Name two diseases caused by Protozoans. What are their causal organisms?

21. Which bacterium causes peptic ulcers? Who discovered the above pathogen for the first time?

22. What is an antibiotic? Give two examples

23. Fill in the blanks

(a) Pneumonia is an example of ——— disease.

(b) Many skin diseases are caused by———.

(c) Antibiotics commonly block biochemical pathways important for the growth of ———.

(d) Living organisms carrying the infecting agents from one person to another are called ———.

24. Name the target organs for the following diseases

(a) Hepatitis targets———.

(b) Fits or unconsciousness targets ———.

(c) Pneumonia targets ———.

(d) Fungal disease targets ———.

25. Who discovered ‘vaccine’ for the first time? Name two diseases which can be prevented by using vaccines.

26. Fill in the blanks

(a) ——— disease continues for many days and causes——— on body.

(b) ———disease continues for a few days and causes no longer term effect on body.

(c) ——— is defined as physical, mental and social well-being and comfort.

(d) Common cold is——— disease.

(e) Many skin diseases are caused by———.

27. Classify the following diseases as infectious or non-infectious.

(a) AIDS

(b) Tuberculosis

(c) Cholera

(d) High blood pressure

(e) Heart disease

(f) Pneumonia

(g) Cancer

28. Name any two groups of micro-organisms from which antibiotics could be extracted.

29. Name any three diseases transmitted through vectors.

30. Explain giving reasons

(a) Balanced diet is necessary for maintaining healthy body.

(b) Health of an organism depends upon the surrounding environmental conditions.

(c) Our surrounding area should be free of stagnant water.

(d) Social harmony and good economic conditions are necessary for good health.

31. What is a disease? How many types of diseases have you studied? Give examples.

32. What do you mean by disease symptoms? Explain giving two examples?

33. Why is immune system essential for our health?

34. What precautions will you take to justify "prevention is better than cure".

35. Why do some children fall ill more frequently than others living in the same locality?

36. Why are antibiotics not effective for viral disease?

37. Becoming exposed to or infected with an infectious microbe does not necessarily mean developing noticeable disease. Explain.

38. Give any four factors necessary for a healthy person.

39. Why is AIDS considered to be a 'Syndrome' and not a disease?