CLASS-XI

SUBJECT-PHYSICS

Chapter -2

Units and Measurement

INDEX

S. No.	CONTENT	P. No.
1	Gist of the Chapter and Formulae Used	3-7
2	Multiple Choice Questions	8-13
3	Assertion Reasoning Questions	14-15
4	Case Study Based Questions	16-19
5	Answer key	20

GIST OF THE CHAPTER AND FORMULAE USED

- Physical quantity
- Fundamental and derived units
    - S.I. units
    - Dimensions
- Application of Dimensional Analysis
    - Limitations of Dimensional Analysis
- Rounding off
- Significant Figures
- Order of Magnitude
- Errors of Measurement
- Propagation of Errors.

❖ PHYSICAL QUANTITY

A quantity which can be measured and expressed in form of law is called a physical quantity.

Physical quantity (Q) = Magnitude x units = n x u

Where

n= numerical value,

u= unit

As the unit (u) changes, magnitude (n) will also change but product 'nu' will remain same.

i.e. nu = constant, or $n_1u_1 = n_2u_2$

❖ S.I. system

It is known as international system of units. There are seven fundamental quantities in this system.

Base Quantity	Unit	Symbol
Length	meter	M
Mass	kilogram	Kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Amount of substance	mole	mol
Luminous intensity	candela	cd

- APPLICATION OF DIMENSIONAL ANALYSIS
  - To find the unit of a physical quantity in a given system of units.
  - To find dimensions of physical constant or coefficients
  - To convert a physical quantity from one system to the other system.
  - To check the dimensional correctness of a given physical relation. This is based on the 'principle of homogeneity'. According to this principle the dimensions of each term on both sides of an equation must be same.
  - To derive new relations.

- LIMITATIONS OF DIMENSIONAL AYALYSIS.
  - Subtraction and addition of parameters cannot be reflected in dimensional analysis.
  - Dimensional analysis cannot confirm the validity of a relationship of the physical quantities.
  - It is impractical for the correlation of more than three parameters.
  - The dimensional analysis cannot determine the nature of the unknown physical quantities.
  - Data obtained from a large number of experiments may be undetermined.

- SIGNIFICANT FIGURES

Every measurement results in a number that includes reliable digits and uncertain digits. Reliable digits plus the first uncertain digit are called **significant digits or significant figure eg**. These indicate the precision of measurement which depends on least count of measuring instrument.

- Rules for determining number of significant figures
  - All non-zero digits are significant.
  - All zeros between two non-zero digits are significant irrespective of decimal place.

- For a value less than 1, zeroes after decimal and before non-zero digits are not significant. Zero before decimal place in such a number is always insignificant.
- Trailing zeroes in a number without decimal place are insignificant.
- Trailing zeroes in a number with decimal place are significant.

❖ RULES FOR ROUNDING OFF THE UNCERTAIN DIGITS.

- Insignificant digit to be dropped is more than 5. Preceding digit is raised by 1.
- Insignificant digit to be dropped is less than 5. Preceding digit is left unchanged.
- Insignificant digit to be dropped is equal to 5. If preceding digit is even, it is left unchanged.
- Insignificant digit to be dropped is equal to 5. If preceding digit is odd, it is raised by 1.

❖ Rules for determining uncertainty in results of arithmetic calculations

To calculate the uncertainty, below process should be used.

- **Add a lowest amount of uncertainty in the original numbers**. Example uncertainty for 3.2 will be ± 0.1 and for 3.22 will be ± 0.01. Calculate these in percentage also.
- **After the calculations, the uncertainties get multiplied/divided/added/subtracted**.
- **Round off the decimal place in the uncertainty to get the final uncertainty result**.

Example, for a rectangle, if length l = 16.2 cm and breadth b = 10.1 cm

Then, take l = 16.2 ± 0.1 cm or 16.2 cm ± 0.6% and breadth = 10.1 ± 0.1 cm or 10.1 cm ± 1%.

On Multiplication, area = length x breadth = 163.62 cm^2 ± 1.6% or 163.62 ± 2.6 cm^2.
Therefore after rounding off, area = 164 ± 3 cm^2.
Hence 3 cm^2 is the uncertainty or the error in estimation.

❖ RULES

- For a set experimental data of ‘n’ significant figures, the result will be valid to ‘n’ significant figures or less (only in case of subtraction).
- The relative error of a value of number specified to significant figures depends not only on n but also on the number itself.
- Intermediate results in multi-step computation should be calculated to one more significant figure in every measurement than the number of digits in the least precise measurement.

❖ ERRORS OF MEASUREMENT

- **Absolute Error**: The magnitude of the difference between the true value of the quantity and the individual measurement value is called absolute error of the measurement. It is denoted by **$|\Delta a|$** (or Mod of Delta a). The mod value is always positive even if Δa is negative. The individual errors are:

$$\Delta a_1 = a_{mean} - a_1, \Delta a_2 = a_{mean} - a_2, \ldots\ldots ,\Delta a_n = a_{mean} - a_n$$

- **Mean absolute error** is the arithmetic mean of all absolute errors. It is represented by Δa_{mean}.

$$\Delta a_{\text{mean}} = (|\Delta a_1| + |\Delta a_2| + |\Delta a_3| + \ldots. + |\Delta a_n|) / n =$$

For single measurement, the value of 'a' is always in the range $a_{\text{mean}} \pm \Delta a_{\text{mean}}$

So, a = $a_{\text{mean}} \pm \Delta a_{\text{mean}}$ Or $a_{\text{mean}} - \Delta a_{\text{mean}} < a < a_{\text{mean}} + \Delta a_{\text{mean}}$

- **Relative Error**: It is the ratio of **mean absolute error** to the **mean value** of the quantity measured.

  Relative Error = $\Delta a_{\text{mean}} / a_{\text{mean}}$

- **Percentage Error:** It is the relative error expressed in percentage. It is denoted by δa.

$$\delta a = (\Delta a_{\text{mean}} / a_{\text{mean}}) \times 100\%$$

❖ COMBINATION OF ERRORS

- If a quantity depends on two or more other quantities, the combination of errors in the two quantities helps to determine and predict the errors in the resultant quantity. There are several procedures for this.
- Suppose two quantities A and B have values as $A \pm \Delta A$ and $B \pm \Delta B$. Z is the result and ΔZ is the error due to combination of A and B.

Criteria	**Sum or Difference**	**Product**	**Raised to Power**
Resultant value Z	$Z = A \pm B$	$Z = AB$	$Z = A^k$
Result with error	$Z \pm \Delta Z = (A \pm \Delta A) + (B \pm \Delta B)$	$Z \pm \Delta Z = (A \pm \Delta A)(B \pm \Delta B)$	$Z \pm \Delta Z = (A \pm \Delta A)^k$
Resultant error range	$\pm \Delta Z = \pm \Delta A \pm \Delta B$	$\Delta Z/Z = \Delta A/A \pm \Delta B/B$	
Maximum error	$\Delta Z = \Delta A + \Delta B$	$\Delta Z/Z = \Delta A/A + \Delta B/B$	$\Delta Z/Z = k(\Delta A/A)$
Error	Sum of absolute errors	Sum of relative errors	k times relative error

MULTIPLE CHOICE QUESTIONS

1. The base quantity among the following is

(1) Speed (2) Weight
(3) Length (4) Area

2. Which of the following is not a unit of time?

(1) Second (2) Minute
(3) Hour (4) Light year

3. One astronomical unit is a distance equal to

(1) 9.46×10^{15} m (2) 1.496×10^{11} m
(3) 3×10^{8} m (4) 3.08×10^{16} m

4. Ampere second is a unit of

(1) Current (2) Charge
(3) Energy (4) Power

5. The most precise reading of the mass of an object, among the following is

(1) 20 g (2) 20.0 g
(3) 20.01 g (4) 20×10^{0} g

6. The most accurate reading of the length of a 6.28 cm long fibre is

(1) 6 cm (2) 6.5 cm
(3) 5.99 cm (4) 6.0 cm

7. Which of the following is a unit that of force?

(1) N m (2) N
(3) N/m (4) N s

8. The number of significant figures in a pure number 410 is

(1) Two (2) Three
(3) One (4) Infinite

9. Thickness of a pencil measured by using a screw gauge (least count .001 cm) comes out to be 0.802 cm. The percentage error in the measurement is

(1) 0.125% (2) 2.43%
(3) 4.12% (4) 2.14%

10. The relative error in the measurement of the side of a cube is 0.027. The relative error in the measurement of its volume is

(1) 0.027 (2) 0.054 (3) 0.081 (4) 0.046

11. Zero error in an instrument introduces

(1) Systematic error
(2) Random error
(3) Least count error
(4) Personal error

12. A packet contains silver powder of mass 20.23 g ± 0.01 g. Some of the powder of mass 5.75 g ± 0.01 g is
taken out from it. The mass of the powder left back is

(1) 14.48 g ± 0.00 g
(2) 14.48 ± 0.02 g
(3) 14.5 g ± 0.1 g
(4) 14.5 g ± 0.2 g

13. The addition of three masses 1.6 g, 7.32 g and 4.238 g, addressed upto proper decimal places is

(1) 13.158 g
(2) 13.2 g
(3) 13.16 g
(4) 13.15 g

14. We can reduce random errors by

(1) Taking large number of observations
(2) Corrected zero error
(3) By following proper technique of experiment
(4) Both (1) & (3)

15. The number of significant figures in the measured value 0.0204 is

(1) Five
(2) Three
(3) Four
(4) Two

16. The number of significant figures in the measured value 26000 is

(1) Five
(2) Two
(3) Three
(4) Infinite

17. The number of significant zeroes present in the measured value 0.020040, is

(1) Five
(2) Two
(3) One
(4) Three

18. The number of significant figures in the measured value 4.700 m is the same as that in the value

(1) 4700 m
(2) 0.047 m
(3) 4070 m
(4) 470.0 m

19. If a calculated value 2.7465 g contains only three significant figures, the two insignificant digits in it are

(1) 2 and 7
(2) 7 and 4
(3) 6 and 5
(4) 4 and 6

20. Round off the value 2.845 to three significant figures.
(1) 2.85 (2) 2.84
(3) 2.80 (4) 2.83

21. A length 5.997 m rounded off to three significant figures is written as
(1) 6.00 m (2) 5.99 m
(3) 5.95 m (4) 5.90 m

22. The order of the magnitude of speed of light in SI unit is
(1) 16 (2) 8
(3) 4 (4) 7

23. The values of a number of quantities are used in a mathematical formula. The quantity that should be most precise and accurate in measurement is the one
(1) Having smallest magnitude (2) Having largest magnitude
(3) Used in the numerator (4) Used in the denominator

24. The dimensional formula for energy is
(1) [MLT–2] (2) [ML2T–2]
(3) [M–1L2T] (4) [M L2 T]

25. The pair of the quantities having same dimensions is
(1) Displacement, velocity (2) Time, frequency
(3) Wavelength, focal length (4) Force, acceleration

26. The uncertain digit in the measurement of a length reported as 41.68 cm is
(1) 4 (2) 1
(3) 6 (4) 8

27. We can reduce random errors by
(1) Taking large number of observations
(2) Corrected zero error
(3) By following proper technique of experiment
(4) Both (1) & (3)

28. The number of significant figures in the measured value 0.0204 is
(1) Five (2) Three
(3) Four (4) Two

29. The number of significant figures in the measured value 26000 is
(1) Five (2) Two
(3) Three (4) Infinite

30. The number of significant zeroes present in the measured value 0.020040, is
(1) Five (2) Two (3) One (4) Three

31. The number of significant figures in the measured value 4.700 m is the same as that in the value
(1) 4700 m
(2) 0.047 m
(3) 4070 m
(4) 470.0 m

32. If a calculated value 2.7465 g contains only three significant figures, the two insignificant digits in it are
(1) 2 and 7
(2) 7 and 4
(3) 6 and 5
(4) 4 and 6

33. A cube has a side of length 1.2×10^{-2}m. Calculate its volume.
(1) 1.7×10^{-6} m^3
(2) 1.73×10^{-6} m^3
(3) 1.70×10^{-6} m^3
(4) 1.732×10^{-6} m^3

34. In a screw gauge, the zero of main scale coincides with fifth division of circular scale in figure (i). The circular division of screw gauge are 50. It moves 0.5mm on main scale in one rotation. The diameter of the ball in figure (ii) is:
(1) 2.25 mm
(2) 2.20 mm
(3) 1.20 mm
(4) 1.25 mm

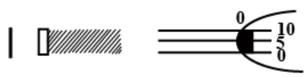

Figure (i)

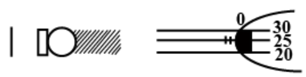

Figure (ii)

35. Which of the following is not a derived force?
(1) Tension in a string
(2) van der Waal forces
(3) Nuclear force between proton-proton
(4) Electrostatic force between proton-proton

36. Which one of the following does not experience strong nuclear force?
(1) Leptons
(2) Baryons
(3) Hadrons
(4) Proton

37. Which pair do not have equal dimensions?
(1) Energy and torque
(2) Force and impulse
(3) Angular momentum and Planck's constant
(4) Elastic modulus and pressure

38. The dimensions of Planck's constant equals to that of
(1) Energy
(2) Momentum
(3) Angular momentum
(4) Power

39. The unit of length, velocity and force are doubled. Which of the following is the correct change in the other units?

(1) Unit of time is doubled
(2) Unit of mass is doubled
(3) Unit of momentum is doubled
(4) Unit of energy is doubled

40. Even if a physical quantity depends upon three quantities, out of which two are dimensionally same, then the formula cannot be derived by the method of dimensions. This statement

(1) May be true
(2) May be false
(3) Must be true
(4) Must be false

41. Light year is a unit of

(1) time
(2) distance
(3) sunlight intensity
(4) mass

42. The dimensional formula for Planck's constant is

(1) [MLT]
(2) [ML2T-1]
(3) [M2L2T-1]
(4) [ML1T-1]

43. The surface tension of a liquid is 70 dyne/cm. In MKS system its value is?

(1) 70 N/m
(2) 7×10^{-2} N/m
(3) 7×10^{2} N/m
(4) 7×10^{3} N/m

44. The dimensions of Kinetic energy is same as that of

(1) Force
(2) Pressure
(3) Work
(4) Momentum

45. At 4° C, the density of water is equal to

(1) 10-3 kg m-3
(2) 10-2 kg m-3
(3) 10 kg m-3
(4) 103 kg m-3

46. One watt hour contains how many joules?

(1) 3.6×10^{8} J
(2) 3.6×10^{2} J
(3) 3.6×10^{3} J
(4) 10^{-3} J

47. Which of the following pairs has the same dimensions?

(1) Specific Heat and Latent Heat (2) Impulse and Momentum

(3) Surface Tension and Force (4) Moment of Inertia and Torque

48. The equation of state of some gases can be expressed as Vander wal equation i.e.

$(P + a/V^2)(V – b) = RT$

Where P is the pressure, V is the volume, T is the absolute temperature and a, b, R are constants. The dimensions of 'a' are:

(1) [M1L1T-1] (2) [M1L-5T1]

(3) [M2L5T-1] (4) [M1L5T-2]

49. Electron volt is a unit of

(1) Charge (2) Potential difference

(3) Energy (4) Magnetic Force

50. There are 20 divisions in 4 cm of the main scale. The vernier scale has 10 divisions. The least count of the instrument is

(1) 0.05 cm (2) 0.5 cm

(3) 5.0 cm (4) 0.005 cm

ASSERTION REASONING

Directions: These questions consist of two statements, each printed as Assertion and Reason. While answering these questions, you are required to choose any one of the following four responses.
(a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.
(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(c) If the Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

Q1 Assertion : When we change the unit of measurement of a quantity, its numerical value changes.
Reason : Smaller the unit of measurement smaller is its numerical value.

Q2 Assertion: Parallax method cannot be used for measuring distances of stars more than 100 light years away.
Reason: Because parallax angle reduces so much that it cannot be measured accurately.

Q3 Assertion: Number of significant figures in 0.005 is one and that in 0.500 is three.
Reason: This is because zeros are not significant.

Q4 Assertion: Out of three measurements l= 0.7m , l=0.70 m and l=0.700m is most accurate.
Reason: In every measurement, only the last significant digit is not accurately known.

Q5 Assertion: Nowadays a standard meter is defined in terms of wavelength of light.
Reason: light has no relation with length.

Q6 Assertion: In $y= A \sin(\omega t - kx)$, $(\omega t - kx)$ is dimensionless.
Reason: Because dimension of $\omega= [M^0L^0T]$.

Q7 Assertion: The Time Period of pendulum is given by $T= 2\pi\sqrt{l/g}$.
Reason: According to principle of homogeneity of dimensions, only that formula is correct in which dimensions of LHS is equal to dimensions of RHS.

Q8 Assertion: The graph between P and Q is straight line, when P/Q is constant.
Reason: The straight line graph means that P proportional to Q or P is equal to constant multiplied by Q.

Q9 Assertion: Radian is the unit of plane angle.
Reason: One radian is the angle subtended at the centre of circle by an arc equal in length to the radius of circle.

Q10 Assertion: A.U. is much bigger than A^o.
Reason: A.U. stands for astronomical unit and A^o stands for angstrom.

Q11 Assertion: Surface tension and surface energy have the same dimensions.
Reason: Because both have the same S.I. unit.

Q12 Assertion: In the relation f= 1/2l√T/m, where symbols have standard meaning, m represent linear mass density.
Reason: The frequency has the dimensions of inverse of time.

Q13 Assertion: The dimensions of a/b in the equation P= a-t^2/ bx , where P is pressure, x is distance and t is time, are MT^{-2}.
Reason: By Principle of homogeneity the dimensions of LHS is equal to dimensions of RHS.

Q14 Assertion: If radius of sphere is (5.3±0.1)cm. Then relative error in its volume will be 0.3/5.3
Reason: The formula for relative error in error in sum /difference of (a±b) is given by Δx/x= Δa/a ± Δb/b.

Q15 Assertion: The pressure on a square plate is measured by measuring the force on the plate and length of two sides of the plate. If the maximum error in the measurement of force and length are respectively 4% and 2%, The maximum error in the measurement of pressure is 6%.
Reason: The maximum percentage error is always algebraic some of two percentage errors.

Q16 Assertion: Light year and year, both measure time.
Reason: Because light year is the time that light takes to reach the earth from sun.

Q17 Assertion: The reliable digit plus the first uncertain digit are known as significant figures.
Reason: If 97.52 is divided by 2.54, the correct result in terms of significant figures is 38.4.

Q18 Assertion: Reynolds number and coefficient of friction have same dimensions.
Reason: Dimensional constants are the numbers having no dimensions.

Q19 Assertion: If L=2.331cm, B=2.1cm, then L+B=4.4 cm.
Reason: The least number of significant figures in any number of problem determines the number of significant figures in the answer of addition or subtraction.

Q20 Assertion: Accuracy of measurement is determined by percentage error.
Reason: The accuracy of measurement is also determined by the number of significant figures. Larger the number of significant figures, more accurate is the measurement.

CASE BASED QUESTIONS

QUES A: System of units: A system of units is a collection of units in which certain units are chosen as fundamental and all others are derived from them. This system is also called an absolute system of units. Some common systems in use are:

- **c.g.s system:** The unit of length is centimetre, mass is gram, time is secong.
- **m.k.s system:** The unit of length is metre, mass is kilogram, time is second.
- **f.p.s system:** The unit of length is foot, mass is pound, time is second.
- **S.I. system:** In 1960, 11th General Conference of Weights and Measures introduced SI system. It has 7 fundamental units (Unit of length is metre, mass is kilogram, Time is second, Temperature is Kelvin, Electric current is Ampere, Luminous intensity is Candela, Amount of substance is mol) and two supplementary units (Unit of plane angle is radian, solid angle is steradian)

A1: Which of the following is not the name of physical quantity?

(a) Kilogram (b) Density

(c) Impulse (d) Energy

A2: The weight of a body is 12g. This statement is not correct because

(a) The correct symbol for the unit of weight has not been used.

(b) The correct symbol for gram is gm.

(c) The weight should be expressed in kg.

(d) Of some reason other than those given above.

A3: If the unit of force and length are doubled, the unit of energy will be

(a) 1/2 times (b) 2 times

(c) 4 times (d) 1/4 times

A4: The density of a liquid is 13.6 g cm^{-3}. Its value ip S.I. is

(a) 13.6 kgm^{-3} (b) 136 kgm^{-3}

(c) 13600 kgm^{-3} (d) 1360 kgm^{-3}

A5: 1Kg-wt in gravitational units equals to

(a) 5.4 N in SI system (b) 4.5 N in SI system

(c) 9.8 N in SI system (d)8.9 N in SI system

Ques B: Dimensions: The dimensions of a physical quantity are the powers to which the base quantities are raised to represent that quantity and expressed by putting square brackets []. The Dimensional formula tells the fundamental factors on which unit depend. The dimensional equation have 3 important applications:

(i) To check the correctness of a physical equation.

(ii) To derive the relation between different physical quantities.

(iii) To change from one system of units to another.

Principle of homogeneity of dimensions states that dimensions of fundamental quantities on both sided of a physical relation must be same.

B1: Give that the displacement of a particle is given by $x = A^2 \sin^2 kt$, where t denotes the time. The unit of k is

(a) radian (b) metre

(c) hertz (d) second

B2: T he dimensional formula for angular momentum is same as that for:

(a) torque (b) Plank's constant

(c) gravitational constant (d) impulse

B3: Checking the correctness of physical equations using the methods of dimensions is based on

(a) Equality of frame of reference
(b) The type of system of units
(c) The method of measurement
(d) Principle of homogeneity of dimensions.

B4: Dimensions cannot be used to

(a) To check dimensional correctness of a formula.
(b) Convert units
(c) Find value of constant of proportionality in an equation.
(d) Deduce a relation among physical quantities.

B5: Two physical quantities whose dimensions are not same, cannot be:

(a) Multiplied with each other (b) Divided

(c) Added or subtracted in same expression (d) added

Ques C: The Van-der Waals equation is $(P + a/V^2)(V-b) = RT$

Where P is pressure, V is molar volume and T is the temperature of the given sample of gas. R is called molar gas constant, a and b are called Vander walls constants

Q.C1 The dimensional formula for b is same as that for

(A) P (B) V (C) PV^2 (D) RT

Q.C2 The dimensional formula for a is same as that for

(A) V^2 (B) P (C) PV^2 (D) RT

Q.C3Which of the following does not possess the same dimensional formula as that for RT?

(A) PV (B) Pb (C) a/V^2 (D) ab/V^2

Q.C4The dimensional formula for ab/RT is

(A) ML^5T^{-2} (B) $M^0L^3T^0$ (C) $ML^{-1}T^{-2}$ (D) $M^0L^6T^0$

Q.C5The dimensional formula of RT is same as that of

(A) Energy (B) Force (C) Specific heat (D) Latent heat

Ques D: Significant figures in the measured value of a physical quantity tell the number of digits in which we have confidence .Larger the number of significant figures obtained in a measurement , greater is the accuracy of measurement and vice – versa . In addition or subtraction, the number of decimal places in the result should equal the smallest number of decimal places in any term in the operation .

In multiplication and division, the number of significant figures in the product or in the quotient is the same as the smallest number of significant figures in any of the factors.

With the help of above comprehension, choose the most appropriate alternative for each of the following questions:

D1. The area enclosed by a circle of diameter 1.06 m with correct number of significant figures is

(a) $0.88m^2$ (c) $1.88m^2$

(b)$0.883m^2$ (d) $0.882026m^2$

D2. The circumference of the circle of diameter 1.06 m with correct number of significant figures is

(a) 3.33m (c) 3.3m

(b)3.33142m (d) 3m

D3. Subtract $2.6x\ 10^4$ from $3.9x\ 10^5$ with due regard to significant figures.

(a) $3.64x10^5$ (c) $3.6x10^5$

(b) $3.7x10^{5}$ (d) $3.65 \text{ x } 10^{6}$

D4. Add $3.8x\ 10^{-6}$ to $4.2 \text{ x } 10^{-5}$ with due regard to significant figures.

(a) $4.6\ \ x10^{-5}$ (c) $4.58x10^{-5}$

(b) $4.6x10^{-6}$ (d) $4.580 \text{ x } 10^{-5}$

D5. Two gold pieces each of mass 0.035g are placed in a box with gold piece is

(a) 2.3g (b) 2.4g

(c) 2.37g (d) 2.370g

ANSWERS OF MULTICHOICE QUESTIONS:

1. (3)	2. (4)	3. (2)	4. (2)	5. (3)	6. (4)	7. (2)	8. (1)	9. (1)	10. (3)
11. (1)	12. (2)	13. (2)	14. (1)	15. (2)	16. (2)	17. (4)	18. (4)	19. (3)	20. (2)
21. (1)	22. (2)	23. (1)	24. (2)	25. (3)	26. (4)	27. (1)	28. (2)	29. (2)	30. (4)
31. (4)	32. (3)	33. (1)	34. (3)	35. (4)	36. (1)	37. (2)	38. (3)	39. (3)	40. (3)
41. (2)	42. (2)	43. (2)	44. (3)	45. (4)	46. (3)	47. (2)	48. (4)	49. (3)	50. (4)

ANSWERS OF ASSERTION & REASONING

Ans1. C	Ans2. A	Ans3. C	Ans4. B	Ans5. C
Ans6. C	Ans7. B	Ans8. A	Ans9. B	Ans10. B
Ans11. C	Ans12. A	Ans13. B	Ans14. A	Ans15. D
Ans16. D	Ans17. B	Ans18. C	Ans19. B	Ans20. B

ANSWERS OF CASE BASED QUESTIONS

A1: (a),	A2: (a),	A3: (c),	A4: (a),	A5: (c)
B1: (c),	B2: (b),	B3: (d),	B4: (d),	B5: (c)
C1 (b),	C2 (c),	C3 (c),	C4 (d),	C5 (a)
D1.(b),	D2. (a),	D3. (c),	D4.(a),	D5. (b)