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C.U.Q

1. Water is used in car radiators as coolant because

1) its density is more 2) high specific heat
3) high thermal conductivity 4) free availability

2. Of the following specific heat is maximum for

1) Mercury 2) Copper 3) Water 4) Silver

3. Heat is

1) kinetic energy of molecules
2) potential and kinetic energy of molecules
3) energy in transits
4) work done on the system

4. Which of the following does not characterise the thermodynamic state of matter

1) Volume 2) Temperature
3) Pressure 4) Work

5. The thermal motion means

1) motion due to heat engine
2) disorderly motion of the body as a whole
3) motion of the body that generates heat
4) random motion of molecules

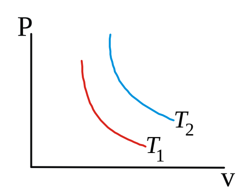
6. Heat required to rise the temperature of one gram of water through 1^0C is

1) 0.001 K cal 2) 0.01 K cal
3) 0.1 K cal 4) 1.0 K cal

7. Heat capacity of a substance is infinite. It means

1) heat is given out 2) heat is taken in
3) no change in temperature whether heat is taken in (or) given out
4) all of the above

8. For a certain mass of a gas Isothermal relation between 'P' and 'V' are shown by the graphs at two different temperatures T_1 and T_2 then



1) $T_1 = T_2$ 2) $T_1 > T_2$ 3) $T_1 < T_2$ 4) $T_1 \geq T_2$

9. Certain amount of heat supplied to an ideal gas under isothermal conditions will result in

1) rise in temperature
2) doing external work and a change in temperature
3) doing external work
4) an increase in the internal energy of the gas

10. The temperature range in the definition of standard calorie is

1) 14.5^0C to 15.5^0C 2) 15.5^0C to 16.5^0C
3) 1^0C to 2^0C 4) 13.5^0C to 14.5^0C

11. The pressure p of a gas is plotted against its absolute temperature T for two different constant volumes V_1 and V_2, where $V_1 > V_2$. If p is taken on y–axis and T on x–axis

1) the curve for V_1 has greater slope than the curve for V_2
2) the curve for V_2 has greater slope than the curve for V_1
3) the curves must intersect at some point other than $T = 0$
4) the curves have the same slope and do not intersect

12. $dU + dW = 0$ is valid for

1) adiabatic process 2) isothermal process
3) isobaric process 4) isochoric process

13. In a given process dW=0, dQ<0 then for a gas

1)temperature–increases 2)volume–decreases
3)pressure–decreases 4)pressure–increases

14. A piece of ice at 0^0C is dropped into water at 0^0C. Then ice will

1) melt 2) be converted into water
3) not melt 4) partially melt

15. The temperature determines the direction of net change of

1) gross kinetic energy
2) intermolecular kinetic energy
3) gross potential energy
4) intermolecular potential energy

16. The direction of flow of heat between two gases is determined by

1) average kinetic energy 2) total energy
3) internal energy 4) potential energy

17. Heat is absorbed by a body . But its temperature does not raised. Which of the following statement explains the phenomena ?

1) Only K.E. of vibration increases
2) Only P.E. of inter molecular force changes
3) No increase in internal energy takes place
4) Increase in K.E. is balanced by decrease in P.E.

18. Zeroth law of thermodynamics gives the concept of

1) pressure 2) volume 3) temperature 4) heat

19. We need mechanical equivalent of heat because

1) it converts work into heat
2) in C.G.S system, heat is not measured in the units of work
3) in SI system, heat is measured in the units of work
4) of some reason other than those mentioned above

20. When we switch on the fan in a closed room. The temperature of the air molecules

1) increases 2) decreases
3) remains unchanged
4) may increase or decrease depending on the speed of rotation of the fan.

21. Which type of molecular motion does contribute towards internal energy for an ideal monoatomic gas

1) translational 2) rotational
3) vibrational 4) all the above

22. In which of the following processes the internal energy of the system remains constant ?

1) Adiabatic 2) Isochoric
3) Isobaric 4) Isothermal

23. The internal energy of a perfect monoatomic gas is

1) complete kinetic
2) complete potential
3) sum of potential and kinetic energy of the molecules
4) difference of kinetic and potential energies of the molecules

24. Which of the following is constant in an isochoric process ?

1) Pressure 2) Volume
3) Temperature 4) Mass

25. How does the internal energy change when the ice and wax melt at their normal melting points?

1) Increases for ice and decreases for wax
2) Decreases for ice and increases for wax
3) Decreases both for ice and wax
4) Increases both for ice and wax

26. In the free expansion of a gas, its internal energy

1) remains constant
2) increases
3) decreases
4) sometimes increases , sometimes decreases

27. The internal energy of an ideal gas depends upon

1) only its pressure
2) only its volume
3) only its temperature
4) its pressure and volume

28. On compressing a gas suddenly, its temperature

1) increases 2) decreases
3) remains constant 4) all the above

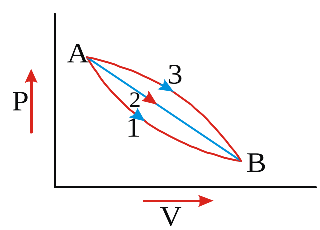
29. When heat is added to a system at constant temperature, which of the following is possible.

1) Internal energy of system increases
2) Work is done by the system
3) Neither internal energy increases nor work done by the system
4) Internal energy increases and work is done by the system

30. The first law of thermodynamics is based on the law of conservation of

1) energy 2) mass 3) momentum 4) pressure

31. A given mass of a gas expands from the state A to the state B by three paths 1,2 and 3 as shown in the figure. If W_1, W_2 and W_3 respectively be the work done by the gas along the three paths then



1) $W_1 > W_2 > W_3$ 2) $W_1 < W_2 < W_3$
3) $W_1 = W_2 = W_3$ 4) $W_1 < W_2 = W_3$

32. A given system undergoes a change in which the work done by the system equals to the decrease in its internal energy. The system must have undergone an

1) isothermal change 2) adiabatic change
3) isobaric change 4) isochoric change

33. A closed vessel contains some gas at a given temperature and pressure. If the vessel is given a very high velocity, then the temperature of the gas

1) increases 2) decreases
3) may increase or decrease depending upon the nature of the gas
4) does not change

34. Unit mass of liquid of volume V_1 completely turns into a gas of volume V_2 at constant atmospheric pressure P and temperature T. The latent heat of vaporization is "L". Then the change in internal energy of the gas is

1) L 2) $L+P(V_2 - V_1)$
3) $L - P(V_2-V_1)$ 4) Zero

35. In an isobaric (constant pressure) process. the correct ratio is

1) $\Delta Q : \Delta U = 1 : 1$ 2) $\Delta Q : \Delta U = 1 : \gamma-1$
3) $\Delta Q : \Delta U = \gamma-1 : 1$ 4) $\Delta Q : \Delta U = \gamma : 1$

36. In an isobaric process, the correct ratio is

1) $\Delta Q : \Delta W = 1 : 1$ 2) $\Delta Q : \Delta W = \gamma : \gamma-1$
3) $\Delta Q : \Delta W = \gamma-1 : \gamma$ 4) $\Delta Q : \Delta W = \gamma : 1$

37. Air in a thermally conducting cylinder is suddenly compressed by a piston, which is then maintained at the same position with the passage of time ?

1) The pressure decreases
2) The pressure increases
3) The pressure remains the same
4) The pressure may increase or decrease depending upon the nature of the gas

38. Which of the following states of matter have two specific heats ?

1) Solid 2) Gas 3) Liquid 4) Plasma

39. The specific heat of a gas in an isothermal process is

1) infinity 2) zero
3) negative 4) remains constant

40. Why the specific heat at a constant pressure is more than that at constant volume ?

1) There is greater inter molecular attraction at constant pressure
2) At constant pressure molecular oscillations are more violent
3) External work need to be done for allowing expansion of gas at constant pressure
4) Due to more reasons other than those mentioned in the above

41. The ratio C_p / C_v of the specific heats at a constant pressure and at a constant volume of any perfect gas

1) can't be greater than 5/4
2) can't be greater than 3/2
3) can't be greater than 5/3
4) can have any value

42. Which of the following formula is wrong ?

1) $C_v = \dfrac{R}{g-1}$ 2) $\dfrac{C_p}{C_V} = g$

3) $C_p = \dfrac{gR}{g-1}$ 4) $C_p - C_v = 2R$

43. **Two identical samples of gases are allowed to expand to the same final volume (i) isothermally (ii) adiabatically. Work done is**
1. more in the isothermal process
2. more in the adiabatic process
3. equivalent in both processes
4. equal in all processes

44. **Which of the following is true in the case of a reversible process ?**
1) There will be energy loss due to friction
2) System and surroundings will not be in thermo dynamic equilibrium
3) Both system and surroundings retains their initial states
4) 1 and 3

45. **The ratio of the relative rise in pressure for adiabatic compression to that for isothermal compression is**
1) g 2) $\frac{1}{g}$ 3) $1-g$ 4) $\frac{1}{1-g}$

46. **Ratio of isothermal elasticity of gas to the adiabatic elasticity is**
1) g 2) $\frac{1}{g}$ 3) $1-g$ 4) $\frac{1}{1-g}$

47. **The conversion of water into ice is an**
1) isothermal process 2) isochoric process
3) isobaric process 4) entropy process

48. **For the Boyle's law to hold good, the necessary condition is**
1) Isobaric 2) Isothermal
3) Isochoric 4) Adiabatic

49. **An isothermal process is a**
1)slow process 2)quick process
3) very quick process 4) both 1 & 2

50. **Two samples of gas A and B, initially at same temperature and pressure, are compressed to half of their initial volume, 'A' isothermally and 'B' adiabatically. The final pressure in**
1) A and B will be same
2) A will be more than in B
3) A will be less than in B
4)A will be double that in B

51. **In which of the following processes all three thermodynamic variables, that is pressure volume and temperature can change**
1) Isobaric 2) Isothermal
3) Isochoric 4) Adiabatic

52. **During adiabatic expansion the increase in volume is associated with**
1) increase in pressure and temperature
2) decrease in pressure and temperature
3) increase in pressure and decrease in temperature
4)Decrese in pressure and increase in temperature

53. **A gas is being compressed adiabatically. The specific heat of the gas during compression is**
1) zero 2) infinite
3) finite but non zero 4) undefined

54. **The gas law $\left[\frac{PV}{T}\right]$ = constant is true for**
1) isothermal change only
2) adiabatic change only
3) Both isothermal & adiabatic changes
4) neither isothermal nor adiabatic change

55. **During adiabatic compression of a gas, its temperature**
1) falls 2) raises
3) remains constant 4) becomes zero

56. **The work done on the system in an adiabatic compression depends on**
1) the increase in internal energy of the system
2) the decrease in internal energy
3) the change in volume of the system
4) all the above

57. **The ratio of slopes of adiabatic and isothermal curves is**
1) g 2) $\frac{1}{g}$ 3) g^2 4) g^3

58. **Two steam engines 'A' and 'B', have their sources respectively at 700 K and 650 K and their sinks at 350 K and 300K. Then**
1) 'A' is more efficient than 'B'
2) 'B' is more efficient than 'A'
3) both A and B are equally efficient
4) depends on fuels used in A and B

59. **If the temperature of the sink is decreased, then the efficiency of heat engine**
1) first increases then decreases
2) increases
3) decreases
4) remains unchanged

60. **An ideal heat engine can be 100% efficient if its sink is at**
1) 0K 2) 273K 3) 0^0C 4) 0^0F

61. **If the temperature of a source increases, then the efficiency of a heat engine**
1) increases 2) decreases
3) remains unchanged 4) none of these

62. **When heat is added to a system then the following is not possible?**
1) Internal energy of the system increases
2) Work is done by the system
3) Neither internal energy increases nor work is done by the system
4) Internal energy increases and also work is done by the system

63. **A sink, that is the system where heat is rejected, is essential for the conversion of heat into work. From which law the above inference follows?**
1) Zeroth 2) First 3) Second 4)Both 1 & 2

64. **The efficiency of a heat engine**
1) is independent of the temperature of the source and the sink
2) is independent of the working substance
3) can be 100%
4) is not affected by the thermal capacity of the source or the sink

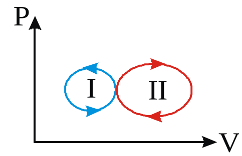
65. **An ideal heat engine working between temperatures T_H and T_L has efficiency h. If both the temperatures are rised by 100K each, then the new efficiency of the heat engine will be**
1) equal to h
2) greater than h
3) less than h
4) greater or less than h depending upon the nature of the working substance

66. **The efficiency of the reversible heat engine is h_r, and that of irreversible heat engine is h_I. Which of the following relation is correct?**
1) $h_r > h_I$ 2) $h_r < h_I$
3) $h_r \geq h_I$ 4) $h_r > 1$ and $h_I < 1$

67. **In a heat engine, the temperature of the working substance at the end of the cycle is**
1) equal to that at the beginning
2) more than that at the beginning
3) less than that at the beginning
4) determined by the amount of heat rejected to the sink

68. **The adiabatic and isothermal elasticities B_f and B_q are related as**
1) $\frac{B_f}{B_q} = g$ 2) $\frac{B_q}{B_f} = g$ 3) $B_f - B_q = g$ 4) $B_q - B_f = g$

69. **For the indicator diagram given below, select wrong statement ?**



1) Cycle - II is heat engine cycle
2) Net work is done on the gas in cycle - I
3) Workdone is positive for cycle - I
4) Workdone is positive for cycle - II

70. **By opening the door of a refrigerator inside a closed room**
1) you can cool the room to a certain degree
2) you can cool it to the temperature inside the refrigerator
3) you can ultimately warm the room slightly
4) you can neither cool nor warm the room

71. **Which of the following will extinguish the fire quickly ?**
1) Water at 100^{0}C 2) Steam at 100^{0}C
3) Water at 0^{0}C 4) Ice at 0^{0}C

72. **Which of the following is true in the case of molecules, when ice melts ?**
1) K.E is gained 2) K.E. is lost
3) P.E is gained 4) P.E. is lost

73. **When two blocks of ice are pressed against each other then they stick together because**
1) cooling is produced
2) heat is produced
3) increase in pressure will increase in melting point
4) increase in pressure will decrease in melting point

74. **A cubical box containing a gas with internal energy U is given velocity V, then the new internal energy of the gas**
1) less than U 2)more than U 3) U 4) zero

75. **A cubical box containing a gas is moving with some velocity. If it is suddenly stopped, then the internal energy of the gas**
1) decreases
2) Increases
3) remains constant
4) may increases or decreases depending on the time interval during which box comes to rest.

76. Which one of the following is wrong statement.

1) During free expansion, temperature of ideal gas does not change.

2) During free expansion, temperature of real gas decreases.

3) During free expansion of real gas temperature does not change.

4) Free expansion is conducted in adiabatic manner.

77. A common salt is first dissolved in water and extracted again from the water. In this process,

1) entropy decreases

2) entropy increases

3) entropy becomes zero

4) entropy remains constant.

78. A large block of ice is placed on a table where the surroundings are at 0^0C, then

1) ice melts at the sides

2) ice melts at the top

3) ice melts at the bottom

4) ice does not melt at all

79. Which of the following substance at 100^0C produces most severe burns ?

1) Hot air 2) Water 3) Steam 4) Oil

80. What energy transformation takes place when ice is converted into water

1) Heat energy to kinetic energy

2) Kinetic energy to heat energy

3) Heat energy to latent heat

4) Heat energy to potential energy

81. Which of the following laws of thermodynamics leads to the interference that it is difficult to convert whole of heat into work ?

1) Zeroth 2) Second 3) First 4) Both 1 & 2

82. Starting with the same initial conditions, an ideal gas expands from volume V_1 to V_2. The amount of work done by the gas is greatest when the expansion is

1) isothermal 2) isobaric

3) adiabatic 4) equal in all cases

83. The second law of thermodynamics implies

1) whole of heat can be converted into mechanical energy

2) no heat engine can be 100% efficient

3) every heat engine has an efficiency of 100%

4) a refrigerator can reduce the temperature to absolute zero

84. In the adiabatic compression the decrease in volume is associated with

1)increase in temperature and decrease in pressure

2) decrease in temperature and increase in pressure

3) decrease in temperature and decrease in pressure

4) increase in temperature and increase in pressure

85. Which of the following is true in the case of an adiabatic process where $g = C_P / C_V$?

1) $P^{1-g}T^{g} =$ constant 2) $P^{g}T^{1-g} =$ constant

3) $PT^{g} =$ constant 4) $P^{g}T =$ constant

86. If an ideal gas is isothermally expanded its internal energy will

1) increase 2) decrease

3) remains same

4) decrease or increase depending on nature of the gas

87. For an adiabatic process the relation between V and T is given by

1) $TV^{g} =$ constant 2) $T^{g}V =$ constant

3) $TV^{1-g} =$ constant 4) $TV^{g-1} =$ constant

88. The temperature of the system decreases in the process of

1) free expansion

2) adiabatic expansion

3) isothermal expansion

4) isothermal compression

89. Heat engine rejects some heat to the sink. This heat

1)converts into electrical energy.

2)converts into light energy.

3)converts into electromagnetic energy

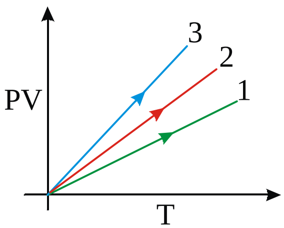
4)is unavailable in the universe.

90. For an adiabatic change in a gas, if P, V,T denotes pressure, volume and absolute temperature of a gas at any time and g is the ratio of specific heats of the gas, then which of the following equation is true?

1) $T^{?}P^{1-?} =$ const. 2) $T^{1-?}P^{?} =$ const.

3) $T^{?-1}V^{?} =$ const. 4) $T^{?}V^{?} =$ const.

91. PV versus T graph of equal masses of H_2, He and CO_2 is shown in figure. Choose the correct alternative ?



(1) 3 corresponds to H_2, 2 to He and 1 to CO_2
(2) 1 corresponds to He, 2 to H_2 and 3 to CO_2
(3) 1 corresponds to He, 3 to H_2 and 2 to CO_2
(4) 1 corresponds to CO_2,2 to H_2 and 3 to He

92. If the ratio of specific heats of a gas at constant pressure to that at constant volume is g , then the change in internal energy of the mass of gas, when the volume changes from V to 2V at constant pressure P, is

1) $R/(g-1)$ 2) PV
3) $PV/(g-1)$ 4) $g\,PV/(g-1)$

93. Heat is added to an ideal gas and the gas expands. In such a process the temperature

1) must always increase
2) will remain the same if the work done is equal to the heat added
3) must always decrease
4) will remain the same if change in internal energy is equal to the heat added

94. First law of thermodynamics states that

1) system can do work
2) system has temperature
3) system has pressure
4) heat is form of energy

95. The material that has largest specific heat is

1) mercury 2) water
3) hydrogen 4) diamond

96. The law obeyed by isothermal process is

1) Gay-Lussac's law 2) Charles law
3) Boyle's law 4) Dalton's law

97. Which law defines entropy in thermodynamics

1) zeroth law 2) First law
3) second law 4) Stefan's law

98. For the conversion of liquid into a solid

1) orderliness decreases and entropy decreases
2) orderliness increases and entropy increases
3) both are not related
4) orderliness increases and entropy decreases

99. Among the following the irreversible process is

1) free expansion of a gas
2)extension or compression of a spring very slowly
3)motion of an object on a perfectly frictionless surface
4) all of them

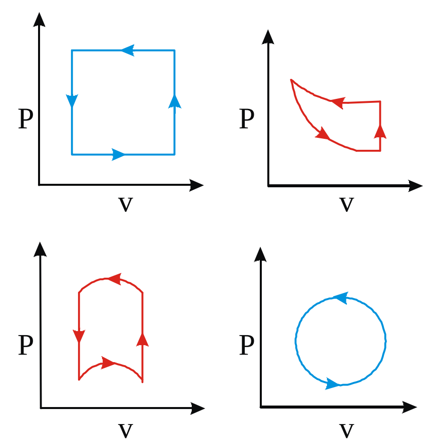
100. Which of the following processes are nearly reversible ?

a. Heat conduction b. Electrolysis
c. Diffusion d. Change of state
1) Only a 2)Both b and d
3) Only c 4) All of the above

101. Gas is taken through a cyclic process completely once. Change in the internal energy of the gas is

1) infinity 2) zero 3) small 4) large

102. What will be the nature of change in internal energy in case of processes shown below ?



1) + ve in all cases
2) – ve in all cases
3) – ve in 1 and 3 and + ve in 2 and 4
4) zero in all cases

103. Which of the following is incorrect regarding the first law of thermodynamics ?

1) It introduces the concept of internal energy
2) It introduces the concept of entropy
3) It is applicable to any process
4) It is a restatement of principle of conservation of energy.

104. The temperature of the system decreases in the process of

1) free expansion
2) isothermal expansion
3) adiabatic expansion
4) isothermal compression

105. In a process the pressure P and volume V of an ideal gas both increase

1) It is not possible to have such a process
2) The workdone by the system is positive
3) The temperature of the system increases
4) 2 and 3

106. The heat capacity of material depends upon

1) the structure of a matter
2) temperature of matter
3) density of matter
4) specific heat of matter

107. Heat cannot flow by itself from a body at lower temperature to a body at higher temperature is a statement or consequence of

1) Ist law of thermodynamics
2) IInd law of thermodynamics
3) conservation of momentum
4) conservation of mass

108. For an isothermal process

1) $dQ = dW$ 2) $dQ = dU$
3) $dW = dU$ 4) $dQ = dU + dW$

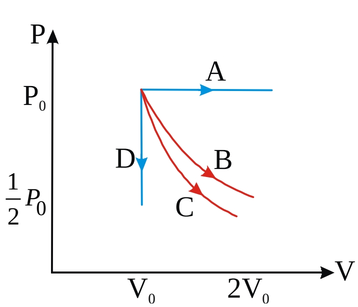
109. When thermodynamic system returns to its original state, which of the following is NOT possible?

1) The work done is Zero
2) The work done is positive
3) The work done is negative
4) The work done is independent of the path followed

110. A liquid in a thermos flask is vigorously shaken. Then the temperature of the liquid

1) is not altered 2) increases
3) decreases 4) none

111. The PV diagram shows four different possible paths of a reversible processes performed on a monoatomic ideal gas. Path A is isobaric, path B is isothermal, path C is adiabatic and path D is isochoric . For which process does the temperature of the gas decrease?



(1) Process A only (2) Process C only
(3) Processes C & D (4) Processes B, C & D

112. Two completely identical samples of the same ideal gas are in equal volume containers with the same pressure and temperature in containers labeled A and B. The gas in container A performs non-zero positive work W on the surroundings during an isobaric process before the pressure is reduced isochorically to 1/2 of its initial amount. The gas in container B has its pressure reduced isochorically to 1/2 of its initial value and then the gas performs same non-zero positive work W on the surroundings during an isobaric process. After the processes are performed on the gases in containers A and B, which is at the higher temperature?

1) The gas in container A
2) The gas in container B
3) The gases have equal temperature.
4) The value of the work W is necessary to answer this question.

113. Which of the following conditions of the Carnot ideal heat engine can be realised in practice?

1) Infinite thermal capacity of the source
2) Infinite thermal capacity of the sink
3) Perfectly non conducting stand
4) Less than 100% efficiency

114. A heat engine works between a source and a sink maintained at constant temperatures T_1 and T_2. For the efficiency to be greatest

1) T_1 and T_2 should be high
2) T_1 and T_2 should be low
3) T_1 should be high and T_2 should be low
4) T_1 should be low and T_2 should be high

115. The heat engine would operate by taking heat at a particular temperature and

1) converting it all into work
2) converting some of it into work and rejecting the rest at lower temperature
3) converting some of it into work and rejecting the rest at same temperature
4) converting some of it into work and rejecting the rest at a higher temperature .

C.U.Q - KEY

1) 2	2) 3	3) 3	4) 4	5) 4	6) 1
7) 3	8) 3	9) 3	10)1	11)2	12)1
13)3	14) 3	15)2	16)1	17)2	18)3
19)2	20)1	21)1	22)4	23)1	24)2
25)1	26)1	27)3	28)1	29)2	30)1
31)2	32)2	33)4	34)3	35)4	36)2
37)1	38)2	39)1	40)3	41)3	42)4
43)1	44)3	45)1	46)2	47)1	48)2
49)1	50)3	51)4	52)2	53)1	54)3
55)2	56)1	57)1	58)2	59)2	60)1
61)1	62)3	63)3	64)2	65)3	66)3
67)1	68)1	69)3	70)3	71)1	72)3
73)4	74)3	75)2	76)3	77)2	78)3
79)3	80)4	81)2	82)2	83)2	84)4
85)1	86)3	87)4	88)2	89)4	90)1
91)1	92)3	93)2	94)1	95)3	96)3
97)3	98)1	99)1	100)2	101)2	102)4
103)2	104)3	105)2	106) 4	107)2	108)1
109)2	110)2	111)3	112)2	113)4	114)3
115)2					

LEVEL - I (C.W)

JOULE'S LAW

1. A piece of lead falls from a height of 100m on a fixed non-conducting slab which brings it to rest. If the specific heat of lead is 30.6 cal/kg °C, the increase in temperature of the slab immediately after collision is

1) 6.72°C 2) 7.62°C 3) 5.62°C 4) 8.72°C

2. Hailstones fall from a certain height. If only 1% of the hailstones melt on reaching the ground, find the height from which they fall. ($g=10ms^{-2}$,L=80calorie/g & J = 4.2J/calorie)

1) 336 m 2) 236 m 3) 436 m 4) 536 m

3. From what minimum height a block of ice has to be dropped in order that it may melt completely on hitting the ground ?

1) mgh 2) $\frac{mgh}{J}$ 3) $\frac{JL}{g}$ 4) $\frac{J}{Lg}$

4. Two spheres A and B with masses in the ratio 2 : 3 and specific heat 2 : 3 fall freely from rest. If the rise in their temperatures on reaching the ground are in the ratio 1 : 2 the ratio of their heights of fall is

1) 3 : 1 2) 1 : 3 3) 4 : 3 4) 3 : 4

5. From what height a block of ice must fall into a well so that $\frac{1}{100}$th of its mass may be melted? ($g = 10\ m/s^2$)

1) 300 m 2) 336 m 3) 660 m 4) none

6. Two identical balls 'A' and 'B' are moving with same velocity. If velocity of 'A' is reduced to half and of 'B' to zero, then the rise in temperatures of 'A' to that of 'B' is

1) 3 : 4 2) 4 : 1 3) 2 : 1 4) 1 : 1

7. A 50kg man is running at a speed of $18kmh^{-1}$. If all the kinetic energy of the man can be used to increase the temperature of water from 20^0C to 30^0C, how much water can be heated with this energy?

1) 15 g 2) 20 g 3) 30 g 4) 40 g

8. A man of 60 kg gains 1000 cal of heat by eating 5 mangoes. His efficiency is 56%. To what height he can jump by using this energy?

1) 4m 2) 20 m 3) 28 m 4) 0.2 m

FIRST LAW OF THERMODYNAMICS

9. How much work to be done in decreasing the volume of an ideal gas by an amount of $2.4 \times 10^{-4}\ m^3$ at constant normal pressure of $1 \times 10^5\ N/m^2$?

1) 28 joule 2) 27 joule 3) 24 joule 4)25joule

10. Find the external work done by the system in kcal, when 20 kcal of heat is supplied to the system and the increase in the internal energy is 8400 J (J=4200J/kcal) ?

1) 16 kcal 2) 18 kcal 3) 20 kcal 4)19 kcal

11 Heat of 30 kcal is supplied to a system and 4200 J of external work is done on the system so that its volume decreases at constant pressure. What is the change in its internal energy ? (J = 4200 J/kcal)

1) 1.302×10^5 J 2) 2.302×10^5 J
3) 3.302×10^5 J 4) 4.302×10^5 J

12. Air expands from 5 litres to 10 litres at 2 atm pressure. External workdone is

1) 10J 2) 1000J 3) 3000 J 4) 300 J

13. Heat given to a system is 35 joules and work done by the system is 15 joules. The change in the internal energy of the system will be

1) – 50 J 2) 20 J 3) 30 J 4) 50 J

14. A gas is compressed at a constant pressure of $50\ N/m^2$ from a volume $10m^3$ to a volume of $4m^3$. 100J of heat is added to the gas then its internal energy is

1) Increases by 400J 2) Increases by 200J
3) Decreases by 400J 4) Decreases by 200J

C_P, C_V AND THEIR RELATIONS

15. Find the change in internal energy in joule when 10g of air is heated from 30°C to 40°C (c_v = 0.172 kcal/kg/KJ = 4200 J/kcal)
1) 62.24 J 2) 72.24 J 3) 52.24 J 4) 82.24 J

16. The temperature of 5 moles of a gas at constant volume is changed from 100^0C to 120^0C. The change in internal energy is 80J. The total heat capacity of the gas at constant volume will be in joule/kelvin is
1) 8 2) 4 3) 0.8 4) 0.4

17. When an ideal diatomic gas is heated at constant pressure, the fraction of heat energy supplied which is used in doing work to maintain pressure constant is
1) 5/7 2) 7/2 3) 2/7 4) 2/5

18. When a monoatomic gas expands at constant pressure, the percentage of heat supplied that increases temperature of the gas and in doing external work in expansion at constant pressure is
1) 100%, 0 2) 60%, 40%
3) 40%, 60% 4) 75%, 25%

19. For a gas, the difference between the two specific heats is 4150J Kg^{-1} K^{-1} and the ratio of specific heats is 1.4. What is the specific heat of the gas at constant volume in J Kg^{-1} K^{-1}?
1) 8475 2) 5186 3) 1660 4) 10375

20. The specific heat of air at constant pressure is 1.005 kJ/kg K and the specific heat of air at constant volume is 0.718 kJ/kgK. Find the specific gas constant.
1) 0.287 kJ/kg K 2) 0.21 kJ/kg K
3) 0.34 kJ/kg K 4) 0.19 kJ/kg K

21. The specific heat of Argon at constant volume is 0.3122kJ/kg/K. Find the specific heat of Argon at constant pressure if R = 8.314 kJ/k mole K. (Molecular weight of argon = 39.95)
1) 5203 2) 5302 3) 2305 4) 3025

22. If the ratio of the specific heats of steam is 1.33 and R = 8312J/k mole K find the molar heat capacities of steam at constant pressure and constant volume.
1) 33.5 kJ/k mole, 25.19 kJ /kg K
2) 25.19 kJ/k mole, 33.5 kJ/kg K
3) 18.82 kJ/k mole, 10.82 kJ/k mole
4) 24.12 kJ /k mole, 16.12 kJ/k mole

DIFFERENT THERMODYNAMIC PROCESSES

23. One mole of an ideal gas undergoes an isothermal change at temperature 'T' so that its volume V is doubled. R is the molar gas constant. Work done by the gas during this change is (2008 M)
1) RT log4 2) RT log2 3) RT log1 4) RT log3

24. One mole of O_2 gas having a volume equal to 22.4 litres at 0^0C and 1 atmospheric pressure is compressed isothermally so that its volume reduces to 11.2 litres. The work done in this process is
1) 1672.5J 2) 1728J 3) –1728J 4) –1572.5J

25. The isothermal Bulk modulus of an ideal gas at pressure 'P' is
1) P 2) γP 3) P/2 4) P/γ

26. Diatomic gas at pressure 'P' and volume 'V' is compressed adiabatically to 1/32 times the original volume. Then the final pressure is
1) P/32 2) 32 P 3) 128 P 4) P / 128

27. The pressure and density of a diatomic gas $(\gamma = 7/5)$ change adiabatically from (P, d) to (P^1, d^1). If $\frac{d^1}{d} = 32$, then $\frac{P^1}{P}$ should be
1) 1/128 2) 32
3) 128 4) none of the above

28. An ideal gas at a pressure of 1 atmosphere and temperature of 27^0C is compressed adiabatically until its pressure becomes 8 times the initial pressure, then the final temperature is $(\gamma = 3/2)$
1) 627^0 C 2) 527^0C 3) 427^0C 4) 327^0C

29. The volume of a gas is reduced adiabatically to $\frac{1}{4}$ of its volume at 27^0C, if the value of $\gamma = 1.4$, then the new temperature will be
1) $350 \times 4^{0.4}$K 2) $300 \times 4^{0.4}$K
3) $150 \times 4^{0.4}$K 4) None of these

30. Two moles of an ideal monoatomic gas at 27^0C occupies a volume of V. If the gas is expanded adiabatically to the volume 2V, then the work done by the gas will be $(g = 5/3)$
1) –2767.23J 2) 2767.23J
3) 2500J 4) –2500J

31. A container of volume $1 m^3$ is divided into two equal compartments, one of which contains an ideal gas at 300 K. The other compartment is vacuum. The whole system is thermally isolated from its surroundings. The partition is removed and the gas expands to occupy the whole volume of the container. Its temperature now would be

1) 300 K 2) 250 K 3) 200 K 4) 100 K

32. A gas at 10°C temperature and 1.013×10^5 Pa pressure is compressed adiabatically to half of its volume. If the ratio of specific heats of the gas is 1.4, what is its final temperature?

1) 103°C 2) 123°C 3) 93°C 4) 146°C

33. Find the work done by a gas when it expands isothermally at 37°C to four times its initial volume.

1) 3753J 2) 3573J 3) 7533J 4) 5375J

HEAT ENGINE

34. The efficiency of a heat engine if the temperature of source 227°C and that of sink is 27°C nearly

1) 0.4 2) 0.5 3) 0.6 4) 0.7

35. A Carnot engine takes 3×10^6 cal. of heat from a reservoir at 627°C, and gives it to a sink at 27°C. The work done by the engine is

1) 4.2×10^6 J 2) 8.4×10^6 J 3) 16.8×10^6 J 4) zero

LEVEL - I(C.W) - KEY

1) 2	2) 1	3) 3	4) 2	5) 2	6) 1
7) 1	8) 1	9) 3	10)2	11) 1	12)2
13)2	14)1	15)2	16)2	17)3	18)2
19)4	20)1	21) 1	22)1	23)2	24)4
25)1	26)3	27)3	28)4	29)2	30)2
31)1	32)1	33)2	34) 1	35) 2	

LEVEL - I (C.W) - HINTS

1. $mgh = JmS\Delta q \Rightarrow \Delta q = \dfrac{gh}{JS}$

2. $mgh = \dfrac{JmL_{ice}}{100}$ 3. W= JH $\Rightarrow$ mgh = JmL_{ice}

4. $mgh = mS\Delta q \Rightarrow ha\,S\Delta q \Rightarrow \dfrac{h_1}{h_2} = \dfrac{S_1}{S_2}\times\dfrac{\Delta q_1}{\Delta q_2}$

5. $mgh = \dfrac{m}{100}L_{ice}$

6. $mS\Delta q = J\dfrac{1}{2}m\left(v_2^2 - v_1^2\right) \Rightarrow \dfrac{q_1}{q_2} = \dfrac{v_2^2 - v_1^2}{v_2^{1^2} - v_1^{1^2}}$

7. W= JH $\Rightarrow \dfrac{1}{2}mv^2 = JmS\Delta q$ 8. mgh=JH

9. $dW = PdV$

10. $dQ = dU + dW \Rightarrow dW = dQ - dU$

11. $dQ = dU + dW$ 12. $W = P\left(V_2 - V_1\right)$

13. $dU = dQ - dW$ 14. $dU = dQ - P\left(V_2 - V_1\right)$

15. $dU_V = mc_v dT$

16. $dQ = dU + PdV = dU + P(0) = dU$

$$\left(\frac{dQ}{dT}\right)_V = \frac{dU}{dT}$$

17. $\dfrac{dW}{dQ} = 1 - \dfrac{1}{g}$ 18. $\dfrac{dU}{dQ} = \dfrac{1}{g}$; $\dfrac{dW}{dQ} = 1 - \dfrac{1}{g}$

19. $C_P - C_V = R \Rightarrow C_V = \dfrac{R}{g-1}$ 20. $c_P - c_V = r$

21. $c_P - c_V = \dfrac{R}{M}$ 22. $C_P = \dfrac{gR}{g-1}$; $C_V = \dfrac{R}{g-1}$

23. $W = nRT\,\log_e\left(\dfrac{V_2}{V_1}\right)$ 24. $W = 2.303nRT\,\log_{10}\left(\dfrac{V_2}{V_1}\right)$

25. Isothermal process PdV+VdP=0

$$\frac{dP}{P} = -\frac{dV}{V};\quad (K) = \frac{dP}{-\left(\frac{dV}{V}\right)} = \frac{dP}{\left(\frac{dP}{P}\right)} = P$$

26. $PV^g = K \Rightarrow \dfrac{p_1}{p_2} = \left(\dfrac{V_2}{V_1}\right)^g$ 27. $P_2/P_1 = \left(d_2/d_1\right)^g$

28. $T_1^g P_1^{1-g} = T_2^g P_2^{1-g}$ 29. $T_2 = T_1\left(\dfrac{V_1}{V_2}\right)^{g-1}$

30. $W = \dfrac{nR}{g-1}\left(T_1 - T_2\right)$

31. For free expansion, $dU = 0 \Rightarrow dT = 0 \Rightarrow T$ is constant.

32. $T_1V_1^{g-1} = T_2V_2^{g-1}$ 33. $W = 2.303nRT\,\log_{10}\left(\dfrac{V_2}{V_1}\right)$

34. $h = 1 - \dfrac{T_2}{T_1}$ 35. $h = \dfrac{W}{Q} = 1 - \dfrac{T_2}{T_1} \Rightarrow W = \left(1 - \dfrac{T_2}{T_1}\right)Q$

LEVEL - I (H.W)

JOULE'S LAW

1. A piece of aluminium falls from a height of 200m on a fixed non conducting slab which brings it to rest. If the specific heat of aluminium is 210 Cal/kg^{0}C. the increase in temperature of the slab immediately after collision (assume that there is no loss of heat) is
   1) 2.2^{o}C 2) 3.3^{o}C 3) 4.4^{o}C 4) 5.5^{o}C
2. Hail stones fall from certain height. If only 2% of the mass of the hail stone melt on reaching the ground,, the height from which they fall is (g = 10 ms^{-2}, L = 80 cal/gm and J = 4.2J/cal)
   1) 33.6 km 2) 67.2 km 3) 672 m 4) 336 m
3. From what minimum height a block of ice has to be dropped in order that 0.5% of ice melts on hitting the ground ?
   1) 171.43m 2) 17.14m 3) 161.43m 4) 1.714km
4. Two spheres 'A' and 'B' of masses in the ratio 1 : 2. Specific heats in the ratio 2 : 3 falls from heights 'h_1' and 'h_2'. On reaching the ground rise in temperatures are equal, then h_1/h_2 =
   1) 3 : 2 2) 2 : 9 3) 2 : 3 4) 2 : 1
5. 2kg ice block should be dropped from 'x km' height to melt completely. The 8 kg ice should be dropped from a height of
   1) 4x Km 2) x Km 3) 2x Km 4) x/2 Km
6. Two metal balls having masses 50g and 100g collides with a target with same velocity. Then the ratio of their rise in temperatures is
   1) 1 : 2 2) 4 : 1 3) 2 : 1 4) 1 : 1
7. A brick weighing 4 Kg is dropped into a 1m deep river from a height of 2m. Assuming that 80% of the gravitational potential energy is finally converted into thermal energy find this thermal energy in calories is
   1) 15 2) 17 3) 23 4) 27
8. A man of 60 kg gains 1000 cal of heat by eating 5 mangoes. His efficiency is 28%. To what height he can jump by using this energy?
   1) 2m 2) 20 m 3) 28 m 4) 0.2 m

FIRST LAW OF THERMODYNAMICS

9. 2kg of water is converted into steam by boiling at atmospheric pressure. The volume changes from 2 x 10^{-3} m^3 to 3.34 m^3. The work done by the system is about
   1) – 340 kJ 2) – 170 kJ 3) 170 kJ 4) 340 kJ
10. Find the external workdone by the system in K cal, when 12.5 k cal of heat is supplied to the system and the corresponding increasing in internal energy is 10500 J (J = 4200 J/kcal)
   1)15 K cal 2)12.5 kcal 3)10.0 kcal 4)7.5 kcal
11. Heat of 20 K cal is supplied to the system and 8400 J of external work is done on the system so that its volume decreases at constant pressure. The change in internal energy is (J = 4200 J /kcal)
   1) 9.24×10^4 J 2) 7.56×10^4 J
   3) 8.4×10^4 J 4) 10.5×10^4J
12. A gas expands from 40 litres to 90 litres at a constant pressure of 8 atmospheres. Work done by the gas during the expansion is
   1) 4×10^{-4}J 2) 4×10^4J 3) 4×10^3J 4) 4×10^2J
13. To a system 300 joules of heat is given and it does 60 joules of work. How much does the internal energy of the system change in this process? (in joule)
   1) 240 2) 156. 5 3) –300 4) –528. 2
14. A gas under constant pressure of 4.5x10^{5}Pa when subjected to 800KJ of heat, changes the volume from 0.5m^3 to 2 m^3. The change in the internal energy of the gas is
   1) 6.75×10^5J 2) 5.25×10^5J
   3) 3.25×10^5J 4) 1.25×10^5J

C_P, C_V AND THEIR RELATIONS

15. Find the change in internal energy in joule when 20gm of a gas is heated from 20^{o}C to 30^{o}C (c_V = 0.18 kcal/kg K; J = 4200J/kcal)
   1) 72.8 J 2) 151.2 J 3) 302 J 4) 450 J
16. When two moles of a gas is heated from O^0 to 10^{0}C at constant volume, its internal energy changes by 420J. The molar specific heat of the gas at constant volume
   1) 5.75 J K^{-1} mole^{-1} 2) 10.55 J K^{-1} mole^{-1}
   3) 21 J K^{-1} mole^{-1} 4) 42 J K^{-1} mole^{-1}
17. A cylinder of fixed capacity 67.2 litres contains helium gas at STP. Calculate the amount of heat required to raise the temperature of the gas by 15^{0}C ? $\left(R=8.314\ J\,mol^{-1}\ k^{-1}\right)$
   1) 561.19 J 2)570.9 J 3)580.9 J 4)590.9 J
18. When a diatomic gas expands at constant pressure, the percentage of heat supplied that increases temperature of the gas and in doing external work in expansion at constant pressure is
   1) 60%, 40% 2) 40%, 60%
   3) 28.57%, 71.42% 4) 71.42%, 28.57%

19. **The molar specific heat of a gas at constant volume is 20 Joule mol^{-1} K^{-1}. The value of γ for it will be**

1) $\frac{11}{10}$ 2) $\frac{7}{5}$ 3) $\frac{5}{3}$ 4) $\frac{3}{2}$

20. **The specific heat of air at constant pressure is 1.005 kJ/kg/K and the specific heat of air at constant volume is 0.718 kJ/kg/K. If the universal gas constant is 8.314 kJ/k mole K find the molecular weight of air ?**

1) 28.97 2) 24.6 3) 22.8 4) 19.6

21. **Calculate the specific heat of a gas at constant volume from the following data. Density of the gas at N.T.P.=19×10^{-2} kg/m^3, (C_p/C_v) = 1.4, J = 4.2 × 10^3 J/kcal; atmospheric pressure = 1.013 × 10^5 N/m^2. (in kcal / kg k)**

1) 2.162 2) 1.612 3) 1.192 4) 2.612

22. **If the ratio of specific heats of neon is 1.667 and R = 8312 J/k mole K find the specific heats of neon at constant pressure and constant volume. (Molecular weight of neon =20.183)**

1) 1.029, 0.6174 2) 1.831, 0.921
3) 1.621, 0.421 4) 0.862, 0.246

DIFFERENT THERMO DYNAMICAL PROCESS

23. **One mole of an ideal gas expands isothermally to double its volume at 27°C. Then the work done by the gas is nearly**

1) 2760 cal 2) 414 cal 3) 1380 cal 4) 600 cal

24. **One mole of an ideal gas expands at a constant temperature of 300 K from an initial volume of 10 litres to a final volume of 20 litres. The work done in expanding the gas is (R = 8.31 J/mole –K) (in** joules)

1) 750 2) 1728 3) 1500 4) 3456

25. **The isothermal bulk modulus of a perfect gas at normal pressure is**

1) $1.013\times10^5 N/m^2$ 2) $1.013\times10^6 N/m^2$
3) $1.013\times10^{-11} N/m^2$ 4) $1.013\times10^{11} N/m^2$

26. **A gas for which γ =1.5 is suddenly compressed to 1/4 th of the initial volume. Then the ratio of the final to initial pressure is**

1) 1:16 2) 1:8 3) 1:4 4) 8:1

27. **The pressure and density of a monoatomic gas $(\gamma=5/3)$ change adiabatically from (P_1, d_1) to (P_2, d_2). If $\frac{d_2}{d_1}=8$ then $\frac{P_2}{P_1}$ should be**

1) $\frac{1}{32}$ 2) 32 3) 128 4) $\frac{1}{8}$

28. **Air is filled in a motor tube at 27^{0}C and at a pressure of 8 atmospheres. The tube suddenly bursts, then temperature of air is [Given γ of air = 1.5]**

1) 27.5^{0}C 2) 75^{0}C 3) 150 K 4) 150^{0}C

29. **A mono atomic gas initially at 27^{0}C is compressed adiabatically to one eighth of its original volume. The temperature after compression will be**

1) 10^{0}C 2) 887^{0}C 3) 927^{0}C 4) 144^{0}C

30. **One gm mol of a diatomic gas $(\gamma=1.4)$ is compressed adiabatically so that its temperature rises from 27^{0}C to 127^{0}C. The work done will be**

1) 2077.5 joules 2) 207.5 joules
3) 207.5 ergs 4) 205.5 joules

31. **A container of volume 2m^3 is divided into two equal compartments, one of which contains an ideal gas at 400 K. The other compartment is vacuum. The whole system is thermally isolated from its surroundings. The partition is removed and the gas expands to occupy the whole volume of the container. Its temperature now would be**

1) 400 K 2) 250 K 3) 200 K 4) 100 K

32. **At 27^{o}C and pressure of 76 cm of Hg the volume of a diatomic gas is 2000 cm^3. If it is compressed adiabatically to a volume of 1000 cm^3, what are its pressure and temperature? (γ =1.4)**

1) 200.5 cm of Hg, 122.9^{o}C
2) 180.4 cm of Hg, 84.2^{o}C
3) 120 cm g kg 80^{o}C
4) 162.4 cm of Hg 92^{o}C

33. **The work done on a gas when it is compressed isothermally at 27^{o}C to half of the initial volume is (nearly)**

1) 3436 J 2) -1718 J
3) +1718 J 4) -3436J

HEAT ENGINE

34. **A Carnot engine has the same efficiency between 800 K to 500K and *x* K to 600 K. The value of '*x*' is**

1) 1000 K 2) 960 K 3) 846 K 4) 754 K

35. **A Carnot's engine working between 27^0C and 127^0C takes up 800 J of heat from the reservoir in one cycle. What is the work done by the engine**

1) 100J 2) 200J 3) 300 J 4) 400 J

LEVEL - I (H.W) - KEY

1) 1	2) 3	3) 1	4) 3	5) 2	6) 4
7) 3	8) 1	9)4	10) 3	11) 1	12)2
13) 1	14)4	15)2	16)3	17) 1	18)4
19)2	20)1	21)3	22)1	23)2	24)2
25)1	26)4	27)2	28)3	29)3	30)1
31)1	32)1	33)2	34)2	35)2	

LEVEL - I (H.W) - HINTS

1. $mgh = JmS\Delta q \Rightarrow \Delta q = {gh}/{JS}$

2. $mgh = JmL \Rightarrow h = \frac{JL}{g}$

3. $W = JH \Rightarrow mgh = J\frac{0.5}{100} \times mL_{ice}$

4. $mgh = JmS\Delta q \Rightarrow h a S \Rightarrow \frac{h_1}{h_2} = \frac{S_1}{S_2}$

5. $mgh = JmL \Rightarrow h a L$; h is independent of mass

6. $\frac{1}{2}mv^2 = JmS\Delta q \Rightarrow \Delta q a v^2$

7. $W = JH \Rightarrow \frac{80}{100}(mgh) = JQ$

8. Efficiency $\times$ energy = work done = mgh

9. W=PdV

10. $dW = dQ - dU$

11. $dU = dQ + dW$

12. $W = P(V_2 - V_1)$

13. $dU = dQ - dW$

14. $dU = dQ - dW$

15. $dU = mc_v dT$

16. $dU = nC_v dT$

17. We know that 1 mole of an ideal gas at STP occupies a volume of 22.4 litres. Thus the cylinder contains 3 moles of helium.

 Heat required $= nC_v\Delta T = 3 \times \frac{3}{2}R\Delta T$

18. $\frac{dU}{dQ} \times 100 = \frac{1}{g} \times 100 ; \frac{dW}{dQ} \times 100 = \left(1 - \frac{1}{g}\right) \times 100$

19. $C_V = \frac{R}{(g-1)} \Rightarrow g = 1 + \frac{R}{C_V}$

20. $c_P - c_V = \frac{R}{M} \Rightarrow M = \frac{R}{c_P - c_V}$

21. $c_V = \frac{R}{M(g-1)} \Rightarrow c_V = \frac{P}{JrT(g-1)}$

22. $C_P = \frac{gR}{(g-1)}, C_V = \frac{R}{(g-1)}$

23. $W = 2.303nRT\ \log_{10}\left(\frac{V_2}{V_1}\right)$

24. $W = 2.303nRT\ \log_{10}\left(\frac{V_2}{V_1}\right)$

25. $K_{iso} = P = 1.013 \times 10^5\ N/m^2$

26. $P_1V_1^g = P_2V_2^g \Rightarrow \frac{P_1}{P_2} = \left(\frac{V_2}{V_1}\right)^g$

27. $\frac{P_1}{P_2} = \left(\frac{d_1}{d_2}\right)^g$

28. $T_1P_1^{g-1} = T_2P_2^{g-1}$

29. $T_1V_1^{g-1} = T_2V_2^{g-1}$

30. $W = \frac{nR(T_2 - T_1)}{g-1}$

31. dU=0, dT=0

32. $P_2 = P_1\left(\frac{V_1}{V_2}\right) \Rightarrow T_2 = T_1\left(\frac{V_1}{V_2}\right)^{g-1}$

33. $dW = 2.303RT\log_{10}\left(\frac{V_2}{V_1}\right)$

34. $h = 1 - \frac{T_2}{T_1}$

35. $\frac{W}{Q_1} = 1 - \frac{T_2}{T_1}$