1. Using which of the following instrument, the temperature of the sun can be determined ?

(1) Platinum thermometer

(2) Gas thermometer

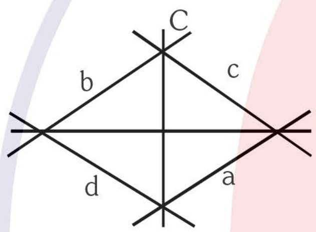
(3) Pyrometer

(4) Vapour pressure thermometer

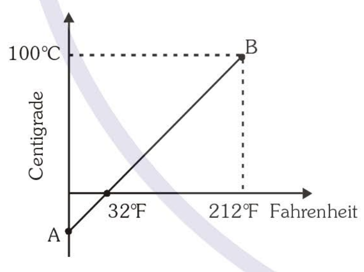
2. Which of the curves in figure represents the relation between Celsius and Fahrenheit temperature?

(1) Curve a (2) Curve b

(3) Curve c (4) Curve d



3. The graph AB shown in figure is a plot of temperature of a body in degree Celsius and degree Fahrenheit. Then



(1) slope of line AB is 9/5

(2) slope of line AB is 5/9

(3) slope of line AB is 1/9

(4) slope of line AB is 3/9

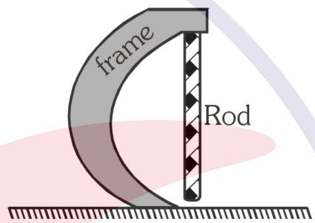
4. Two thermometers X and Y have ice points marked at 15° and 20° and steam points marked as 75° and 100° respectively. When thermometer X measures the temperature of a bath as 60° on it, what would thermometer Y read when it is used to measure the temperature of the same bath ?

(1) 60° (2) 75° (3) 80° (4) 90°

5. A new scale of temperature (which is linear) called the W scale, the freezing and boiling points of water are 39°W and 239°W respectively. What will be the temperature on the new scale, corresponding to a temperature of 39°C on the Celsius scale ?

(1) 200° W (2) 139° W (3) 78° W (4) 117°W

6. At STP a rod is hung from a frame as shown in figure, leaving a small gap between the rod and floor. The frame and rod system is heated uniformly upto 350 K. Then



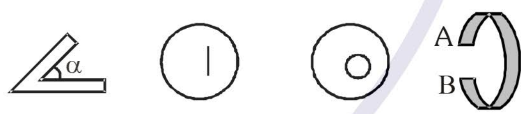
(1) The rod will never touch the floor in any case.

(2) If $\alpha_{rod} > \alpha_{frame}$, then rod may touch the floor.

(3) If $\alpha_{rod} < \alpha_{frame}$, then rod may touch the floor.

(4) None of the above

7. The figure below shows four isotropic solids having positive coefficient of thermal expansion. A student predicts that on heating the solid following things can happen. Mark true (T) or False (F) for comments made by the student.



(i) The angle α in figure (1) will not change.

(ii) The length of line in figure (2) will decrease.

(iii) The radius of inner hole will decrease.

(iv) The distance AB will increase.

(1) T F F T (2) F T T F (3) T T T T (4) F F T F

8. Suppose there is a hole in a copper plate. On heating the plate, diameter of hole, would :

(1) always increase

(2) always decrease

(3) always remain the same

(4) none of these

9. The table gives the initial length ℓ_0, change in temperature ΔT and change in length $\Delta\ell$ of four rods. Which rod has greatest coefficient of linear expansion

Rod	ℓ_0(m)	ΔT(°C)	$\Delta\ell$(°C)
A1	1	100	1
A2	1	100	2
A3	1.5	50	3
A4	2.5	20	4

(1) A_1 (2) A_2 (3) A_3 (4) A_4

10. Two rods one of aluminium of length l_1 having coefficient of linear expansion α_a, and other steel of length l_2 having coefficient of linear expansion α_s are joined end to end. The expansion in both the rods is same on variation of temperature. Then the value of $\frac{l_1}{l_1+l_2}$ is

(1) $\frac{\alpha_s}{\alpha_a+\alpha_s}$ (2) $\frac{\alpha_s}{\alpha_a-\alpha_s}$

(3) $\frac{\alpha_a+\alpha_s}{\alpha_s}$ (4) None of these

11. An iron bar (Young's modulus = 10^{11} N/m^2, $\alpha = 10^{-6}$ /°C) 1 m long and 10^{-3} m^2 in area is heated from 0°C to 100°C without being allowed to bend or expand. Find the compressive force developed inside the bar.

(1) 10,000 N (2) 1000 N

(3) 5000 N (4) 10^5 N

12. A rod of length 2m rests on smooth horizontal floor. If the rod is heated from 0°C to 20°C. Find the longitudinal strain developed?

($\alpha = 5\times10^{-5}$/°C)

(1) 10^{-3} (2) 2×10^{-3} (3) Zero (4) None

13. An ideal gas is expanding such that PT^4 = constant. The coefficient of volume expansion of the gas is :

(1) $\frac{1}{T}$ (2) $\frac{3}{T}$ (3) $\frac{5}{T}$ (4) $\frac{4}{T}$

14. A bullet moving with velocity v collides against wall. consequently half of its kinetic energy is converted into heat. If the whole heat is acquired by the bullet, the rise in temperature will be:–

(1) $v^2/4S$ (2) $4v^2 / 2S$ (3) $v^2 / 2S$ (4) v^2 / S

15. A block of ice with mass *m* falls into a lake. After impact, a mass of ice *m*/5 melts. Both the block of ice and the lake have a temperature of 0°C. If L represents the heat of fusion, the minimum distance the ice fell before striking the surface is

(1) $\frac{L}{5g}$ (2) $\frac{5L}{g}$

(3) $\frac{gL}{5m}$ (4) $\frac{mL}{5g}$

16. A bullet of mass 10 g moving with a speed of 20 m/s hits an ice block of mass 990 g kept on a frictionless floor and gets stuck in it. How much ice will melt if 50% of the lost KE goes to ice ? (initial temperature of the ice block and bullet = 0°C)

(1) 0.001 g (2) 0.002 g

(3) 0.003 g (4) 0.004 g

17. A piece of ice falls from a height h so that it melts completely. Only half of the heat produced is absorbed by the ice and all energy of ice gets converted into heat during its fall. The value of h is :

[Latent heat of ice is 3.4×10^5 J/kg and g = 10 N/kg]

(1) 34 km (2) 136 km

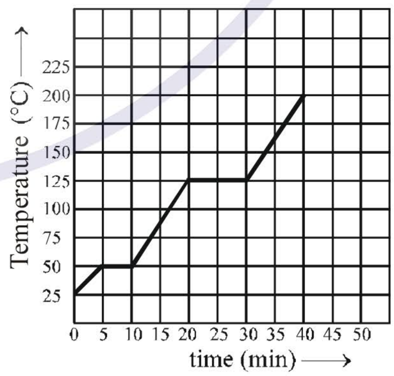
(3) 68 km (4) 544 km

18. The amount of heat required to convert 1 gm of ice at 0°C into steam at 100°C, is

(1) 716 cal. (2) 500 cal.

(3) 180 cal. (4) 100 cal.

19. The graph shown in the figure represent change in the temperature of 5 kg of a substance as it abosrbs heat at a constant rate of 42 kJ min^{-1}. The latent heat of vapourazation of the substance is :



(1) 630 kJ kg^{-1}

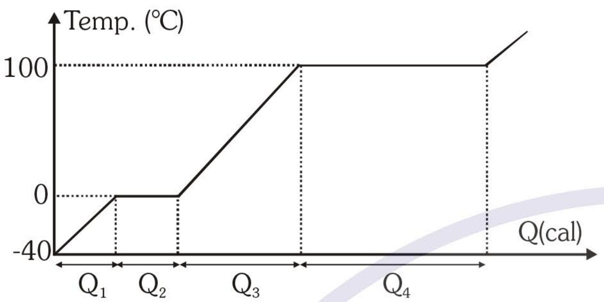
(2) 126 kJ kg^{-1}

(3) 84 kJ kg^{-1}

(4) 12.6 kJ kg^{-1}

20. Figure shows the temperature variation when heat is added continuously to a specimen of ice (10 g) at –40 °C at constant rate.

(Specific heat of ice = 0.53 cal/g °C and L_{ice} = 80 cal/g, L_{water}= 540 cal/g)



Column–I		Column–II	
(A)	Value of Q_1 (in cal)	(P)	800
(B)	Value of Q_2 (in cal)	(Q)	1000
(C)	Value of Q_3 (in cal)	(R)	5400
(D)	Value of Q_4 (in cal)	(S)	212
		(T)	900

(1) A→S; B→P; C→Q; D→T
(2) A→P; B→S; C→Q; D→R
(3) A→P; B→S; C→R; D→Q
(4) A→S; B→P; C→Q; D→R

21. A 2100 W continuous flow geyser (instant geyser) has water inlet temperature = 10°C while the water flows out at the rate of 20 g/sec. The outlet temperature of water must be about

(1) 20°C (2) 30°C
(3) 35°C (4) 40°C

22. Two identical bodies are made of a material for which the heat capacity increases with temperature. One of these is at 100 °C, while the other one is at 0°C. If the two bodies are brought into contact, then, assuming no heat loss, the final common temperature is :-

(1) less than 50 °C but greater than 0 °C
(2) 0 °C
(3) 50 °C
(4) more than 50 °C

23. Steam at 100°C is added slowly to 1400 gm of water at 16°C until the temperature of water is raised to 80°C. The mass of steam required to do this is (L_V = 540 cal/gm) :

(1) 160 gm (2) 125 mg (3) 250 gm (4) 320 gm

24. 1 kg of ice at – 10°C is mixed with 4.4 kg of water at 30°C. The final temperature of mixture is :

(1) 2.3°C (2) 4.4°C (3) 5.3°C (4) 8.7°C

25. 2 kg ice at – 20°C is mixed with 5 kg water at 20°C. Then final amount of water in the mixture would be;

Given specific heat of ice = 0.5 cal/g°C,
Specific heat of water = 1 cal/g°C,
Latent heat of fusion for ice = 80 cal/g.

(1) 6 kg (2) 5 kg (3) 4 kg (4) 2 kg

26. Equal volume of H_2, O_2 and He gases are at same temperature and pressure. Which of these will have large number of molecules :-

(1) H_2
(2) O_2
(3) He
(4) All the gase will have same number of molecules

27. The equation of state for 22g of CO_2 at a pressure P and temperature T, when occupying a volume V, will be :– (where R is the gas constant.)

(1) PV = 5 RT (2) PV = (5/2) RT
(3) PV = (5/16) RT (4) PV = (1/2)RT

28. Two vessels separately contain two ideal gases A and B at the same temperature, the pressure of A being twice that of B. Under such conditions, the density of A is found to be 2.5 times the density of B. The ratio of molecular weight of A and B is:

(1) $\frac{1}{2}$ (2) $\frac{3}{4}$
(3) $\frac{5}{4}$ (4) $\frac{4}{3}$

29. A given sample of an ideal gas occupies a volume V at a pressure P and absolute temperature T. The mass of each molecule of the gas is m. Which of the following gives the density of the gas ?

(1) P/(kTV) (2) mkT
(3) P/(kT) (4) Pm/(kT)

30. A balloon contains 500 m^3 of helium at 27°C and 1 atmosphere pressure. The volume of the helium at –3°C temperature and 0.5 atmosphere pressure will be-

(1) 500 m^3 (2) 700 m^3
(3) 900 m^3 (4) 1000 m^3

31. On increasing the temperature of a gas filled in a closed container by 1°C its pressure increases by 0.4%, then initial temperature of the gas is-

(1) 25°C (2) 250°C (3) 250 K (4) 2500°C

32. 28 gm of N_2 gas is contained in a flask at a pressure 10 atm. and at a temperature of 57°C. It is found that due to leakage in the flask, the pressure is reduced to half and the temperature reduced to 27°C. The quantity of N_2 gas that leaked out is –

(1) 11/20 gm (2) 80/11 gm

(3) 5/63 gm (4) 63/5 gm

33. A vessel has 6g of oxygen at pressure P and temperature 400 K. A small hole is made in it so that oxygen leaks out. How much oxygen leaks out if the final pressure is P/2 and temperature is 300 K ?

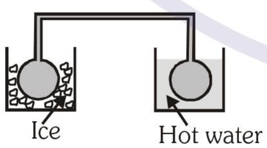
(1) 3g (2) 2g (3) 4g (4) 5g

34. Two closed containers of equal volume filled with air at pressure P_0 and temperature T_0. Both are connected by a narrow tube. If one of the container is maintained at temperature T_0 and other at temperature T, then new pressure in the conainers will be :-

(1) $\dfrac{2P_0T}{T+T_0}$ (2) $\dfrac{P_0T}{T+T_0}$

(3) $\dfrac{P_0T}{2(T+T_0)}$ (4) $\dfrac{T+T_0}{P_0}$

35. Two identical glass bulbs are interconnected by a thin glass tube at 0°C. A gas is filled at N.T.P. in these bulb is placed in ice and another bulb is placed in hot bath, then the pressure of the gas becomes 1.5 times. The temperature of hot bath will be :–



(1) 100°C (2) 182°C (3) 256°C (4) 546°C

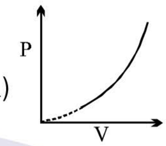
36. An ideal gas expands according to the law P^2V = constant. The internal energy of the gas :-

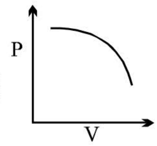
(1) Increases continuously
(2) Decreases continuously
(3) Remains constant
(4) First increases and then decreases

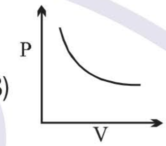
37. An ideal gas mixture filled inside a balloon expands according to the relation $PV^{2/3}$ = constant. The temperature inside the balloon is

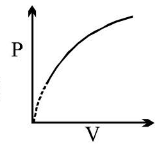
(1) increasing (2) decreasing
(3) constant (4) can't be said

38. An ideal gas follows a process PT = constant. The correct graph between pressure & volume is :-

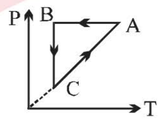
(1) 

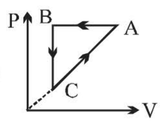
(2) 

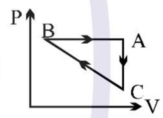
(3) 

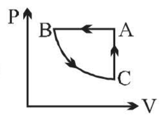
(4) 

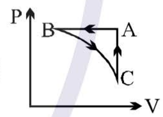
39. A cyclic process ABCA is shown in P–T diagram. When presented on P–V, it would



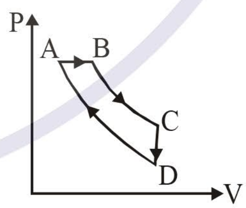
(1) 

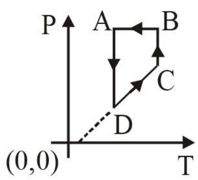
(2) 

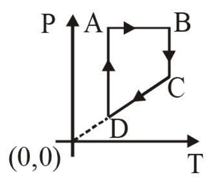
(3) 

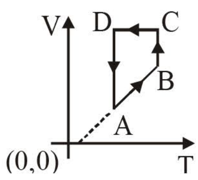
(4) 

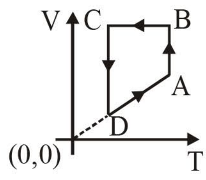
40. For P-V diagram of a thermodynamic cycle as shown in figure, process BC and DA are isothermal. Which of the corresponding graphs is correct ?



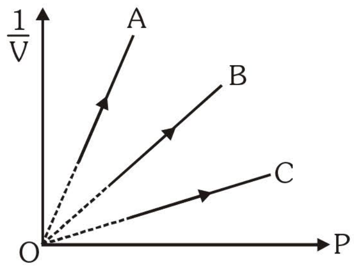
(1) 

(2) 

(3) 

(4) 

41. Figure shows the isotherms of a fixed mass of an ideal gas at three temperatures T_A, T_B and T_C then



(1) $T_A > T_B > T_C$
(2) $T_A < T_B < T_C$
(3) $T_B < T_A < T_C$
(4) $T_A = T_B = T_C$

42. Consider a gas with density ρ and $\overline{c}$ as the root mean square velocity of its molecules contained in a volume. If the system moves as whole with velocity v, then the pressure exerted by the gas is

(1) $\frac{1}{3}\rho(\overline{c})^2$ (2) $\frac{1}{3}\rho(\overline{c}+v)^2$

(3) $\frac{1}{3}\rho(\overline{c}-v)^2$ (4) $\frac{1}{3}\rho(c^{-2}-v)^2$

43. Three particles have speeds of 2u , 10u and 11u. Which of the following statements is correct?

(1) The r.m.s. speed exceeds the mean speed by about u.
(2) The mean speed exceeds the r.m.s. speed by about u.
(3) The r.m.s. speed equals the mean speed.
(4) The r.m.s. speed exceeds the mean speed by more than 2u.

44. For the molecules of an Ideal gas, Which of the following velocity average can not be zero

(1) $< v >$ (2) $< v^4 >$
(3) $< v^3 >$ (4) $< v^5 >$

45. The speeds of 5 molecules of a gas (in arbitary units) are as follows 2,3,4,5,6 The root mean square speed for these moecules is -

(1) 2.91 (2) 3.52 (3) 4.00 (4) 4.24

46. If the root mean square speed of hydrogen molecules is equal to root mean square speed of oxygen molecules at 47°C, the temperature of hydrogen is-

(1) 20 K (2) 47 K (3) 50 K (4) 80 K

47. Two containers of same volume are filled with atomic Hydrogen and Helium respectively at 1 and 2 atm pressure. If the temperature of both specimen are same then average speed V for hydrogen atoms will be -

(1) $\langle V_H \rangle = \sqrt{2}\,\langle V_{He} \rangle$

(2) $\langle V_H \rangle = \langle V_{He} \rangle$

(3) $\langle V_H \rangle = 2\,\langle V_{He} \rangle$

(4) $\langle V_H \rangle = \frac{\langle V_{He} \rangle}{2}$

48. The root mean square (rms) speed of oxygen molecules O_2 at a certain temperature T (absolute) is v. If the temperature is doubled and oxygen gas dissociates into atomic oxygen. The rms speed :

(1) becomes $v/\sqrt{2}$ (2) remains v

(3) becomes $\sqrt{2}v$ (4) becomes 2v

49. The molecules of a given mass of a gas have r.m.s. velocity of 200 m/s at 127°C and 1.0×10^5 N/m^2 pressure. When the temperature and pressure of the gas are respectively, 227°C and 0.05×10^5 N/m^2, the r.m.s. velocity of its molecules in m/s is :

(1) $100\sqrt{2}$ (2) $100\sqrt{5}$

(3) $\frac{200}{3}$ (4) $\frac{500\sqrt{2}}{3}$

50. A gas is equilibrium at T kelvin. If mass of one molecule is m and its component of velocity in y direction is v_y. Then mean of its v_y^2 is

(1) $\frac{3kT}{m}$ (2) $\frac{2kT}{m}$

(3) $\frac{kT}{m}$ (4) zero

51. According to Maxwell's law of distribution of velocites of molecules, the most probable velocity is :-

(1) greater than the mean velocity
(2) equal to the mean velocity
(3) equal to the root mean square velocity
(4) less than the root mean square velocity

52. The reason for the absence of atmosphere on moon is that the :

(1) Value of v_{rms} of the molecules of gas is more than the value of escape velocity

(2) Value of v_{rms} of gas is less than escape velocity

(3) Value of v_{rms} is negiligible

(4) None of the above

53. A gas mixture consists of 2 moles of oxygen and 4 moles of argon at temperature T. Neglecting all vibrational modes, the total internal energy of the system is

(1) 4 RT (2) 15 RT (3) 9 RT (4) 11 RT

54. N molecules of an ideal gas at temperature T_1 and presseure P_1 are contained in a closed box. If the molecules in the box gets doubled, Keeping total kinetic energy as same then if new pressure is P_2 and temperature is T_2, Then :

(1) $P_2 = P, T_2 = T_1$

(2) $P_2 = P_1, T_2 = T_1 / 2$

(3) $P_2 = 2P_1, T_2 = T_1$

(4) $P_2 = 2P_1, T_2 = T_1 / 2$

55. Relation between pressure (P) and energy density (E) of an ideal gas is -

(1) P = 2/3 E (2) P = 3/2 E

(3) P = 3/5 E (4) P = E

56. Three monoatomic perfect gases at absolute temperature T_1, T_2 and T_3 are mixed. If number of molecules of the gases are n_1, n_2 and n_3 respectively then temperature of mixture will be (assume no loss of energy)

(1) $\frac{T_1+T_2+T_3}{3}$ (2) $\frac{n_1^2T_1+n_2^2T_2+n_3^2T_3}{3}$

(3) $\frac{n_1T_1+n_2T_2+n_3T_3}{n_1+n_2+n_3}$ (4) $\frac{T_1+T_2+T_3}{n_1+n_2+n_3}$

57. Which of the following statement is true according to kinetic theory of gases?

(1) The collision between two molecules is inelastic and the time between two collisions is less than the time taken during the collision.

(2) There is a force of attraction between the molecules

(3) All the molecules of a gas move with same velocity

(4) The average of the distances travelled between two successive collisions is mean free path.

58. The mean free path of molecules of a gas, (radius 'r') is inversely proportional to :-

(1) r^3 (2) r^2 (3) r (4) $\sqrt{r}$

59. The ratio of number of collisions per second at the walls of containers by He and O_2 gas molecule kept at same volume and temperature, is (assume normal incidence on walls)

(1) 2 : 1 (2) 1 : 2

(3) $2\sqrt{2}$: 1 (4) 1 : $2\sqrt{2}$

60. The specific heat of an ideal gas depends on temperature is -

(1) $\frac{1}{T}$

(2) T

(3) $\sqrt{T}$

(4) Does not depends on temperature

61. The equation of state of a gas is given by $\left(P+\frac{aT^2}{V}\right)V^C = (RT + b)$, where a, b, c and R are constants. This isotherms can be represented by $P = AV^m - BV^n$, where A and B depend only on temperature and

(1) m = – c and n = – 1

(2) m = c and n = 1

(3) m = – c and n = 1

(4) m = c and n = – 1

62. For hydrogen gas $c_P - c_V$ = a and for a oxygen gas $c_P - c_V$ = b then the relation between a and b is (where c_P & c_V are gram specific heats)

(1) a = 16 b (2) b = 16 a

(3) a = b (4) None of these

63. For a gas $\frac{R}{C_V}$ = 0.4. This gas is made up of molecules which are :

(1) Monoatomic

(2) Mixture of diatomic and polyatomic molecules

(3) Diatomic

(4) Polyatomic

64. If 2 gm moles of a diatomic gas and 1 gm mole of a mono-atomic gas are mixed then the value of γ (= Cp/Cv) for mixture will be :–

(1) $\frac{13}{19}$ (2) $\frac{19}{13}$ (3) $\frac{7}{5}$ (4) $\frac{5}{3}$

65. For a certain process, pressure of diatomic gas varies according to the relation $P = aV^2$, where a is constant. What is the molar heat capacity of the gas for this process ?

(1) $\frac{17R}{6}$ (2) $\frac{6R}{17}$ (3) $\frac{13R}{6}$ (4) $\frac{16R}{7}$

66. Molar specific heat at constant volume, for a non-linear triatomic gas is (vibration mode neglected)

(1) 3R (2) 4R (3) 2R (4) R

67. Relation between the ratio of specific heats (γ) of gas and degree of freedom 'f" will be

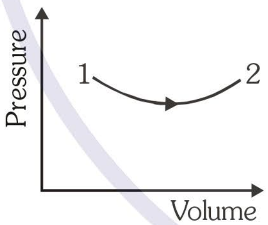
(1) $\gamma = f + 2$ (2) $\frac{1}{\gamma} = \frac{1}{f} + \frac{1}{2}$

(3) $f = 2 / (\gamma-1)$ (4) $f = 2(\gamma-1)$

68. One mole of an ideal monatomic gas undergoes a process described by the equation PV^5 = constant. The heat capacity of the gas during this process is

(1) $\frac{3}{2}R$ (2) $\frac{5}{4}R$ (3) $\frac{3}{4}R$ (4) $\frac{5}{2}R$

69. Consider the process on a system shown in figure. During the process, the work done by the system.



(1) Continuously increases
(2) Continuously decreases
(3) First increases then decreases
(4) First decreases then increases

70. One mole of an ideal gas at temperature T_1 expends according to the law $\frac{P}{V^2}$ = a (constant). The work done by the gas till temperature of gas becomes T_2 is :

(1) $\frac{1}{2}R(T_2 - T_1)$ (2) $\frac{1}{3}R(T_2 - T_1)$

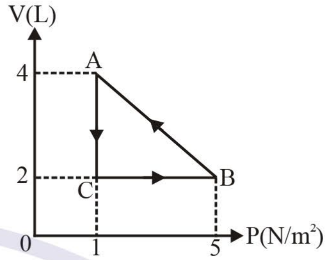
(3) $\frac{1}{4}R(T_2 - T_1)$ (4) $\frac{1}{5}R(T_2 - T_1)$

71. In an isometric change :

(1) $\delta Q = dU$ (2) $\delta W = dU$

(3) $\delta Q + \delta W = dU$ (4) None of these

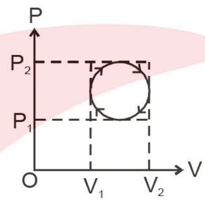
72. Calculate the work done for B → A, :-



(1) 6×10^{-3} J (2) 12×10^{-3} J

(3) 3×10^{-3} J (4) 4×10^{-3} J

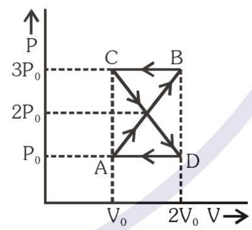
73. In a cyclic process shown on the P – V diagram the magnitude of the work done is :



(1) $\pi\left(\frac{P_2 - P_1}{2}\right)^2$ (2) $\pi\left(\frac{V_2 - V_1}{2}\right)^2$

(3) $\frac{\pi}{4}(P_2 - P_1)(V_2 - V_1)$ (4) $\pi(P_2V_2 - P_1V_1)$

74. A thermodynamic system undergoes cyclic process ABCDA as shown in fig. The work done by the system in the cycle is :-



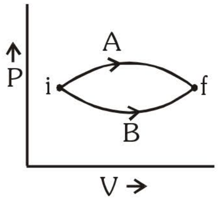
(1) P_0V_0 (2) $2P_0V_0$ (3) $\frac{P_0V_0}{2}$ (4) Zero

75. If the ratio of specific heat of a gas at constant pressure to that at constant volume is γ, the change in internal energy of gas, when the volume changes from V to 2V at constant pressure P, is:-

(1) $\frac{PV}{(\gamma - 1)}$ (2) PV

(3) $\frac{R}{(\gamma - 1)}$ (4) $\frac{\gamma PV}{(\gamma - 1)}$

76. A system is taken along the paths A and B as shown. If the amounts of heat given in these processes are ΔQ_A and ΔQ_B and change in internal energy are ΔU_A and ΔU_B respectively then :-



(1) $\Delta Q_A = \Delta Q_B$; $\Delta U_A < \Delta U_B$

(2) $\Delta Q_A \geq \Delta Q_B$; $\Delta U_A = \Delta U_B$

(3) $\Delta Q_A < \Delta Q_B$; $\Delta U_A > \Delta U_B$

(4) $\Delta Q_A > \Delta Q_B$; $\Delta U_A = \Delta U_B$

77. The amount of heat energy required to raise the temperature of 1 g of Helium at NTP, from T_1 K to T_2 K at constant volume is :-

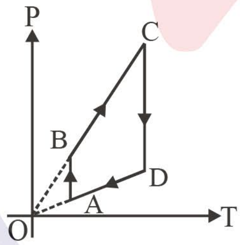
(1) $\frac{5}{4} N_a k_B \left(\frac{T_2}{T_1}\right)$ (2) $\frac{5}{8} N_a k_B (T_2 - T_1)$

(3) $\frac{5}{2} N_a k_B (T_2 - T_1)$ (4) $\frac{5}{4} N_a k_B (T_2 - T_1)$

78. 1 kg of a gas does 20 kJ of work and receives 16 kJ of heat when it is expanded between two states. A second kind of expansion can be found between the same initial and final state which requires a heat input of 9 kJ. The work done by the gas in the second expansion is :

(1) 32 kJ (2) 5 kJ (3) –4 kJ (4) 13 kJ

79. A P-T graph is shown for a cyclic process. Select correct statement regarding this



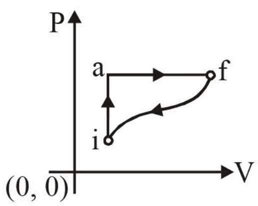
(1) During process CD, work done by gas is negative

(2) During process AB, work done by gas is positive

(3) During process BC internal energy of system increases

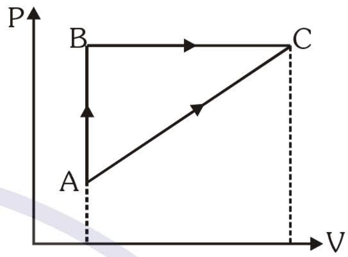
(4) During process BC internal energy of system decreases

80. In the diagram shown Q_{iaf} = 80 cal and W_{iaf} = 50 cal. If W = –30 cal for the curved path fi, value of Q for path fi, will be :-



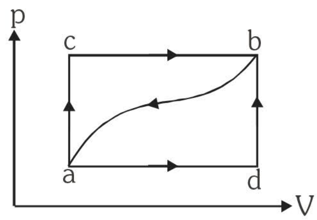
(1) 60 cal (2) 30 cal (3) –30 cal (4) –60 cal

81. A thermodynamical process is shown in figure with $P_A = 3 \times 10^4$ Pa; $V_A = 2 \times 10^{-3}$ m^3; $P_B = 8 \times 10^4$ P_a, $V_C = 5 \times 10^{-3}$ m^3. In the processes AB and BC, 200 J and 600 J of heat is added to the system respectively. The change in internal energy of the system in process AC would be :-



(1) 560 J (2) 800 J (3) 600 J (4) 640 J

82. When a system is taken from state 'a' to state 'b' along the path 'acb', it is found that a quantity of heat Q = 200 J is absorbed by the system and a work W = 80J is done by it. Along the path 'adb', Q = 144J. The work done along the path 'adb' is



(1) 6J (2) 12 J (3) 18 J (4) 24 J

83. A gas for which $\gamma = 4/3$ is heated at constant pressure. The percentage of total heat given that will be used for external work is :

(1) 40% (2) 25% (3) 60% (4) 20%

84. For monoatomic gas the relation between pressure of a gas and temperature T is $P^2 \alpha T^C$ where C is. (For adiabatic process)

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

85. An ideal monatomic gas at 300 K expands adiabatically to 8 times its volume. What is the final temperature ?

(1) 75 K (2) 300 K

(3) 560 K (4) 340 K

86. The volume of a poly-atomic gas $\left(\gamma = \frac{4}{3}\right)$ compressed adiabatically to $\frac{1}{27^{th}}$ of the original volume. If the original pressure of the gas is P_0 the new pressure will be

(1) $8\ P_0$ (2) $81\ P_0$

(3) $16\ P_0$ (4) $2\ P_0$

87. A diatomic gas undergoes adiabatic compression and its volume reduces to half of initial volume then its final pressure would be if gas initial pressure P

(1) $2^{1.4}P$ (2) $P/2$

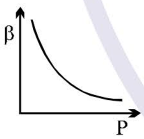
(3) $2P$ (4) $3.07\ P$

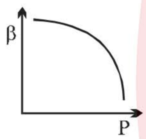
88. The molar heat capacity in a process of a diatomic gas, if it does a work of $\frac{Q}{4}$ when a heat of Q is supplied to it, is :-

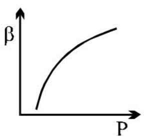
(1) $\frac{2}{5}R$ (2) $\frac{5}{2}R$

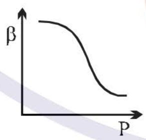
(3) $\frac{10}{3}R$ (4) $\frac{6}{7}R$

89. Which of the following graphs correctly represents the variation of $\beta = -(dV/dP)/V$ with P for an ideal gas at constant temperature?

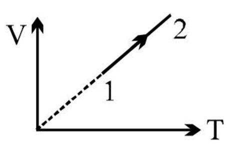
(1)


(2)


(3)


(4)


90. An ideal gas undergoes the process $1 \rightarrow 2$ as shown in the figure, the heat supplied and work done in the process is ΔQ and ΔW respectively. The ratio Q : W is



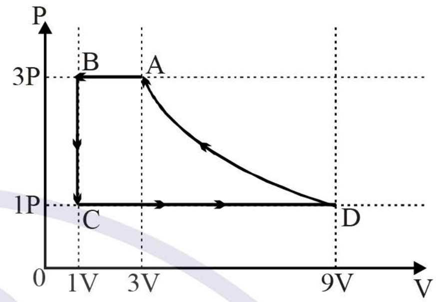
(1) $\gamma : \gamma - 1$

(2) γ

(3) $\gamma - 1$

(4) $\gamma - 1/\gamma$

91. One mole of a monatomic ideal gas is taken through a cycle ABCDA as shown in the P-V diagram. Column-II gives the characteristics involved in the cycle. Match them with each of the processes given in Column-I.



Column-I	**Column-II**
(A) Process $A \rightarrow B$	(p) Internal energy decreases
(B) Process $B \rightarrow C$	(q) Internal energy increases
(C) Process $C \rightarrow D$	(r) Heat is lost
(D) Process $D \rightarrow A$	(s) Heat is gained
	(t) Work is done on the gas

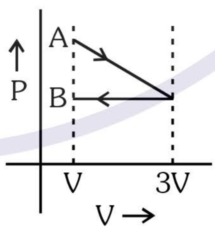
(1) $A \rightarrow p,r,t$; $B \rightarrow p,r$; $C \rightarrow q,s$; $D \rightarrow r,t$

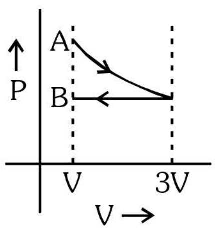
(2) $A \rightarrow r,t$; $B \rightarrow q,r$; $C \rightarrow q,s$; $D \rightarrow r,s$

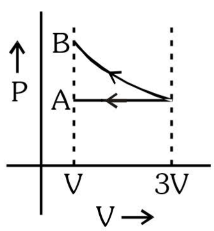
(3) $A \rightarrow p,r,t$; $B \rightarrow p,q,r$; $C \rightarrow s$; $D \rightarrow r,t$

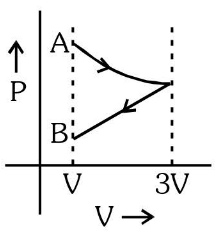
(4) $A \rightarrow p,r,t$; $B \rightarrow p,r$; $C \rightarrow q$; $D \rightarrow r,s$

92. One mole of an ideal gas goes from an initial state A to final state B via two processes. It firstly undergoes isothermal expansion from volume V to 3V and then its volume is reduced from 3V to V at constant pressure. The correct P-V diagram representing the two processes is :-

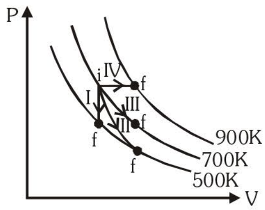
(1)


(2)


(3)


(4)


93. Thermodynamic processes are indicated in the following diagram :



Match the following

	Column-1		Column-2
P.	Process I	a.	Adiabatic
Q.	Process II	b.	Isobaric
R.	Process III	c.	Isochoric
S.	Process IV	d.	Isothermal

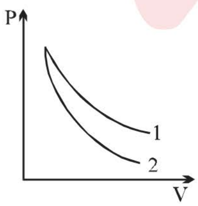
(1) $P \rightarrow c,\ \ Q \rightarrow a,\ \ R \rightarrow d,\ \ S \rightarrow b$

(2) $P \rightarrow c,\ \ Q \rightarrow d,\ \ R \rightarrow b,\ \ S \rightarrow a$

(3) $P \rightarrow d,\ \ Q \rightarrow b,\ \ R \rightarrow a,\ \ S \rightarrow c$

(4) $P \rightarrow a,\ \ Q \rightarrow c,\ \ R \rightarrow d,\ \ S \rightarrow b$

94. P-V plots for two gases during adiabatic processes are shown in the figure. Plots 1 and 2 should correspond respectively to

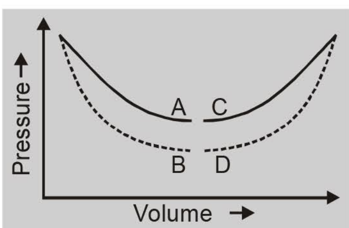


(1) He and O_2 (2) O_2 and He

(3) He and Ar (4) O_2 and N_2

95. In which of the figure no heat exchange between the gas and the surroundings will take place, if the gas is taken along curve:

(curves are isothermal and adiabatic)



(1) A (2) B (3) C (4) D

96. A gas speciman in one vessel is expended isothermally to double its volume and a simillar specimen in the second vessel is expanded adiabatically the same extent, then :

(1) In the second vessel, both pressure and work done are more

(2) In the second vessel, pressure in more, but the work done isless.

(3) In the first vessel, both pressure & work done are more.

(4) In the first vessel, pressure is more, but work done is less

97. A gas is compressed isothermally to half its initial volume. The same gas is compressed separately through an adiabatic process until its volume is again reduced to half. Then :-

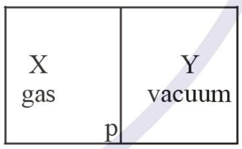
(1) Compressing the gas isothermally will require more work to be done.

(2) Compressing the gas through adiabatic process will require more work to be done.

(3) Compressing the gas isothermally or adiabatically will require the same amount of work.

(4) Which of the case (whether compression through isothermal or through adiabatic process) requires more work will depend upon the atomicity of the gas.

98. A closed container is fully insulated from outside. One half of it is filled with an ideal gas X separated by a plate P from the other half Y which contains a vacuum as shown in figure. When P is removed, X moves into Y. Which of the following statements is correct?



(1) No work is done by X

(2) X decreases in temperature

(3) X increases in internal energy

(4) X doubles in pressure

99. According to the second law of thermodynamics :

(1) heat energy cannot be completely converted to work

(2) work cannot be completely converted to heat energy

(3) for all cyclic processes we have $dQ/T < 0$

(4) the reason all heat engine efficiencies are less than 100% is friction, which is unavoidable

100. A Carnot engine takes 3×10^6 cal of heat from reservoir at 627°C and gives it to a sink at 27°C. Then 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

101. A Carnot engine working between 300 K and 600 K has a work output of 800 J per cycle. The amount of heat energy supplied to engine from the source in each cycle is :-

(1) 800 J (2) 1600 J (3) 3200 J (4) 6400 J

102. The efficiency of an ideal heat engine working between the freezing point and boiling point of water, is :-

(1) 26.8% (2) 20% (3) 6.25% (4) 12.5%

103. A Carnot engine whose sink is at 300 K has an efficiency of 40%. By how much amount should the temperature of source be increased so as to increase its efficiency by 50% of original efficiency?

(1) 150 K (2) 250 K (3) 300 K (4) 450 K

104. A Carnot engine takes 3000 kcal of heat from a reservoir at 627°C and gives a part of 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

105. The efficiency of a Carnot's engine at a particular source and sink temperature is $\frac{1}{2}$. When the sink temperature is reduced by 100°C, the engine efficiency becomes $\frac{2}{3}$. Find the source temperature.

(1) 300 K (2) 600 K (3) 900 K (4) 1200 K

106. The efficiency of carnot engine is 50% and temperature of sink is 500K. If temperature of source is kept constant and its efficiency raised to 60%, then the required temperature of the sink will be :-

(1) 100 K (2) 600 K (3) 400 K (4) 500 K

107. A refrigerator transfer 360 joule of energy in one second from temperature –3°C to 27°C. Calculate the average power consumed, assuming no energy losses in the process.

(1) 18 W (2) 54 W

(3) 40 W (4) 120 W

108. A reversible refrigerator operates between a low temperature reservoir at T_C and a high temperature reservoir at T_H. Its coefficient of performance is given by :

(1) $(T_H - T_C)/T_C$ (2) $T_C/(T_H - T_C)$

(3) $(T_H - T_C)/T_H$ (4) $T_H/(T_H - T_C)$

109. A refrigerator transfer 180 joule of energy in one second from temperature –0°C to 30°C. Calculate the average power consumed, assuming no energy losses in the process. (approx)

(1) 18 W (2) 54 W (3) 20 W (4) 120 W

110. The coefficient of performance of a refrigerator is 5. If the temperature inside freezer is –20°C, the temperature of the surroundings to which it rejects heat is :

(1) 21°C (2) 31°C (3) 41°C (4) 11°C

111. A refrigerator works between 4°C and 30°C. It is required to remove 300 calories of heat every second in order to keep the temperature of the refrigerated space constant. The power required is:

(Take 1 cal = 4.2 Joules)

(1) 1.182 W (2) 11.82 W

(3) 118.25 W (4) 1182 W

112. The temperature inside a refrigerator is t_2°C and the room temperature is t_1°C. The amount of heat delivered to the room for each joule of electrical energy consumed ideally will be :-

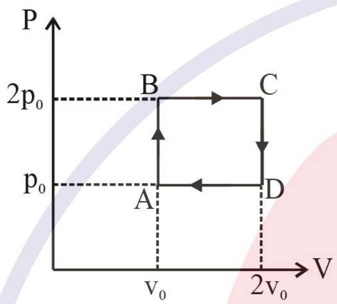
(1) $\frac{t_2 + 273}{t_1 - t_2}$ (2) $\frac{t_1 + t_2}{t_1 + 273}$

(3) $\frac{t_1}{t_1 - t_2}$ (4) $\frac{t_1 + 273}{t_1 - t_2}$

113. A carnot engine having an efficiency of $\frac{1}{20}$ as heat engine, is used as a refrigerator. If the work done on the system is 20 J, the amount of energy absorbed from the reservoir at lower temperature is :-

(1) 380 J (2) 399 J (3) 400 J (4) 10 J

114. The P-V diagram represents the thermodynamic cycle of an engine, operating with an ideal monoatomic gas. The amount of heat, extracted from the source in a single cycle is :



(1) p_0v_0 (2) $\left(\frac{13}{2}\right)p_0v_0$

(3) $\left(\frac{11}{2}\right)p_0v_0$ (4) $4p_0v_0$

115. In the above question efficiency of cycle ABCDA is nearly :

(1) 12.5% (2) 15.2% (3) 9.1% (4) 10.5%

116 On a cold morning, a metal surface will feel colder to touch than a wooden surface because

(1) Metal has high specific heat

(2) Metal has high thermal conductivity

(3) Metal has low specific heat

(4) Metal has low thermal conductivity

117. The ratio of cofficient of thermal conductivity of two different materials is 4:9. If the thermal resistance of rods of same thickness of these material is same, then what is ratio of length of these rods -

(1) 3:5 (2) 4:9 (3) 25:9 (4) 9:25

118. Which of the following cylindrical rods will conduct most heat, when their ends are maintained at the same steady temperature

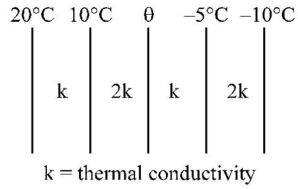
(1) Length 1 m; radius 1 cm

(2) Length 2 m; radius 1 cm

(3) Length 2 m; radius 2 cm

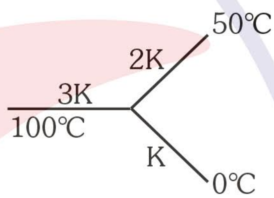
(4) Length 1 m; radius 2 cm

119. The figure shows the face and interface temperature of a composite slab containing of four layers of two materials having identical thickness. Under steady state condition, find the value of temperature θ.



(1) 5°C (2) 10°C (3) –15°C (4) 15°C

120. Three rods of same dimensions have thermal conductivities 3K, 2K and K. They are arranged as shown, with their ends at 100°C, 50°C and 0°C. The temperature of their junction is :-



(1) 75°C (2) $\frac{200}{3}$°C (3) 40°C (4) $\frac{100}{3}$°C

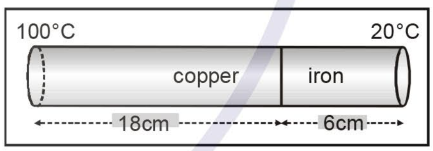
121. The coefficient of thermal conductivity of copper is nine times that of steel. In the composite cylindrical bar shown in the figure what will be the temperature at the junction of copper and steel ?

(1) 80°C

(2) 67°C

(3) 33°C

(4) 25°C

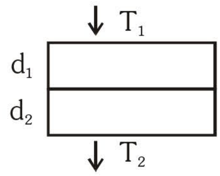


122. A Cylinder of radius R made of material of thermal conductivity K_1 is surrounded by a cylindrical shell of inner radius R and outer radius 2 R made of a meterial of thermal conductivity K_2. The two ends of combined system are maintained at two different temp there is no loss of heat across cylindrical surface and system is in steady state calculate effective thermal conductivity of system.

(1) $\frac{K_1 + 3K_2}{4}$ (2) $K_1 + K$

(3) $\frac{K_1 + 8K_2}{9}$ (4) $\frac{8K_1 + K_2}{9}$

123. Two conductors having thickness d_1 and d_2, thermal conductivity k_1 and k_2 are placed one above the another. Find the equivalent thermal conductance :-



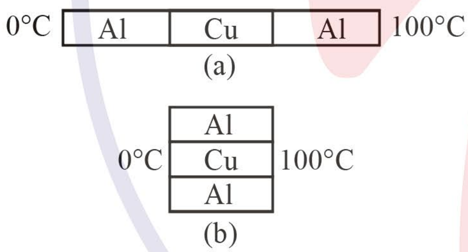
(1) $\frac{(d_1+d_2)(k_1d_2+k_2d_1)}{2(k_1+k_2)}$

(2) $\frac{(d_1-d_2)(k_1d_2+k_2d_1)}{2(k_1+k_2)}$

(3) $\frac{k_1k_2(d_1+d_2)}{d_1k_2+d_2k_1}$

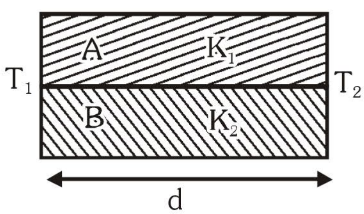
(4) None of these

124. The three rods shown in figure have identical dimensions. Heat flows from the hot end at a rate of 40 W in the arrangement (a). Find the rates of heat flow when the rods are joined as in arrangement (b). (Assume K_{Al} = 200 W/m °C and K_{Cu} = 400 W/m °C)



(1) 75 W (2) 200 W (3) 400 W (4) 4 W

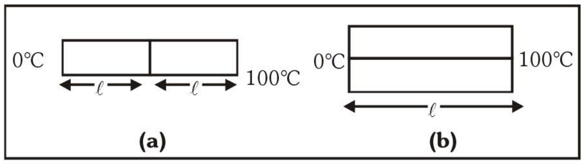
125. Two rods A and B of different materials are welded together as shown in figure. Their thermal conductivities are K_1 and K_2. The thermal conductivity of the composite rod will be :-



(1) $\frac{3(K_1+K_2)}{2}$ (2) $K_1 + K_2$

(3) $2(K_1 + K_2)$ (4) $\frac{K_1+K_2}{2}$

126. Two identical square rods of metal are welded end to end as shown in figure (1), 20 calories of heat flows through it in 4 minutes. If the rods are welded as shown in figure (2), the same amount of heat will flow through the rods in -



(1) 1 minute

(2) 2 minutes

(3) 4 minutes

(4) 16 minutes

127. In natural convection, a heated portion of a liquid moves because :

(1) Its molecular motion becomes aligned

(2) Of moleuclar collisions within it

(3) Its density is less than that of the surrounding fluid

(4) Of currents of the surrounding fluid

128. It is hotter at the same distance over the top of a fire than it is in the side of it, mainly because

(1) Air conducts heat upwards

(2) Heat is radiated upwards

(3) Convection takes more heat upwards

(4) Convection, conduction and radiation all contribute significantly transferring heat upward

129. The power radiated by a black body is P and it radiates maximum energy at wavelength λ_0. If the temperature of the black body is now changed so that it radiates maximum energy at wavelength $\frac{3}{5}\lambda_0$, the power radiated by it becomes nP. The value of n is :-

(1) $\frac{3}{5}$ (2) $\frac{4}{3}$

(3) $\frac{625}{81}$ (4) $\frac{81}{625}$

130. Two stars appear to be red and blue, what is true about them -

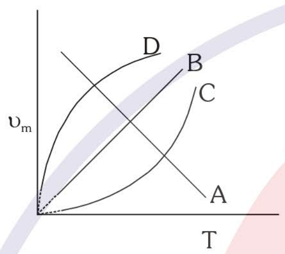
(1) The red star is nearer

(2) The blue star is nearer

(3) The temperature of red star is more

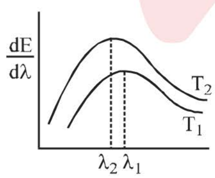
(4) The temperature of blue star is more

131. The $\upsilon_m - T$ curve for a perfect black body is –
($\upsilon_m \rightarrow$ frequency corresponding to maximum emission of radiation)



(1) A (2) B (3) C (4) D

132. The spectral emissive power E_λ for a body at temperature T_1 is plotted against the wavelength and area under the curve is found to be A. At a different temperature T_2 the area is found to be 625A. Then $\lambda_1/\lambda_2 =$



(1) 5 (2) 1/5 (3) $1/\sqrt{5}$ (4) $\sqrt{5}$

133. The temperature of a furnace is 2324°C and the intensity is maximum in its radiation spectrum nearly at 12000 A°. If the intensity in the spectrum of a star is maximum nearly at 4800 A°, then the surface temperature of star is

(1) 8400°C (2) 7200°C

(3) 6219.5°C (4) 5900°C

134. Two stars A and B of surface area S_a and S_b & temperature T_a and T_b glow red and blue respectively. Choose the correct option.

(1) $T_a > T_b$ (2) $T_a < T_b$

(3) $T_aS_a = T_bS_b$ (4) $T_aS_b = T_bS_a$

135. Three objects coloured black, gray and white can withstand hostile conditions upto 2800°C. These objects are thrown into a furnace where each of them attains a temperature of 2000°C. Which object will gloss brightest :-

(1) The white object

(2) The black object

(3) All glow with equal brightness

(4) Gray object

136. A piece of iron is heated in a flame. It first becomes dull red then becomes reddish yellow and finally turns to white hot. The correct explanation for the above observation is possible by using :-

(1) Newton's Law of cooling

(2) Stefan's Law

(3) Wein's displacement Law

(4) Kirchoff's Law

137. The rectangular surface of area 8cm × 4 cm of a black body at a temperature of 127°C emits energy at the rate of E per second. If the length and breadth of the surface are each reduced to half of the initial value and the temperature is raised to 527°C, the rate of emission of energy will become.

(1) 4E (2) $\frac{81}{16}$E (3) $\frac{9}{16}$E (4) 16 E

138. A black body, at a temperature of 227°C, radiates heat at a rate of 7 cal cm^{-2} s^{-1}. At a temperature of 727°C, the rate of heat radiated in the same units will be :–

(1) 80 (2) 60 (3) 50 (4) 112

139. A spherical black body with a radius of 10 cm radiates 810 watt power at 900 K. If the radius were halved and the temperature doubled, the power radiated in watt would be :-

(1) 450 (2) 1000

(3) 3240 (4) 225

140. Cooling rate of a sphere of 600 K at external environment (200 K) is R. When the temperature of sphere is reduced to 400 K then cooling rate of the sphere becomes :

(1) $\frac{3}{16}$ R (2) $\frac{16}{3}$ R

(3) $\frac{9}{27}$ R (4) None

141. A solid cube and sphere are made of same substance and both have same surface area. If the temperature of both bodies 120^0 C then :

(1) Both will loss of Heat by same rate

(2) Rate of loss of Heat of cube will be more than that of the sphere

(3) Rate of loss of Heat of the sphere will be more than that of the cube

(4) Rate of loss of Heat will be more for that whose mass is more

142. Two spheres of radii in the ratio 1 : 2 and densities in the ratio 2 : 1 and of same specific heat, are heated to same temperature and left in the same surrounding. Their rate of falling temperature will be in the ratio :

(1) 2 :1 (2) 1 : 1

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

143. Newton's law of cooling is used in laboratory for the determination of the

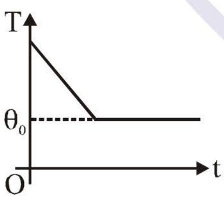
(1) Specific heat of the gases

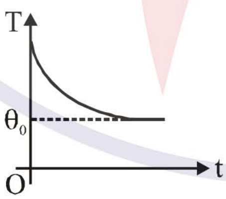
(2) The latent heat of gases

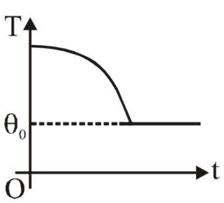
(3) Specific heat of liquids

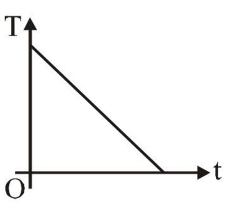
(4) Latent heat of liquids

144. If a piece of metal is heated to temperature θ and then allowed to cool in a room which is at temperature θ_0, the graph between the temperature T of the metal and time t will be closest to

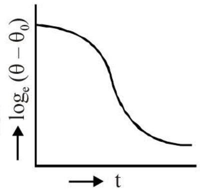
(1) 

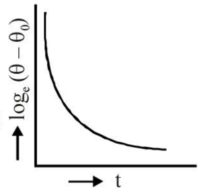
(2) 

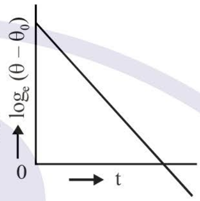
(3) 

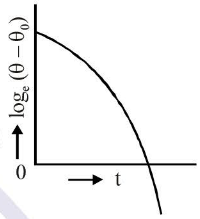
(4) 

145. A liquid in a beaker has temperature θ at time t and θ_0 is temperature of surroundings, then according to Newton's law of cooling, correct graph between $\log_e(\theta - \theta_0)$ and t is:

(1) 

(2) 

(3) 

(4) 

146. A body cools down from 80°C to 60°C in 10 minutes when the temperature of surroundings is 30°C. The temperature of the body after next 10 minutes will be :-

(1) 30°C (2) 48°C (3) 50°C (4) 52°C

147. A body cool from 90°C to 70°C in 5 minutes if temperature of surrounding is 20°C find the time taken by body to cool from 60°C to 30°C. Assuming Newton's law of cooling is valid.

(1) 10 min (2) 12 min (3) 18 min (4) 5 min

148. A body cools from a temperature 3T to 2T in 15 min. The room temperature is T. Assume that Newton's law of cooling is applicable. The temperature of the body at the end of next 15 min will be :-

(1) $\frac{4}{3}$T (2) T (3) $\frac{7}{4}$T (4) $\frac{3}{2}$T

149. The total radiant energy per unit area, normal to the direction of incidence, received at a distance R from the centre of a star of radius r, whose outer surface radiates as a black body at a temperature T Kelvin is given by :-

(1) $\frac{4\pi\sigma r^2 T^4}{R^2}$ (2) $\frac{\sigma r^2 T^4}{R^2}$

(3) $\frac{\sigma r^2 T^4}{4\pi r^2}$ (4) $\frac{\sigma r^4 T^4}{r^4}$

(Where σ is Stefan's Constant)

150. If e_λ and a_λ be the emissive power and absorption power respectively of a body and E_λ be the emissive power of an ideal black body, then from Kirchhoff's laws

(1) $a_\lambda = E_\lambda / e_\lambda$ (2) $a_\lambda / e_\lambda = E_\lambda$

(3) $e_\lambda / a_\lambda = E_\lambda$ (4) $e_\lambda = E_\lambda / a_\lambda$

151. If E is the total energy emitted by a body at a temperature T K and E_{max} is the maximum energy emitted by it at the same temperature, then -

(1) $E \propto T^4$; $E_{max} \propto T^5$ (2) $E \propto T^4$; $E_{max} \propto T^{-5}$

(3) $E \propto T^{-4}$; $E_{max} \propto T^4$ (4) $E \propto T^5$; $E_{max} \propto T^4$

ANSWER KEY

Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	**3**	**1**	**2**	**3**	**4**	**2**	**1**	**1**	**4**	**1**	**1**	**3**	**3**	**1**	**1**
Que.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Ans.	**3**	**3**	**1**	**3**	**4**	**3**	**4**	**1**	**4**	**1**	**4**	**4**	**3**	**4**	**3**
Que.	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
Ans.	**3**	**4**	**2**	**1**	**4**	**1**	**1**	**3**	**3**	**2**	**2**	**1**	**1**	**2**	**4**
Que.	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Ans.	**1**	**3**	**4**	**2**	**3**	**4**	**1**	**4**	**2**	**1**	**3**	**4**	**2**	**3**	**4**
Que.	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
Ans.	**1**	**1**	**3**	**2**	**1**	**1**	**3**	**2**	**1**	**2**	**1**	**1**	**3**	**4**	**1**
Que.	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
Ans.	**4**	**2**	**4**	**3**	**4**	**1**	**4**	**2**	**4**	**1**	**2**	**1**	**3**	**1**	**1**
Que.	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105
Ans.	**1**	**2**	**1**	**2**	**2**	**3**	**2**	**1**	**1**	**2**	**2**	**1**	**2**	**2**	**2**
Que.	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
Ans.	**3**	**3**	**2**	**3**	**2**	**3**	**4**	**1**	**2**	**2**	**2**	**2**	**4**	**1**	**2**
Que.	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135
Ans.	**1**	**1**	**3**	**3**	**4**	**1**	**3**	**3**	**3**	**4**	**2**	**1**	**3**	**2**	**2**
Que.	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150
Ans.	**3**	**1**	**4**	**3**	**1**	**1**	**2**	**3**	**2**	**3**	**2**	**3**	**4**	**2**	**3**
Que.	151														
Ans.	**1**														