HEAT & THERMODYNAMICS LEVEL-1

SELECT THE CORRECT ALTERNATIVE (ONLY ONE CORRECT ANSWER)

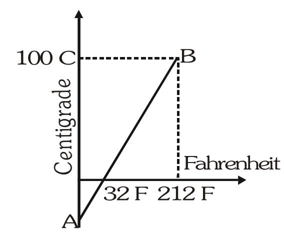
1. On an X temperature scale, water freezes at –125.0 X and boils at 375.0 X. On a Y temperature scale, water freezes at –70.0 Y and boils at –30.0 Y. The value of temperature on X–scale equal to the temperature of 50.0 Y on Y–scale is :–

(A) 455.0 X (B) –125.0 X (C) 1375.0 X (D) 1500.0 X

2. A centigrade and a Fahrenheit thermometer are dipped in boiling water. The water temperature is lowered until the Fahrenheit thermometer registers 140 F What is the temperature as registered by the centigrade thermometer :–

(A) 30 (B) 40 (C) 60 (D) 80

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



(A) Slope of line AB is 9/5
(B) Slope of line AB is 5/9
(C) Slope of line AB is 1/9
(D) slope of line AB is 3/9

4. Two absolute scales X and Y assigned numerical values 200 and 450 to the triple point of water. What is the relation between T_X and T_Y ?

(A) $9T_X = 4T_Y$ (B) $4T_X = 9T_Y$ (C) $T_X = 3T_Y$ (D) None of these

5. A faulty thermometer reads freezing point and boiling point of water as –5 C and 95 C respectively. What is the correct value of temperature as it reads 60 C on faulty thermometer?

(A) 60 C (B) 65 C (C) 64 C (D) 62 C

6. A steel scale is to be prepared such that the millimeter intervals are to be accurate within 6 10^{-5} mm. The maximum temperature variation during the ruling of the millimeter marks is (α=12 $10^{-6}C^{-1}$):–

(A) 4.0 C (B) 4.5 C (C) 5.0 C (D) 5.5 C.

7. A meter washer has a hole of diameter d_1 and external diameter d_2 , where $d_2=3d_1$. On heating, d_2 increases by 0.3%. Then d_1 will :–

(A) decrease by 0.1% (B) decrease by 0.3% (C) increase by 0.1% (D) increase by 0.3%.

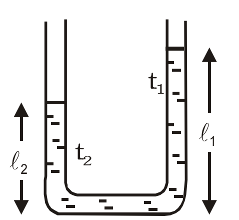
8. At 4 C, 0.98 of the volume of a body is immersed in water. The temperature at which the entire body gets immersed in water is (neglect the expansion of the body) $(\gamma_w = 3.3 \times 10^{-4} K^{-1})$:–

(A) 40.8 C (B) 64.6 C (C) 60.6 C (D) 58.8 C

9. Two metal rods of the same length and area of cross–section are fixed ends to end between rigid supports. The materials of the rods have Young moduli Y_1 and Y_2, and coefficients of linear expansion α_1 and α_2. When rods are cooled the junction between the rods does not shift if:–

(A) $Y_1\alpha_1 = Y_2\alpha_2$ (B) $Y_1\alpha_2 = Y_2\alpha_1$ (C) $Y_1\alpha^2_1 = Y_2\alpha^2_2$ (D) $Y^2_1\alpha_1 = Y^2_2\alpha_2$

10. In a vertical U–tube containing a liquid, the two arms are maintained at different temperatures, t_1 and t_2. The liquid columns in the two arms have heights ℓ_1 and ℓ_2 respectively. The coefficient of volume expansion of the liquid is equal to:–

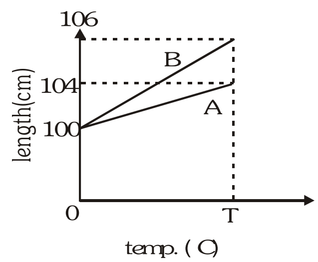


(A) $\frac{\ell_1 - \ell_2}{\ell_2 t_1 - \ell_1 t_2}$ (B) $\frac{\ell_1 - \ell_2}{\ell_1 t_1 - \ell_2 t_2}$ (C) $\frac{\ell_1 + \ell_2}{\ell_2 t_1 + \ell_1 t_2}$ (D) $\frac{\ell_1 + \ell_2}{\ell_1 t_1 + \ell_2 t_2}$

11. A steel rod of length 1 m is heated from 25 C to 75 C keeping its length constant. The longitudinal strain developed in the rod is:– (Given : Coefficient of linear expansion of steel = 12 x 10^{-6}/ C)
(A) $6 \quad 10^{-6}$ (B) $-6 \quad 10^{-5}$ (C) $-6 \quad 10^{-4}$ (D) zero

12. A brass disc fits simply in a hole of a steel plate. The disc from the hole can be loosened if the system ($\alpha_{brass} > \alpha_{steel}$)
(A) First heated then cooled (B) First cooled then heated
(C) Is heated (D) Is cooled

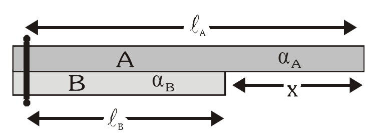
13. The variation of lengths of two metal rods A and B with change in temperature is shown in figure. The ratio of $\frac{\alpha_A}{\alpha_B}$ is:–



(A) $\frac{3}{2}$ (B) $\frac{2}{3}$ (C) $\frac{4}{3}$ (D) $\frac{3}{4}$

14. A steel tape is placed around the earth at the equator when the temperature is 10 C. What will be the clearance between the tape and the ground (assumed to be uniform) if the temperature of the tape rises to 40 C ? Neglect expansion of the earth. Radius of earth at equator is 6400 km & $\alpha_{steel} = 1.2 \quad 10^{-5}\ K^{-1}$
(A) 2.3 m (B) 2.1 m (C) 2.3 km (D) 230 m

15. Bars of two different metals are bolted together, as shown in figure.The distance x does not change with temperature if:–



(A) $\frac{\ell_A}{\ell_B} = \frac{\alpha_A}{\alpha_B}$ (B) $\frac{\ell_A}{\ell_B} = \frac{\alpha_B}{\alpha_A}$ (C) $\frac{\ell_A^2}{\ell_B^2} = \frac{\alpha_A}{\alpha_B}$ (D) $\frac{\ell_A^2}{\ell_B^2} = \frac{\alpha_B}{\alpha_A}$

16. A metal rod A of length ℓ_0 expands by $\Delta\ell$ when its temperature is raised by 100 C. Another rod B of different metal of length $2\ell_0$ expands by $\Delta\ell/2$ for same rise in temperature. A third rod C of length $3\ell_0$ is made up of pieces of rods A and B placed end to end expands by $2\Delta\ell$ on heating through 100 K. The length of each portion of the composite rod is:–
(A) $\frac{5}{3}\ell_0, \frac{4}{3}\ell_0$ (B) $\ell_0, 2\ell_0$ (C) $\frac{3\ell_0}{2}, \frac{3\ell_0}{2}$ (D) $\frac{2}{3}\ell_0, \frac{7}{3}\ell_0$

17. The coefficient of linear expansion 'α' of a rod of length 2m varies with the distance x from the end of the rod as $\alpha = \alpha_0 + \alpha_1 x$ where $\alpha_0 = 1.76 \quad 10^{-5}\ C^{-1}$ and $\alpha_1 = 1.2 \quad 10^{-6} m^{-1}\ C^{-1}$. The increase in the length of the rod, when heated through 100 C is:–
(A) 2cm (B) 3.76mm (C) 1.2 mm (D) None of these

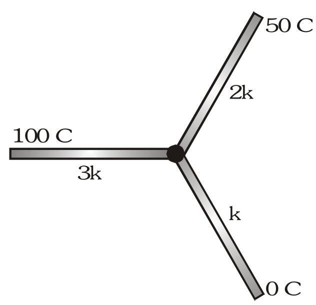
18. The coefficient of linear expansion α of the material of a rod of length ℓ_0 varies with absolute temperature as $\alpha = aT - bT^2$ where a & b are constants. The linear expansion of the rod when heated from T_1 to $T_2 = 2T_1$ is:–
(A) $\left(\frac{3}{2}aT_1^2 - \frac{7b}{3}T_1^3\right)L_0$ (B) $\left(4a - \frac{7b}{3}\right)T_1 L_0$ (C) $\left(2aT_1^2 - \frac{7b}{3}T_1^3\right)L_0$ (D) None of these

19. A clock with a metallic pendulum gains 6 seconds each day when the temperature is 20 C and loses 6 second when the temperature is 40 C. Find the coefficient of linear expansion of the metal.
(A) 1.4 10^{-5} C^{-1} (B) 1.4 10^{-6} C^{-1} (C) 1.4 10^{-4} C^{-1} (D) 0.4 10^{-6} C^{-1}

20. A steel scale measures the length of a copper rod as ℓ_0 when both are at 20 C, which is the calibration temperature for the scale. The scale reading when both are at 40 C, is:–
(A) $(1+20\alpha_C)\ell_0$ (B) $(1+20\alpha_S)\ell_0$ (C) $\left(\frac{1+20\alpha_S}{1+20\alpha_C}\right)\ell_0$ (D) $\left(\frac{1+20\alpha_C}{1+20\alpha_S}\right)\ell_0$

21. The coefficient of apparent expansion of a liquid when determined using two different vessels A and B are γ_1 and γ_2 respectively. If the coefficient of linear expansion of the vessel A is α_1, the coefficient of linear expansion of the vessel B is:–
(A) $\frac{\alpha_1\gamma_1\gamma_2}{\gamma_1+\gamma_2}$ (B) $\frac{\gamma_1-\gamma_2}{2\alpha_1}$ (C) $\frac{\gamma_1+\gamma_2+\alpha}{3}$ (D) $\frac{\gamma_1-\gamma_2+3\alpha_1}{3}$

22. Three rods of the 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:–



(A) 75 C (B) $\frac{200}{3}$°C (C) 40 C (D) $\frac{100}{3}$°C

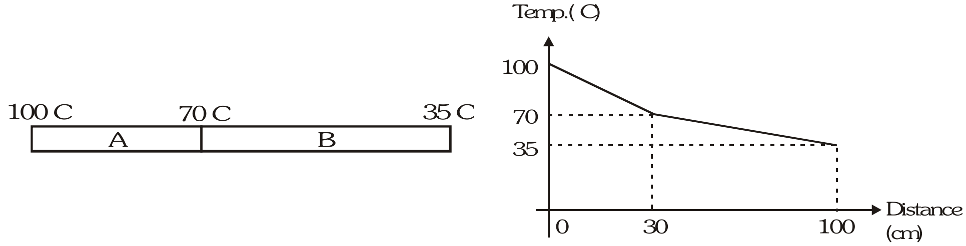
23. A cup of tea cools from 80 C to 60 C in one minute. The ambient temperature is 30 C. In cooling from 60 C to 50 C. It will take :–
(A) 50 s (B) 90 s (C) 60 s (D) 48 s

24. Ice starts forming in lake with water at 0 C when the atmospheric temperature is –10 C. If the time taken for 1 cm of ice be 7 hours, then the time taken for the thickness of ice to change from 1 cm to 2 cm is :–
(A) 7 hours (B) 14 hours (C) less than 7 hours (D) more than 7 hours

25. There is a small hole in a container. At what temperature should it be maintained in order that it emits one calorie of energy per second per meter^2 :–
(A) 10K (B) 500K (C) 200K (D) 100K

26. A blackened metallic foil is kept at a distance d from a spherical heater. The power absorbed by the foil is P. If the temperature of heater and distance both are doubled, then the power absorbed by the foil will be:–
(A) 8P (B) 4P (C) 2P (D) P

27. Two different rods A and B are kept as shown in figure. The variation of temperature of different cross sections with distance is plotted in a graph shown in figure. The ratio of thermal conductivities of A and B is-

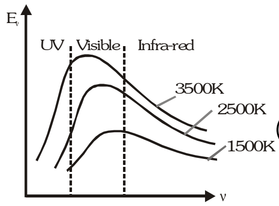


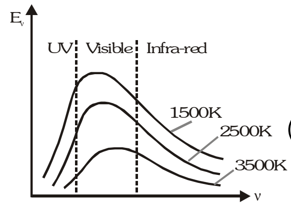
(A) 2 (B) 0.5 (C) 1 (D) 2/3

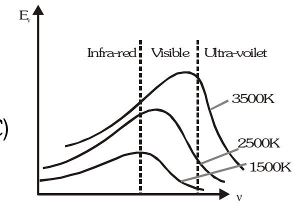
28. The area of cross–section of rod is given by $A = A_0 (1 + \alpha x)$ where A_0 & α are constant and x is the distance from one end. If the thermal conductivity of the material is K, what is the thermal resistance of the rod if its length is ℓ_0?

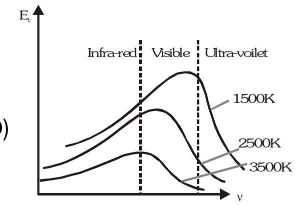
(A) $KA_0\alpha\ \ell n(1 + \alpha\ell_0)$ (B) $\frac{1}{KA_0\alpha}\ell n(1+\alpha\ell_0)$ (C) $\frac{\alpha}{KA_0}\ell n(1+\alpha\ell_0)$ (D) $\frac{KA_0}{\alpha}\ell n(1+\alpha\ell_0)$

29. Which of the following graph shows the correct variation in intensity of heat radiations by black body and frequency at a fixed temperature:–

(A) 

(B) 

(C) 

(D) 

30. A red star and a green star radiate energy at the same rate which star is bigger.
(A) Red (B) Green
(C) Both have same size (D) Can't be say anything

31. 250 g of water and an equal volume of alcohol of mass 200 g are placed successively in the same calorimeter and cools from 60 C to 55 C in 130 sec and 67 sec respectively. If the water equivalent of the calorimeter is 10 g then the specific heat of alcohol in cal/g C is :–
(A) 1.30 (B) 0.67 (C) 0.62 (D) 0.985

32. The weight of a person is 60 kg. If he gets 10 calories of heat through food and the efficiency of his body is 28%, then upto what height he can climb ? Take $g = 10\ m\ s^{-2}$
(A) 100 cm (B) 1.96 cm (C) 400 cm (D) 1000 cm

33. Two identical masses of 5 kg each fall on a wheel from a height of 10m. The wheel disturbs a mass of 2 kg water, the rise in temperature of water will be :–
(A) 2.6 C (B) 1.2 C (C) 0.32 C (D) 0.12 C

34. Hailstone at 0 C falls from a height of 1 km on an insulating surface converting whole of its kinetic energy into heat. What part of it will melt:– [$g = 10\ m/s^2$, $L_{ice} = 330\ \ 10^3\ J\ kg^{-1}$]

(A) $\frac{1}{33}$ (B) $\frac{1}{8}$ (C) $\frac{1}{33}\times10^{-4}$ (D) All of it will melt

35. If H_C, H_K and H_F are heat required to raise the temperature of one gram of water by one degree in Celsius, Kelvin and Fahrenheit temperature scales respectively then :–
(A) $H_K > H_C > H_F$ (B) $H_F > H_C > H_K$ (C) $H_K = H_C > H_F$ (D) $H_K = H_C = H_F$

36. Steam at 100 C is passed through 1.1 kg of water contained in a calorimeter of water equivalent 0.02 kg at 15 C till the temperature of the calorimeter and its contents rises to 80 C. The mass of the steam condensed in kg is :–
(A) 0.130 (B) 0.065 (C) 0.260 (D) 0.135

37. Water is used to cool the radiators of engines in cars because :–
(A) of its low boiling point (B) of its high specific heat
(C) of its low density (D) of its easy availability

38. If mass–energy equivalence is taken into account, when water is cooled to form ice, the mass of water should:–
(**Note** : The mass energy of an object is the energy equivalent of its mass, as given by $E = mc^2$, where m = mass of object & c = speed of light)
(A) increase (B) remain unchanged
(C) decrease (D) first increase then decrease

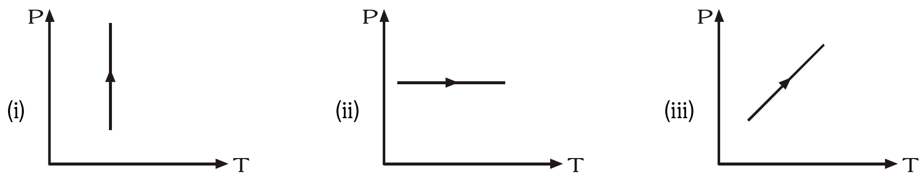
39. If the intermolecular forces vanish away, the volume occupied by the molecules contained in 4.5 kg. water at standard temperature and pressure will be given by :–

(A) 5.6 m^3 (B) 4.5 m^3 (C) 11.2 litre (D) 11.2 m^3

40. A refrigerator converts 100 g of water at 25 C into ice at – 10 C in one hour and 50 minutes. The quantity of heat removed per minute is:– (Specific heat of ice = 0.5 cal/g C, latent heat of fusion = 80 cal/g)

(A) 50 cal (B) 100 cal (C) 200 cal (D) 75 cal

41. Pressure versus temperature graphs of an ideal gas are as shown in figure. Choose the wrong statement:–



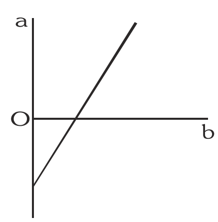
(A) Density of gas is increasing in graph (i) (B) Density of gas decreasing in graph (ii)

(C) Density of gas is constant in graph (iii) (D) None of the above

42. In a process the density of a gas remains constant. If the temperature is doubled, then the change in the pressure will be:–

(A) 100 % increase (B) 200 % increase (C) 50 % decrease (D) 25 % decrease

43. The expansion of unit mass of a perfect gas at constant pressure is shown in the diagram. Here:–



(A) a = volume, b = C temperature (B) a = volume, b = K temperature

(C) a = C temperature, b = volume (D) a = K temperature, b = volume

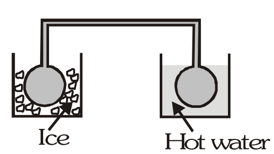
44. Air is filled at 60 C in a vessel of open mouth. The vessel is heated to a temperature T so that $\frac{1}{4}^{th}$ part of air escapes. The value of T is :–

(A) 80 C (B) 444 C (C) 333 C (D) 171 C

45. One mole of an ideal gas undergoes a process $P = \frac{P_0}{1+(V_0/V)^2}$ Here P_0 and V_0 are constants. Change in temperature of the gas when volume is changed from $V = V_0$ to $V = 2V_0$ is :–

(A) $-\frac{2P_0V_0}{5R}$ (B) $\frac{11P_0V_0}{10R}$ (C) $-\frac{5P_0V_0}{4R}$ (D) P_0V_0

46. 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 :–



(A) 100 C (B) 182 C (C) 256 C (D) 546 C

47. A gas has volume V and pressure P. The total translational kinetic energy of all the molecules of the gas is:–

(A) $\frac{3}{2}$PV only if the gas is monoatomic. (B) $\frac{3}{2}$PV only if the gas is diatomic.

(C) $>\frac{3}{2}$PV if the gas is diatomic. (D) $\frac{3}{2}$PV in all cases.

48. A mixture of n_1 moles of monoatomic gas and n_2 moles of diatomic gas has $\frac{C_P}{C_V} = \gamma = 1.5$:–

(A) $n_1 = n_2$ (B) $2n_1 = n_2$ (C) $n_1 = 2n_2$ (D) $2n_1 = 3n_2$

49. Four containers are filled with monoatomic ideal gases. For each container, the number of moles, the mass of an individual atom and the rms speed of the atoms are expressed in terms of n, m and v_{rms} respectively. If T_A, T_B,T_C and T_D are their temperatures respectively then which one of the options correctly represents the order ?

	A	B	C	D
Number of moles	n	3n	2n	n
Mass	4m	m	3m	2m
Rms speed	v_{rms}	$2v_{rms}$	v_{rms}	$2v_{rms}$
Temperature	T_A	T_B	T_C	T_D

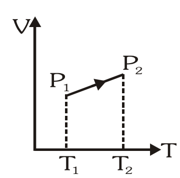
(A) $T_B = T_C > T_A > T_D$ (B) $T_D > T_A > T_C > T_B$ (C) $T_D > T_A = T_B > T_C$ (D) $T_B > T_C > T_A > T_D$

50. 10^{23} molecules of a gas strike a target of area 1 m^2 at angle 45 to normal and rebound elastically with speed 1 kms^{-1}. The impulse normal to wall per molecule is:– [Given : mass of molecule = 3.32 10^{-27}kg]

(A) 4.7 10^{-24} kg ms^{-1} (B) 7.4 10^{-24} kg ms^{-1}

(C) 3.32 10^{-24} kg ms^{-1} (D) 2.33 kg ms^{-1}

51. From the following V–T diagram we can conclude:–

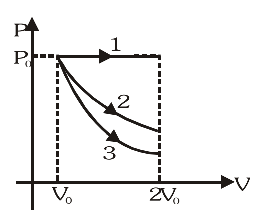


(A) $P_1 = P_2$ (B) $P_1>P_2$ (C) $P_1 < P_2$ (D) Can't say anything

52. The density in grams per litre of ethylene (C_2H_4) at STP is :–

(A) 1.25 (B) 2.50 (C) 3.75 (D) 5.25

53. A gas is expanded from volume V_0 to $2V_0$ under three different processes. Process 1 is isobaric process, process 2 is isothermal and process 3 is adiabatic. Let ΔU_1, ΔU_2 and ΔU_3, be the change in internal energy of the gas is these processes. Then :–



(A) $\Delta U_1 > \Delta U_2 > \Delta U_3$ (B) $\Delta U_1 < \Delta U_2 < \Delta U_3$

(C) $\Delta U_2 < \Delta U_1 < \Delta U_3$ (D) $\Delta U_2 < \Delta U_3 < \Delta U_1$

54. Some of the thermodynamic parameters are state variables while some are process variables. Some grouping of the parameters are given. Choose the correct one.

(A) State variables : Temperature, No of moles
Process variables : Internal energy, work done by the gas.
(B) State variables : Volume, Temperature
Process variables : Internal energy, work done by the gas.
(C) State variables : Work done by the gas, heat rejected by the gas
Process variables : Temperature, volume.
(D) State variables : Internal energy, volume
Process variables : Work done by the gas, heat absorbed by the gas.

55. For an ideal gas PT^{11} = constant then volume expansion coefficient is equal to :–

(A) $\frac{11}{T}$ (B) $\frac{1}{T}$ (C) $\frac{12}{T}$ (D) $\frac{2}{T}$

56. The internal energy of a gas is given by U = 5 + 2PV. It expands from V_0 to $2V_0$ against a constant pressure P_0. The heat absorbed by the gas in the process is :–

(A) $-3P_0V_0$ (B) $3P_0V_0$ (C) $2P_0V_0$ (D) P_0V_0

57. When water is heated from 0 C to 4 C and C_P and C_V are its specific heats at constant pressure and constant volume respectively, then :–

(A) $C_P > C_V$ (B) $C_P < C_V$ (C) $C_P = C_V$ (D) $C_P - C_V = R$

58. The molar specific heat of the process $V \propto T^4$ for CH_4 gas at room temperature is:–

(A) 4R (B) 7R (C) 3R (D) 8R

59. 5n, n and 5n moles of a monoatomic, diatomic and non-linear polyatomic gases (which do not react chemically with each other) are mixed at room temperature. The equivalent degree of freedom for the mixture is :–

(A) $\frac{25}{7}$ (B) $\frac{48}{11}$ (C) $\frac{52}{11}$ (D) $\frac{50}{11}$

60. The internal energy of a gas in an adiabatic process is given by U = a + bPV, find γ :–

(A) $\frac{a+1}{a}$ (B) $\frac{b+1}{b}$ (C) $\frac{b+1}{a}$ (D) $\frac{a}{b+1}$

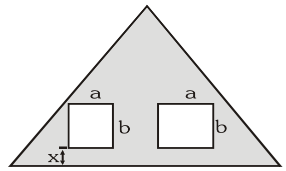
ANSWER KEY LEVEL–1

Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	C	C	B	A	B	C	D	B	A	A	C	D	B	C	B	A	B	A	A	D
Que.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Ans.	D	B	D	D	D	B	B	B	C	A	C	B	D	A	C	D	B	C	A	B
Que.	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Ans.	D	A	C	D	B	D	D	A	C	A	C	A	A	D	C	B	B	B	D	B

HEAT & THERMODYNAMICS LEVEL-2

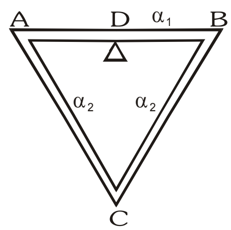
Select the correct alternatives (one or more than one correct answers)

1. A triangular plate has two cavities, one square and one rectangular as shown in figure. The plate is heated.



(A) a increase, b decrease
(B) a and b both increase
(C) a and b increase, x and ℓ decrease
(D) a, b, x and ℓ all increase

2. Three rods of equal length are joined to form an equilateral triangle ABC.D is the midpoint of AB. The coefficient of linear expansion is α_1 for AB, and α_2 for AC and BC. If the distance DC remains constant for small changes in temperature:–



(A) $\alpha_1 = \alpha_2$
(B) $\alpha_1 = 2\alpha_2$
(C) $\alpha_1 = 4\alpha_2$
(D) $\alpha_1 = \frac{1}{2}\alpha_2$

3. If water at 0 C, kept in a container with an open top, is placed in a large evacuated chamber:–
(A) All the water will vaporize.
(B) All the water will freeze.
(C) Part of the water will vaporize and the rest will freeze.
(D) Ice, water and water vapour will be formed and reach equilibrium at the triple point.

4. In the previous question, if the specific latent heat of vaporization of water at 0 C is η times the specific latent heat of freezing of water at 0 C, the fraction of water that will ultimately freeze is:–

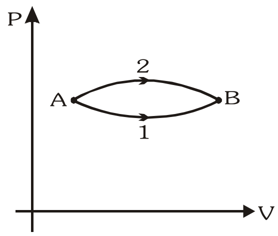
(A) $\frac{1}{\eta}$
(B) $\frac{\eta}{\eta+1}$
(C) $\frac{\eta-1}{\eta}$
(D) $\frac{\eta-1}{\eta+1}$

5. Which of the following statements is/are correct ?
(A) A gas has two specific heats only
(B) A material will have only one specific heat, if and only if its coefficient of thermal expansion is equal to zero.
(C) A gas has infinite number of specific heats.
(D) None of these

6. When two samples at different temperatures are mixed, the temperature of the mixture can be :–
(A) lesser than lower or greater than higher temperature
(B) equal to lower or higher temperature
(C) greater than lower but lesser than higher temperature
(D) average of lower and higher temperatures.

7. Two identical beakers are filled with water to the same level at 4 C. If one say A is heated while the other B is cooled, then:–
(A) water level in A will rise
(B) water level in B will rise
(C) water level in A will fall
(D) water level in B will fall

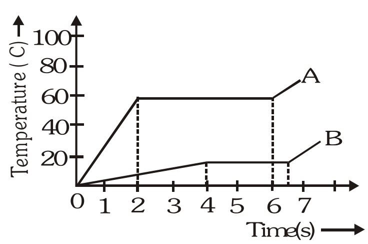
8. The figure shows two paths for the change of state of a gas from A to B. The ratio of molar heat capacities in path 1 and path 2 is:–



(A) > 1 (B) < 1 (C) 1 (D) Data insufficient

9. During the melting of a slab of ice at 273 K at atmospheric pressure:–
(A) Positive work is done by the ice–water system on the atmosphere.
(B) Positive work is done on the ice–water system by the atmosphere.
(C) The internal energy of ice–water system increases.
(D) The internal energy of the ice–water system decreases.

10. Two substances A and B of equal mass m are heated by uniform rate of 6 cal s^{-1} under similar conditions. A graph between temperature and time is shown in figure. Ratio of heat absorbed H_A/H_B by them for complete fusion is:–

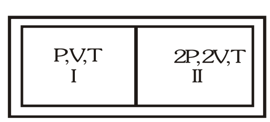


(A) $\frac{9}{4}$ (B) $\frac{4}{9}$ (C) $\frac{8}{5}$ (D) $\frac{5}{8}$

11. Three closed vessels A, B and C at the same temperature T and contain gases which obey the Maxwellian distribution of velocities. Vessel A contains only O_2, B only N_2 and C a mixture of equal quantities of O_2 and N_2. If the average speed of the O_2 molecules in vessel A is v_1, that of the N_2 molecules in vessel B is v_2, the average speed of O_2 molecules in vessel C is where M is the mass of an oxygen molecule:–

(A) $(v_1+v_2)/2$ (B) v_1 (C) $(v_1 v_2)^{1/2}$ (D) $\sqrt{3kT/M}$

12. A partition divides a container having insulated walls into two compartments I and II.The same gas fills the two compartments whose initial parameters are given. The partition is a conducting wall which can move freely without friction. Which of the following statements is/are correct, with reference to the final equilibrium position ?



(A) The pressure in the two compartments are equal. (B) Volume of compartment I is $\frac{3V}{5}$

(C) Volume of compartment II is $\frac{12V}{5}$ (D) Final pressure in compartment I is $\frac{5P}{3}$

13. During experiment, an ideal gas is found to obey a condition P^2/ρ= constant [ρ = density of the gas]. The gas is initially at temperature T, pressure P and density ρ . The gas expands such that density changes to $\rho/2$

(A) The pressure of the gas changes to $\sqrt{2}$ P

(B) The temperature of the gas changes to $\sqrt{2}$ T

(C) The graph of the above process on the P–T diagram is parabola

(D) The graph of the above process on the P–T diagram is hyperbola

14. An ideal gas can be expanded from an initial state to a certain volume through two different processes (i) PV^2 = constant and (ii) $P = KV^2$ where K is a positive constant. Then:–

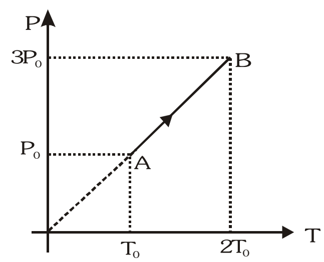
(A) Final temperature in (i) will be greater than in (ii)

(B) Final temperature in (ii) will be greater than in (i)

(C) Total heat given to the gas in (i) case is greater than in (ii)

(D) Total heat given to the gas in (ii) case is greater than in (i)

15. Pressure versus temperature graph of an ideal gas is shown in figure.Density of the gas at point A is ρ_0. Density at B will be:–



(A) $\frac{3}{4}\rho_0$ (B) $\frac{3}{2}\rho_0$ (C) $\frac{4}{3}\rho_0$ (D) $2\rho_0$

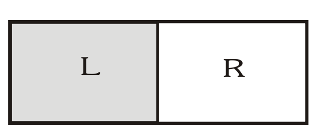
16. When unit mass of water boils to become steam at 100^0C, it absorbs Q amount of heat. The densities of water and steam at 100^0C are ρ_1 and ρ_2 respectively and the atmospheric pressure is P_0. The increase in internal energy of the water is:–

(A) Q (B) $Q + P_0\left(\frac{1}{\rho_1} - \frac{1}{\rho_2}\right)$ (C) $Q + P_0\left(\frac{1}{\rho_2} - \frac{1}{\rho_1}\right)$ (D) $Q - P_0\left(\frac{1}{\rho_1} + \frac{1}{\rho_2}\right)$

17. At temperature T,N molecules of gas A each having mass m and at the same temperature 2 N molecules of gas B each having mass 2 m are filled in a container. The mean square velocity of molecules of gas B is v^2 and x component of mean square velocity of molecules of gas A is w^2. The ratio of w^2 / v^2 is :–

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

18. A vessel is partitioned in two equal halves by a fixed diathermic separator. Two different ideal gases are filled in left (L) and right (R) halves. The rms speed of the molecules in L part is equal to the mean speed of molecules in the R part. Then the ratio of the mass of a molecule in L part to that of a molecule in R part is:–



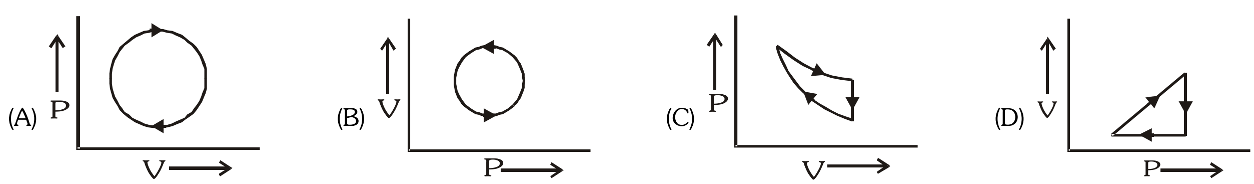
(A) $\sqrt{\frac{3}{2}}$ (B) $\sqrt{\pi/4}$ (C) $\sqrt{2/3}$ (D) $3\pi/8$

19. A closed vessel contains a mixture of two diatomic gases A and B. Molar mass of A is 16 times that of B and mass of gas A contained in the vessel is 2 times that of B. Which of the following statements are true?
(A) Average kinetic energy per molecule of A is equal to that of B
(B) Root mean square value of translational velocity of B is four times that of A
(C) Pressure exerted by B is eight times of that exerted by A
(D) Number of molecules of B in the cylinder is eight times that of A

20. N(<100) molecules of a gas have velocities 1,2,3.... N, km/s respectively. Then:–
(A) rms speed and average speed of molecules are same
(B) Ratio of rms speed to average speed is $\frac{\sqrt{(2N+1)(N+1)}}{6N}$
(C) Ratio of rms speed to average speed is $\frac{\sqrt{(2N+1)(N+1)}}{6}$
(D) Ratio of rms speed to average speed of a molecule $\frac{2}{\sqrt{6}}\sqrt{\frac{(2N+1)}{(N+1)}}$

21. Let $\bar{v}$, v_{rms} and v_p respectively denote the mean speed, the root–mean–square speed, and the most probable speed of the molecules in an ideal monoatomic gas at absolute temperature T. The mass of a molecule is m:–
(A) No molecule can have speed greater than v_{rms}
(B) No molecule can have speed less than $\frac{v_p}{\sqrt{2}}$
(C) $v_p < \bar{v} < v_{rms}$
(D) The average kinetic energy of a molecule is $\frac{3}{4}mv_p^2$

22. The following are the P–V diagrams for cyclic processes for a gas. In which of these processes is heat absorbed by the gas ?

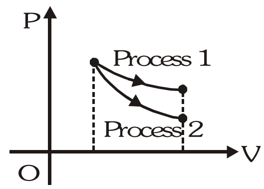


23. The internal energy of a system remains constant when it undergoes :–
(A) a cyclic process
(B) an isothermal process
(C) an adiabatic process
(D) any process in which the heat given out by the system is equal to the work done on the system

24. C_P is always greater than C_V due to the fact that :–
(A) No work is being done on heating the gas at constant volume.
(B) When a gas absorbs heat at constant pressure its volume must change so as to do some external work.
(C) The internal energy is a function of temperature only for an ideal gas.
(D) For the same rise of temperature, the internal energy of a gas changes by a smaller amount at constant volume than at constant pressure.

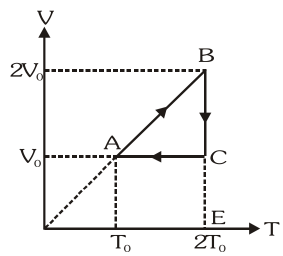
25. An ideal gas is heated from temperature T_1 to T_2 under various conditions. The correct statement(s) is/are:–
(A) $\Delta U = nC_V (T_2 - T_1)$ for isobaric, isochoric and adiabatic process
(B) Work is done at expense of internal energy in an adiabatic process and both have equal values
(C) $\Delta U = 0$ for an isothermal process
(D) $C = 0$ for an adiabatic process

26. The indicator diagram for two process 1 and 2 carried on an ideal gas is shown in figure.If m_1 and m_2 be the slopes $\left(\frac{dP}{dV}\right)$ for process 1 and process 2 respectively, then:–



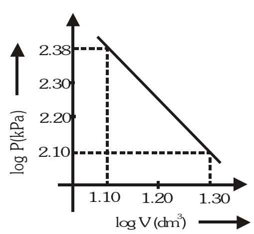
(A) $m_1=m_2$ (B) $m_1>m_2$ (C) $m_1<m_2$ (D) $m_2C_V=m_1C_P$

27. An ideal monoatomic gas undergoes a cycle process ABCA as shown in the fig. The ratio of heat absorbed during AB to the work done on the gas during BC is:–



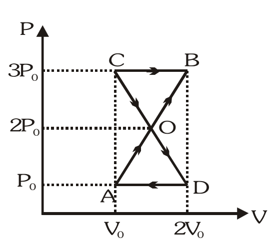
(A) $\frac{5}{2\ell n2}$ (B) $\frac{5}{3}$ (C) $\frac{5}{4\ \ell n2}$ (D) $\frac{5}{6}$

28. Logarithms of readings of pressure and volume for an ideal gas were plotted on a graph as shown in Figure. By measuring the gradient, It can be shown that the gas may be :–



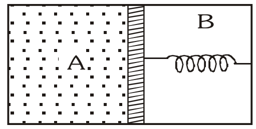
(A) Monoatomic and undergoing an adiabatic change.
(B) Monoatomic and undergoing an isothermal change.
(C) Diatomic and undergoing an adiabatic change.
(D) Triatomic and undergoing an isothermal change.

29. A thermodynamic system undergoes cyclic process ABCDA as shown in figure. The work done by the system is :–



(A) P_0V_0 (B) $2P_0V_0$ (C) $\frac{P_0V_0}{2}$ (D) zero

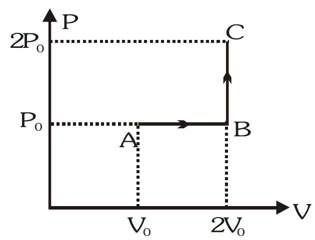
30. A thermally insulated chamber of volume $2V_0$ is divided by a frictionless piston of area S into two equal parts A and B. Part A has an ideal gas at pressure P_0 and temperature T_0 and in part B is vacuum. A massless spring of force constant k is connected with piston and the wall of the container as shown. Initially spring is unstretched. Gas in chamber A is allowed to expand. Let in equilibrium spring is compressed by x_0. Then:–



(A) Final pressure of the gas is $\frac{kx_0 6}{S}$ (B) Work done by the gas is $\frac{1}{2}kx^2{}_0$

(C) Change in internal energy of the gas is $\frac{1}{2}kx^2{}_0$ (D) Temperature of the gas is decreased.

31. One mole of an ideal monatomic gas is taken from A to C along the path ABC. The temperature of the gas at A is T_0. For the process ABC :–



(A) Work done by the gas is RT_0

(B) Change in internal energy of the gas is $\frac{11}{2}RT_0$

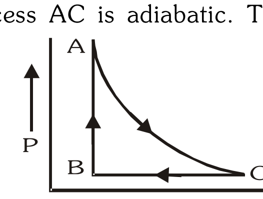
(C) Heat absorbed by the gas is $\frac{11}{2}RT_0$ (D) Heat absorbed by the gas is $\frac{13}{2}RT_0$

32. The specific heats of a gas are C_P=0.2 cal/g C & C_V = 0.15 cal/g C. [Take R=2 cal/mole^0 C]
(A) The molar mass of the gas is 40 g
(B) The molar mass of the gas cannot be determined from the data given
(C) The number of degrees of freedom of the gas molecules is 6
(D) The number of degrees of freedom of the gas molecules is 8

33. Two cylinders A and B fitted with piston contain the equal amount of an ideal diatomic gas at 300K. The piston of A is free to move, while that of B is held fixed. The same amount of heat is given to the gas in each cylinder. If the rise in temperature of the gas in A is 30K, then the rise in the temperature of the gas in B is:–
(A) 30 K (B) 10 K (C) 50 K (D) 42 K

34. One mole of an ideal gas at an initial temperature of T K does 6 R joules of work adiabatically. If the ratio of specific heats of this gas at constant pressure and at constant volume is 5/3, the final temperature of gas will be:–
(A) (T + 2.4) K (B) (T – 2.4) K (C) (T + 4) K (D) (T – 4) K

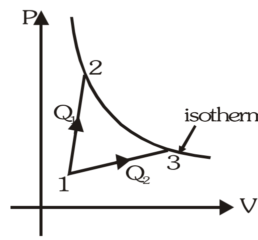
35. One mole of ideal gas undergoes a cyclic process ACBA as shown in figure. Process AC is adiabatic. The temperatures at A, B and C are 300, 600 and 450K respectively:–



(A) In process CA change in internal energy is 225R.
(B) In process AB change in internal energy is –150R.
(C) In process BC change in internal energy is –225R.
(D) Change in internal energy during the whole cyclic process is +150R.

36. A gas expands such that its initial and final temperatures are equal. Also, the process followed by the gas traces a straight line on the P–V diagram :–
(A) The temperature of the gas remains constant throughout.
(B) The temperature of the gas first increases and then decreases.
(C) The temperature of the gas first decreases and then increases.
(D) The straight line has a negative slope.

37. A gas takes part in two processes in which it is heated from the same initial state 1 to the same final temperature. The processes are shown on the P–V diagram by the straight line 1–2 and 1–3.2 and 3 are the points on the same isothermal curve. Q_1 and Q_2 are the heat transfer along the two processes. Then :–



(A) $Q_1 = Q_2$ (B) $Q_1 < Q_2$ (C) $Q_1 > Q_2$ (D) insufficient data

38. Radiation from a black body at the thermodynamic temperature T_1 is measured by a small detector at distance d_1 from it. When the temperature is increased to T_2 and the distance to d_2, the power received by the detector is unchanged. What is the ratio d_2/d_1?

(A) $\frac{T_2}{T_1}$ (B) $\left(\frac{T_2}{T_1}\right)^2$ (C) $\left(\frac{T_1}{T_2}\right)_2^2$ (D) $\left(\frac{T_2}{T_1}\right)^4$

39. A point source of heat of power *P* is placed at the center of a spherical shell of mean radius *R*. The material of the shell has thermal conductivity *k*. If the temperature difference between the outer and the inner surface of the shell is not to exceed *T*, then the thickness of the shell should not be less than :–

(A) $\frac{2\pi R^2 kT}{P}$ (B) $\frac{4\pi R^2 kT}{P}$ (C) $\frac{\pi R^2 kT}{P}$ (D) $\frac{\pi R^2 kT}{4P}$

40. A black body emits radiation at the rate P when its temperature is T. At this temperature the wavelength at which the radiation has maximum intensity is λ_0. If at another temperature T' the power radiated is 'P' and wavelength at maximum intensity is $\frac{\lambda_0}{2}$ then:–
(A) P' T' = 32 PT (B) P' T' = 16 PT (C) P' T' = 8 PT (D) P' T' = 4 PT

41. The emissive power of a black body at T=300 K is 100 Watt/m^2. Consider a body B of area A = 10 m^2, coefficient of reflectivity r = 0.3 and coefficient of transmission t=0.5. Its temperature is 300 K. Then which of the following is incorrect:–
(A) The emissive power of B is 20 W/m^2 (B) The emissive power of B is 200 W/m^2
(C) The power emitted by B is 200 Watt (D) The emissivity of B is = 0.2

42. A metallic sphere having radius 0.08 m and mass m = 10 kg is heated to a temperature of 227 C and suspended inside a box whose walls are at a temperature of 27 C. The maximum rate at which its temperature will fall is:– (Take e = 1, Stefan's constant $\sigma = 5.8 \times 10^{-8}$ Wm^{-2} K^{-4} and specific heat of the metal s = 90 cal/kg/deg, J = 4.2 J/Calorie)
(A) 0.055 C/s (B) 0.066 C/s (C) 0.044 C/s (D) 0.03 C/s

43. A hollow copper sphere & a hollow copper cube of same surface area & negligible thickness , are filled with warm water of same temperature and placed in an enclosure of constant temperature , a few degrees below that of the bodies . Then in the beginning :–

(A) The rate of energy lost by the sphere is greater than that by the cube

(B) The rate of energy lost by the two are equal

(C) The rate of energy lost by the sphere is less than that by the cube

(D) The rate of fall of temperature for sphere is less than that for the cube .

44. Two long, thin, solid cylinders are identical in size, but they are made of different substances with two different thermal conductivities. The two cylinders are connected in series between a reservoir at temperature T_{hot} and a reservoir at temperature T_{cold}. The temperature at the boundary between the two cylinders is T_b. One can conclude that:–

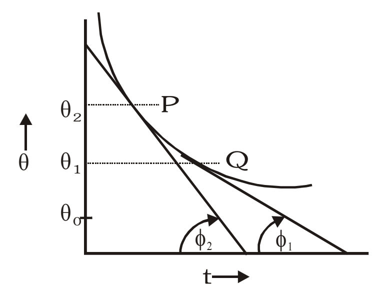
(A) T_b is closer to T_{hot} than it is to T_{cold}.

(B) T_b is closer to T_{cold} than it is to T_{hot}.

(C) T_b is closer to the temp. of the reservoir that is in contact with the cylinder with the lower thermal conductivity.

(D) T_b is closer to the temp. of the reservoir that is in contact with the cylinder with the higher thermal conductivity.

45. A body cools in a surrounding which is at a constant temperature of θ_0. Assume that it obeys Newton's law of cooling. Its temperature θ is plotted against time t. Tangent are drawn to the curve at the points $P(\theta = \theta_2)$ and $Q(\theta = \theta_1)$. These tangents meet the time axis at angles of ϕ_2 and ϕ_1 as shown, then:–



(A) $\frac{\tan\phi_2}{\tan\phi_1} = \frac{\theta_1 - \theta_0}{\theta_2 - \theta_0}$ (B) $\frac{\tan\phi_2}{\tan\phi_1} = \frac{\theta_2 - \theta_0}{\theta_1 - \theta_0}$ (C) $\frac{\tan\phi_1}{\tan\phi_2} = \frac{\theta_1}{\theta_2}$ (D) $\frac{\tan\phi_1}{\tan\phi_2} = \frac{\theta_2}{\theta_1}$

46. A spherical body with an initial temperature T_1 is allowed to cool in surroundings at temperature T_0 ($<T_1$). The mass of the body is m, its gram specific heat is c, density ρ, area A. If σ be the Stefan's constant then the temperature T of the body at time t can be best represented by:–

(A) $T = (T_1 - T_0)\, e^{-kt}$ where $k = \frac{12\sigma A T_0^3}{r\rho c}$

(B) $T = (T_1 - T_0)\, \ell n\,(kt)$ where $k = \frac{\sigma A T_0}{mc^3}$

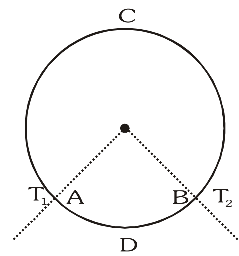
(C) $T = T_0 + (T_1 - T_0)\, e^{-kt}$ where $k = \frac{12\sigma T_0^3}{r\rho c}$

(D) $T = T_1 e^{-kt} - T_0$ where $k = \frac{\sigma A T_0^3}{r\rho c}$

47. A rod of length L with sides fully insulated is of a material whose thermal conductivity varies with temperature as $K = \frac{\alpha}{T}$, where α is a constant. The ends of the rod are kept at temperature T_1 and T_2. The temperature T at x, where x is the distance from the end whose temperature is T_1 is:–

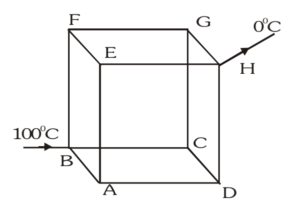
(A) $T_1\left(\frac{T_2}{T_1}\right)^{\frac{x}{L}}$ (B) $\frac{x}{L}\ell n\frac{T_2}{T_1}$ (C) $T_1 e^{\frac{T_2 x}{T_1 L}}$ (D) $T_1 + \frac{T_2 - T_1}{L}x$

48. A ring consisting of two parts ADB and ACB of same conductivity k carries an amount of heat H. The ADB part is now replaced with another metal keeping the temperatures T_1 and T_2 constant. The heat carried increases to 2H. What should be the conductivity of the new ADB part? Given $\frac{ACB}{ADB} = 3$



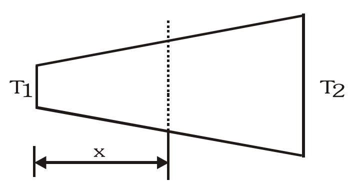
(A) $\frac{7}{3}k$ (B) 2k (C) $\frac{5}{2}k$ (D) 3k

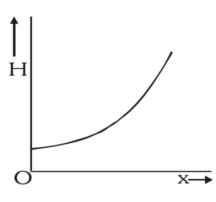
49. Twelve conducting rods form the sides of a uniform cube of side ℓ. If in steady state, B and H ends of the cube are at 100^0C and 0^0C respectively. Find the temperature of the junction 'A' :–

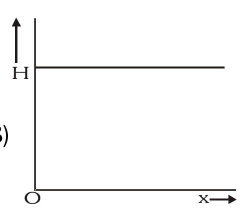


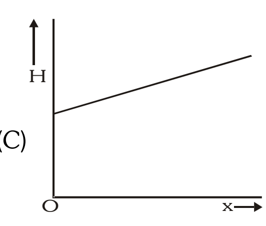
(A) 80^0C (B) 60^0C (C) 40^0C (D) 70^0C

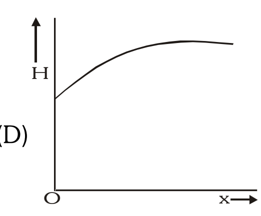
50. Radius of a conductor increases uniformly from left end to right end as shown in Fig. Material of the conductor is isotropic and its curved surface is thermally isolated from surrounding. Its ends are maintained at temperatures T_1 and T_2 ($T_1 > T_2$). If, in steady state, heat flow rate is equal to H, then which of the following graphs is correct ?



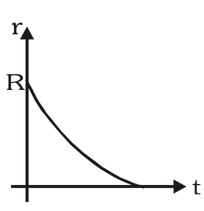
(A)


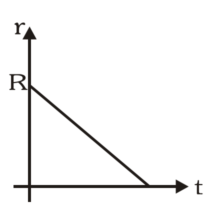
(B)


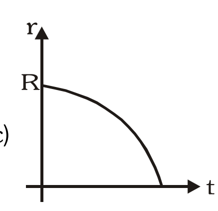
(C)


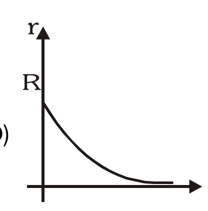
(D)


51. A sphere of ice at 0^0C having initial radius R is placed in an environment having ambient temperature > 0^0C. The ice melts uniformly, such that shape remains spherical. After a time 't' the radius of the sphere has reduced to r. Which graph best depicts r(t)

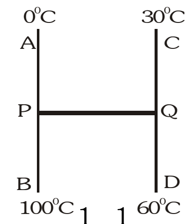
(A)


(B)


c)


(D)


52. Three identical rods AB, CD and PQ are joined as shown. P and Q are mid points of AB and CD respectively. Ends A, B, C and D are maintained at 0^0C, 100^0C, 30^0C and 60^0C respectively. The direction of heat flow in PQ is:–



(A) From P to Q (B) From Q to P

(C) Heat does not flow in PQ (D) Data not sufficient

53. Three bodies A, B and C have equal surface area and thermal emissivities in the ratio $e_A : e_B : e_C = 1 : \frac{1}{2} : \frac{1}{4}$. All the three bodies are radiating at same rate. Their wavelengths corresponding to maximum intensity are λ_A , λ_B and λ_C respectively and their temperatures are T_A, T_B and T_C on kelvin scale, then select the incorrect statement

(A) $\sqrt{T_A T_C} = T_B$ (B) $\sqrt{\lambda_A \lambda_C} = \lambda_B$ (C) $\sqrt{e_A T_A}\ \sqrt{e_C T_C} = e_B T_B$ (D) $\sqrt{e_A \lambda_A T_A . e_B \lambda_B T_B} = e_C \lambda_C T_C$

54. A and B are two points on a uniform metal ring whose centre is C. The angle ACB = θ. A and B maintained at two different constant temperatures. When θ = 180 , the rate of total heat flow from A to B is 1.2 W. When θ = 90 , this rate will be:–

(A) 0.6 W (B) 0.9 W (C) 1.6 W (D) 1.8 W

55. In a 10–metre–deep lake, the bottom is at a constant temperature of 4 C. The air temperature is constant at –4 C. The thermal conductivity of ice is 3 times that of water. Neglecting the expansion of water on freezing, the maximum thickness of ice will be:–

(A) 7.5 m (B) 6 m (C) 5 m (D) 2.5 m

56. The solar constant for the earth is Σ. The surface temperature of the sun is T K. The sun subtends an angle θ at the earth:–

(A) $\Sigma \propto T^4$ (B) $\Sigma \propto T^2$ (C) $\Sigma \propto \theta^2$ (D) $\Sigma \propto \theta$

57. A system S receives heat continuously from an electrical heater of power 10W. The temperature of S becomes constant at 50 C when the surrounding temperature is 20 C. After the heater is switched off, S cools from 35.1 C to 34.9 C in 1 minute. The heat capacity of S is:–

(A) 100 J/ C (B) 300 J/ C (C) 750 J/ C (D) 1500 J/ C

58. If the absorption coefficient and reflection coefficient of a surface of a body are 0.4 and 0.6 respectively then:–

(A) Emissive power will be 0.2 (B) Transmission power will be 0.2

(C) Body will be totally transparent (D) Body will be totally opaque.

59. Temperature of black body is 3000K when black body cools, then change in wevelength Δ λ = 9 micron corresponding to maximum energy density. Now temperature of black body is :–

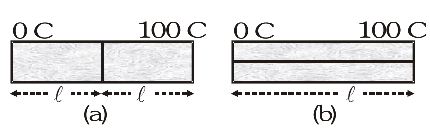
(A) 300 K (B) 2700 K (C) 270 K (D) 1800 K

60. Two Plates of equal areas are placed in contact with each other. Their thickness are 2cm and 3cm respectively. Temperature of external surface of first plate is –25 C and that of external surface of second plate is 25 C What will be temperature of contact surface if the plates :–

(i) Are of same material (ii) Have thermal Conductivity in ratio 2 : 3.

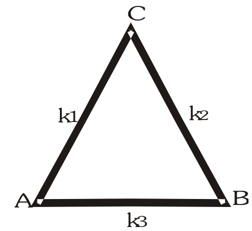
(A) (i) –5 C (ii) 0 C (B) (i) 5 C (ii) 0 C (C) (i) 0 C (ii) –5 C (D) None of these

61. Two identical square rods of metal are welded end to end as shown in figure (a) 20 calories of heat flows through it in 4 minutes. If the rods are welded as shown in figure (b), the same amount of heat will flow through the rods in :–



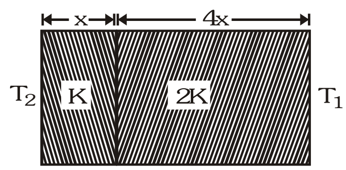
(A) 1 minute (B) 2 minutes (C) 4 minutes (D) 16 minutes

62. Three rods of same dimensions are arranged as shown in the figure. They have thermal conductivities k_1, k_2 & k_3. The points A and B are maintained at different temperatures. For the heat to flow at the same rate along ACB and AB :–



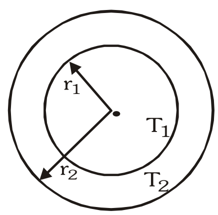
(A) $k_3 = 2(k_1 + k_2)$
(B) $k_3 = \frac{k_1 k_2}{k_1 + k_2}$
(C) $k_3 = k_1 + k_2$
(D) $k_3 = \frac{1}{2}(k_1 + k_2)$

63. The temperature of the two outer surfaces of a composite slab, consisting of two materials having coefficients of thermal conductivity K and 2K and thickness x and 4x, respectively are T_2 and $T_1 (T_2 > T_1)$. The rate of heat transfer through the slab, in a steady state is $\left(\frac{A(T_2 - T_1)K}{x}\right)f$, with f equals to:–



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

64. The figure shows a system of two concentric spheres of radii r_1 and r_2 and kept at temperatures T_1 and T_2, respectively. The radial rate of flow of heat in a substance between the two concentric spheres, is proportional to:–



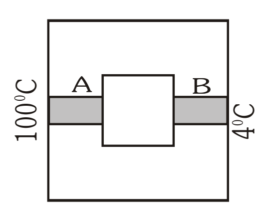
(A) $\frac{(r_2 - r_1)}{(r_1 r_2)}$
(B) $\ell n\left(\frac{r_2}{r_1}\right)$
(C) $\frac{r_1 r_2}{(r_2 - r_1)}$
(D) $(r_2 - r_1)$

65. The pressure of one mole of an ideal gas varies according to the law $P = P_0 - aV^2$, where P_0 and a are positive constants. The highest temperature that the gas may attain is:–

(A) $\frac{2P_0}{3R}\left(\frac{P_0}{3a}\right)^{1/2}$
(B) $\frac{3P_0}{2R}\left(\frac{P_0}{3a}\right)^{1/2}$
(C) $\frac{P_0}{R}\left(\frac{P_0}{3a}\right)^{1/2}$
(D) $\frac{P_0}{R}\left(\frac{P_0}{3a}\right)^{1/2}$

66. A thermally insulated vessel contains some water at 0^0C. The vessel is connected to a vacuum pump to pump out water vapour. This results in some water getting frozen. It is given latent heat of vaporization of water at 0 C = 21 10^5 J/kg and latent heat of freezing of water = 3.36 10^5 J/kg. The maximum percentage amount of water that will be solidified in this manner will be:–
(A) 86.2%
(B) 33.6%
(C) 21%
(D) 24.36%

67. A closed cubical box made of perfectly insulating material has walls of thickness 8 cm and the only way for heat to enter or leave the box is through two solid metal plugs A and B, each of cross–sectional area 12 cm^2 and length 8 cm fixed in the opposite walls of the box as shown in the figure. Outer surface A is kept at 100 C while the outer surface B is kept at 4 C. The thermal conductivity of the material of the plugs is 0.5 $cals^{-1}cm^{-1}$ (C^{-1}). A source of energy generating 36 $cals^{-1}$ is enclosed inside the box. The equilibrium temperature of the inner surface of the box (assuming



that it is same at all points on the inner surface) is:–

(A) 38 C (B) 57 C (C) 76 C (D) 85 C

68. Three identical adiabatic containers have helium, neon and oxygen gases at the same pressure. The gases are compressed to half their original volume. Then:–

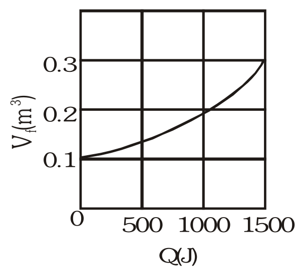
(A) The final temperature of the gas in each container is same

(B) The final pressure of the gas in each container is same

(C) The final temperature of both helium and neon is same

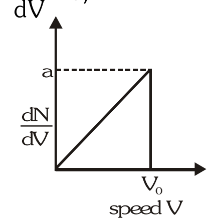
(D) The final pressure of both helium and neon is same

69. Suppose 0.5 mole of an ideal gas undergoes an isothermal expansion as energy is added to it as heat Q. Graph shows the final volume V_f versus Q. The temperature of the gas is :– (use ℓn 9 = 2 and R= $\frac{25}{3}$ J/mol-K)



(A) 293 K (B) 360 K (C) 386 K (D) 412 K

70. Graph shows a hypothetical speed distribution for a sample of N gas particle :–(for V > V_0; $\frac{dN}{dV}$ =0)



(A) The value of V_0 is 2N.

(B) The ratio V_{avg}/V_0 is equal to 2/3.

(C) The ratio V_{rms}/V_0 is equal to $1/\sqrt{2}$

(D) Three fourth of the total particle has a speed between 0.5 V_0 and V_0.

71. The temperature of an isotropic cubical solid of length ℓ_0, density ρ_0 and coefficient of linear expansion α is increased by 20 C. Then at higher temperature, to a good approximation:–

(A) Length is ℓ_0 (1+20α) (B) Total surface area is ℓ_0^2 (1+40α)

(C) Total volume is ℓ_0^3 (1+60α) (D) Density is $\frac{\rho_0}{1+60\alpha}$

72. A glass rod when measured with a zinc scale, both being at 30 C, appears to be of length 100 cm. If the scale shows correct reading at 0 C, then the true length of glass rod at 30 C and 0 C are:–

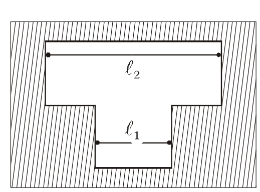
(α_{glass} = 8 10^{-6} C^{-1}, α_{zinc} = 26 10^{-6} K^{-1})

(A) 100.054 cm, 100.054 cm (B) 100.078 cm, 100.078 cm

(C) 100.078 cm, 100.054 cm (D) 100.054 cm, 100.078 cm

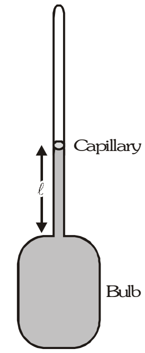
73. Two fine steel wires, fastened between the projections of a heavy brass bar, are just taut when the whole system is at 0 C. What is the tensile stress in the steel wires when the temperature of the system is raised by 200 C?

(α_{brass} = 2 10^{-5} C^{-1}, α_{steel} = 1.2 10^{-5} C^{-1}, Y_{steel} = 200 GNm^{-2})



(A) 3.2 Nm^{-2} (B) 3.2 10^8 Nm^{-2} (C) 32 10^8 Nm^{-2} (D) 0.48 Nm^{-2}

74. In a mercury–glass thermometer the cross–section of the capillary portion is A_0 and the volume of the bulb is V_0 at 273 K. If α and γ are the coefficients of linear and cubical expansion coefficients of glass and mercury respectively then length of mercury in the capillary at temperature t C is (Ignore the increase in cross–sectional area of capillary)



(A) $\frac{V_0}{A_0}(\gamma - 3\alpha)t$ (B) $\frac{V_0}{A_0}(2\gamma - 3\alpha)t$

(C) $\frac{V_0}{A_0}(\gamma - 3\alpha)(t+273)$ (D) $\frac{V_0 \gamma t}{A_0}$

75. 5g of steam at 100 C is mixed with 10 g of ice at 0 C. Choose correct alternative/s) :–(Given s_{water} = 1 cal/g C, L_F = 80 cal/g, L_V = 540 cal/g)
(A) Equilibrium temperature of mixture is 160 C (B) Equilibrium temperature of mixture is 100^0C

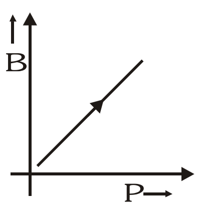
(C) At equilibrium, mixture contain $13\frac{1}{3}$ g of water (D) At equilibrium, mixture contain $1\frac{2}{3}$ g of steam

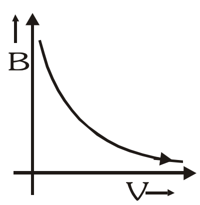
76. n moles of an ideal triatomic linear gas undergoes a process in which the temperature changes with volume as $T = k_1V^2$ where k_1 is a constant. Choose incorrect alternative:–

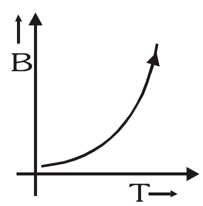
(A) At normal temperature $C_v = \frac{5}{2}R$ (B) At any temperature $C_p - C_v = R$

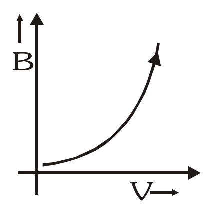
(C) At normal temperature molar heat capacity C=3R (D) At any temperature molar heat capacity C=3R

77. A sample of gas follows process represented by PV^2 = constant. Bulk modulus for this process is B, then which of the following graph is correct?

(A) 

(B) 

(C) 

(D) 

78. Four moles of hydrogen, two moles of helium and one mole of water vapour form an ideal gas mixture. What is the molar specific heat at constant pressure of mixture ?

(A) $\frac{16}{7}R$ (B) $\frac{23}{7}R$ (C) $\frac{19}{7}R$ (D) $\frac{26}{7}R$

79. A inert gas obeys the law PV^x = constant. For what value of x, it has negative molar specific heat–
(A) $x > 1.67$ (B) $x < 1.67$ (C) $1 < x < 1.4$ (D) $1 < x < 1.67$

ANSWER KEY LEVEL-2

Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	B,D	C	C	B	BC	BCD	AB	B	BC	C	B	ABCD	BD	AC	B	B	D	D	ABCD	D
Que.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Ans.	CD	ABC	ABD	AB	ABCD	CD	C	C	D	ABCD	AC	AC	D	D	A	BD	B	B	B	A
Que.	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Ans.	B	B	BD	D	B	C	A	A	B	B	B	A	D	C	A	AC	D	D	A	A
Que.	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	
Ans.	A	B	D	C	A	A	C	CD	B	ABCD	ACD	C	B	A	BCD	D	ABC	A	D	