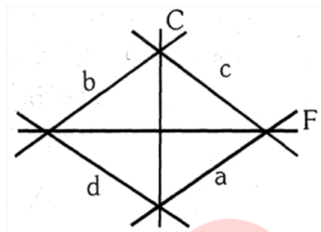
EXERCISE-I (Conceptual Questions) **Build Up Your Understanding**

TEMPERATURE & THERMAL EXPANSION

1. At what temperature does the temperature in Celsius and Fahrenheit equalise
(1) –40° (2) 40° (3) 36.6° (4) 38°

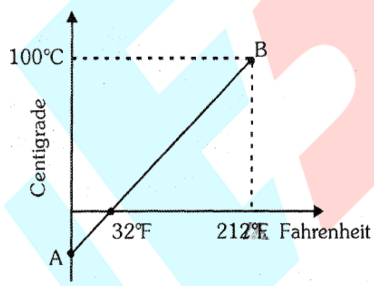
2. A difference of temperature of 25° C is equivalent to a difference of :
(1) 45° F (2) 72° F (3) 32°F (4) 25° F

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



(1) Curve a (2) Curve b (3) Curve c (4) Curved

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



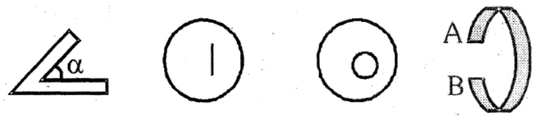
(1) slope of line AB is 9/5 (2) slope of line AB is 5/9
(3) slope of line AB is 1/9 (4) slope of line AB is 3/9

5. Oxygen boils at –183°C. This temperature is approximately in Fahrenheit is :-
(1) –329°F (2) –261°F (3) –215°F (4) –297°F

6. 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

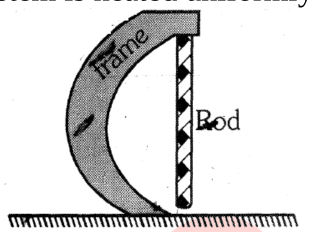
7. Two thermometers X and Y have ice points marked at 15° and 25° and steam points marked as 75° and 125° respectively. When thermometer X measures the temperature of a bath as 60° on it, what would thermometer Y read when it is used to measure the temperature of the same bath ?
(1) 60° (2) 75° (3) 100° (4) 90°

8· 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) TTTT (4) FFTF

9. 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 lever 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

10. A steel tape gives correct measurement at 20°C. A piece of wood is being measured with the steel tape at 0°C. The reading is 25 cm on the tape, the real length of the given piece of wood must be:
(1) 25 cm (2) < 25 cm (3) > 25 cm (4) can not say

11. The volume of a metal sphere increases by 0.15% when its temperature is raised by 24°C. The coefficient of linear expansion of metal is :
(1) 2.5×10^{-5} /°C (2) 2.0×10^{-5} /°C (3) -1.5×10^{-5} /°C (4) 1.2×10^{-5} /°C

12. 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

13. If two rods of length L and 2L having coefficients of linear expansion α and 2α respectively are connected so that total length becomes 3L, the average coefficient of linear expansion of the composition rod equals:
(1) $\frac{3}{2}\alpha$ (2) $\frac{5}{2}\alpha$ (3) $\frac{5}{3}\alpha$ (4) none of these

14. The table gives the initial length λ_0, change in temperature ΔT and change in length $\Delta\lambda$ of four rods. Which rod has greatest coefficient of linear expansion.

Rod	λ_0(m)	ΔT(°C)	$\Delta\lambda$(m)
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

15. An iron bar (Young's modulus = 10^{11} N/m^2, = 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

16. A rod of length 2 m rests on smooth horizontal floor. If the rod is heated from 0°C to 20°C. Find the longitudinal strain developed?
($\alpha = 5 \times 10^{-5}$ /°C)
(1) 10^{-3} (2) 2×10^{-3} (3) Zero (4) None

CALORIMETRY

17. A body of mass 5 kg falls from a height of 30 meter. If its all mechanical energy is changed into heat, then heat produced will be:-
(1) 350 cal (2) 150 cal (3) 60 cal (4) 6 cal

18. 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

19. The amount of heat required in converting 1 g ice at –10°C into steam at 100°C will be :-
(1) 3028 J (2) 6056 J (3) 721 J (4) 616 J

20. 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

21. 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 :
(1) 2.6°C (2) 1.2°C (3) 0.32°C (4) 0.12°C

22. A block of mass 2.5 kg is heated to temperature of 500°C and placed on a large ice block. What is the maximum amount of ice that can melt (approx.).
Specific heat for the body = 0.1 cal/g°C.
(1) 1 kg (2) l.5 kg (3) 2 kg (4) 2.5 kg

23. 1 kg of ice at –10°C is mixed with 4.4 kg of water at 30°C. The final temperature of mixture is (specific heat of ice = 2100 J/kg-k)
(1) 2.3°C (2) 4.4°C (3) 5.3°C (4) 8.7°C

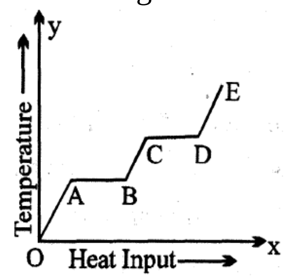
24. The amount of heat required to convert 1 g of ice at 0°C into steam at 100°C, is
(1) 716 cal. (2) 500 cal. (3) 180 cal. (4) 100 cal.

25. The latent heat for vapourisation for 1 g water is 536 cal. Its value in Joule/kg will be :-
(1) 2.25×10^6 (2) 2.25×10^3 (3) 2.25 (4) None of these

26. If 10 g ice at 0°C is mixed with 10 g water at 20°C, the final temperature will be :-
(1) 50°C (2) 10°C (3) 0°C (4) 15°C

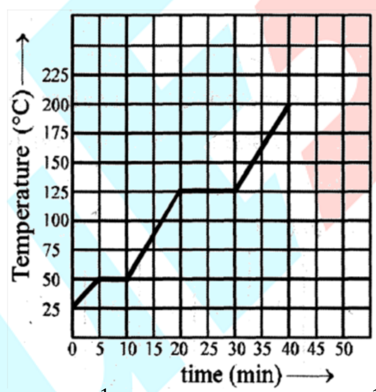
27. 420 joule of energy supplied to 10 g of water will raise its temperature by nearly :-
(1) 1°C (2) 4.2°C (3) 10°C (4) 42°C

28. A solid material is supplied with heat at a constant rate. The temperature of material is changing with heat input as shown in the figure. What does slope DE represent.



(1) latent heat of liquid (2) latent heat of vapour
(3) heat capacity of vapour (4) inverse of heat capacity of vapour

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

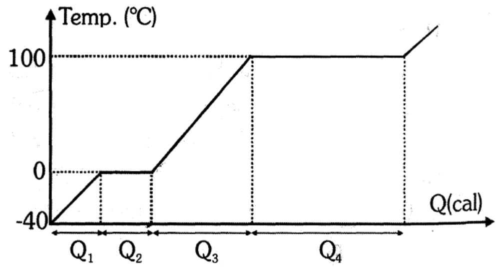


(1) 630 kJ kg^{-1} (2) 126 kJ kg^{-1} (3) 84 kJ kg^{-1} (4) 12.6 kJ kg^{-1}

30. 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) $\frac{mL}{5g}$

31. 10 g of ice at 0°C is kept in a calorimeter of water equivalent 10 g. How much heat should be supplied to the apparatus to evaporate the water thus formed? (Neglect loss of heat)
(1) 6200 cal (2) 7200 cal (3) 13600 cal (4) 8200 cal

32. Figure shows the temperature variation when heat is added continuously to a specimen of ice (1 0 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

33. The thermal capacity of any body is
(1) a measure of its capacity to absorb heat
(2) a measure of its capacity to provide heat
(3) the quantity of heat required to raise its temperature by a unit degree
(4) the quantity of heat required to raise the temperature of a unit mass of the body by a unit degree

34. 2 litre water at 27°C is heated by a 1 kW heater in an open container. On an average heat is lost to surroundings at the rate 160 J/s. The time required for the temperature to reach 77°C is
(1) 8 min 20 sec (2) 10 min (3) 7 min (4) 14 min

35. A piece of ice (heat capacity= 2100 J kg^{-1} $°C^{-1}$ and latent heat = 3.36×10^5 J kg^{-1}) of mass m grams is at –5°C at atmospheric pressure. It is given 420 J of heat so that the ice starts melting. Finally when the ice-water mixture is in equilibrium, it is found that 1 g of ice has melted. Assuming there is no other heat exchange in the process, the value of m is :
(1) 40 g (2) 8 g (3) 16 g (4) 24 g

36. 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/s. The outlet temperature of water must be about
(1) 20°C (2) 30°C (3) 35°C (4) 40°C

37. A continuous flow water heater (geyser) has an electrical power rating = 2 kW and efficiency of conversion of electrical power into heat = 80%. If water is flowing through the device at the rate of 100 cc/s and the inlet temperature is 10°C, the outlet temperature will be
(1) 12.2°C (2) 13.8°C (3) 20°C (4) 16.5°C

CONDUCTION AND CONVECTION

38. The ratio of coefficient of thermal conductivity of two different materials is 5:3. If the thermal resistance of rods of same area of these material is same, then what is ratio of length of these rods-
(1) 3 : 5 (2) 5 : 3 (3) 25 : 9 (4) 9 : 25

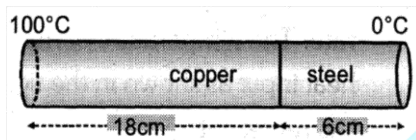
39. Rate of heat flow through a cylindrical rod is Q_1. Temperatures of ends of rod are T_1 and T_2. If all the linear dimensions of the rod become double and temperature difference remains same, it's rate of heat flow is Q_2, then :-

(1) $Q_1 = 2Q_2$ (2) $Q_2 = 2Q$ (3) $Q_2 = 4Q_1$ (4) $Q_1 = 4Q_2$

40. A heat flux of 4000 J/s is to be passed through a copper rod of length 10 cm and area of cross section 100 cm^2. The thermal conductivity of copper is 400 W/m °C. The two ends of this rod must be kept at a temperature difference of

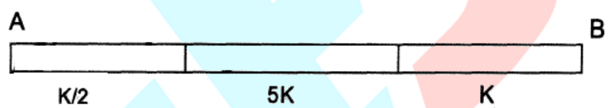
(1) 1°C (2) 10°C (3) 100°C (4) 1000°C

41. 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 ?



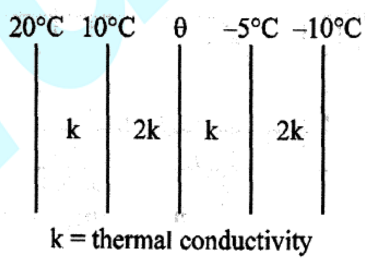
(1) 75°C (2) 67°C (3) 33°C (4) 25°C

42. A composite rod made of three rods of equal length and cross-section as shown in the fig. The thermal conductivities of the materials of the rods are K/2, 5K and K respectively. The end A and end B are at constant temperatures. All heat entering the face A goes out of the end B and there being no loss of heat from the sides of the bar. The effective thermal conductivity of the bar is-



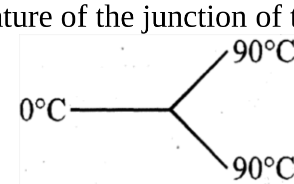
(1) 15K / 16 (2) 6K / 13 (3) 5K / 16 (4) 2K / 13

43. 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.



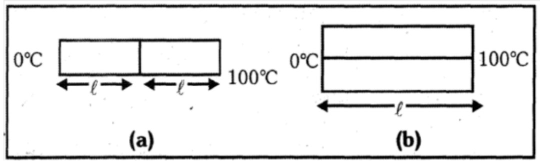
(1) 5°C (2) 10°C (3) –15°C (4) 15°C

44. Three rods made of the same material and having the same cross-section have been joined as shown in the figure. Each rod is of the same length. The left and right ends are kept at 0°C and 90°C respectively. The temperature of the junction of the three rods will be :



(1) 45°C (2) 60°C (3) 30°C (4) 20°C

45. 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

46. The coefficient of thermal conductivity depends upon-
(1) Temperature difference of two ends (2) Area of the plate
(3) Thickness of the plate (4) Material of the plate

47. 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

48. Gravitational force is required for -
(1) Stirring of liquid (2) Convection
(3) Conduction (4) Radiation

49. The layers of atmosphere are heated through -
(1) Convection (2) Conduction (3) Radiation (4) 2 and 3 both

50. The lengths and radii of two rods made of same material are in the ratios 1:2 and 2:3 respectively. If the temperature difference between the ends for the two rods be the same then in the steady state. The amount of heat flowing per second through them will be in the ratio of
(1) 1 : 3 (2) 4 : 3 (3) 8: 9 (4)3 : 2

51. Two metal rods, 1 & 2 of same length have same temperature difference between their ends, their thermal conductivities are K_1 & K_2 and cross sectional areas A_1 & A_2 respectively. What is required condition for same rate of heat conduction in them.
(1) $K_1 = K_2$ (2) $K_1 A_1 = K_2 A_2$ (3) $\frac{K_1}{A_1} = \frac{K_2}{A_2}$ (4) $\frac{K_1}{l_1^2} = \frac{K_2}{l_2^2}$

52. The temperature of hot and cold end of a 20 cm long rod in thermal steady state are at 100°C and 20°C respectively. Temperature at the centre of the rod is
(1) 50°C (2) 60°C (3) 40°C (4) 30°C

53. Consider a compound slab consisting of two different materials having equal thicknesses and thermal conductivities K and 2K respectively. The equivalent thermal conductivity of the slab is
(1) 3K (2) $\frac{4}{3}K$ (3) $\frac{2}{3}K$ (4) $\sqrt{2}K$

54. Under steady state, the temperature of a body

(1) Increases with time
(2) Decreases with time
(3) Does not change with time and is same at all the points of the body
(4) Does not change with time but is different at different points of the body

55. The area of the glass of a window of a room is 10 m^2 and thickness 2 mm. The outer and inner temperature are 40°C and 20°C respectively. Thermal conductivity of glass in MKS system is 0.2 then heat flowing in the room per second will be-
(1) 3×10^4 joules (2) 2×10^4 joules (3) 30 joules (4) 45 joules

56. If the coefficient of conductivity of aluminium is 0.5 cal/cm-sec-°C, then in order to conduct 10 cal/sec-cm^2 in the steady state, the temperature gradient in aluminium must be
(1) 5°C/cm (2) 10°C/cm (3) 20°C/cm (4) 10.5°C/cm

57. The dimensional formula for thermal resistance is
(1) $M^{-1}L^{-2}T^{3}\theta$ (2) $M^{-1}L^{-2}T^{-3}\theta$ (3) $ML^{2}T^{-2}\theta$ (4) $ML^{2}T^{2}\theta^{-1}$

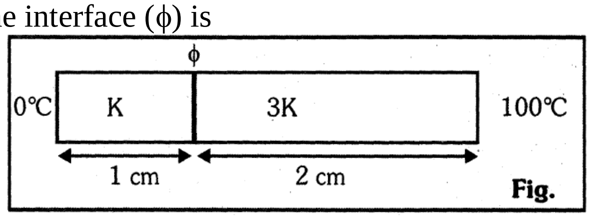
58. The material used in the manufacture of cooker must have (K-coefficient of thermal conductivity, S^{-} specific heat of material used) :
(1) high K and low S (2) low K and low S
(3) high K and high S (4) low K and high S

59. The cause of air currents from ocean to ground is example of
(1) The specific heat of water is mote than that of send
(2) Convection
(3) Radiation
(4) Diffraction

60. On a cold morning, a person will feel metal surface 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

61. The ratio of the diameters of two metallic rods of the same material is 2 : 1 and their lengths are in the ratio 1 : 4. If the temperature difference between them are equal, the rate of flow of heat in them will be in the ratio of -
(1) 2 : 1 (2) 4 : 1 (3) 8 : 1 (4) 16 : 1

62. Two bars of thermal conductivities K and 3K and lengths 1 cm and 2 cm respectively have equal cross-sectional area. They are joined length wise as shown in the figure. If the temperature at the ends of this composite bar is 0°C and 100°C respectively (see figure), then the temperature of the interface (ϕ) is



(1) 50°C (2) $\frac{100}{3}$ °C (3) 60°C (4) $\frac{200}{3}$ °C

63. Mud houses are cooler in summer and warmer in winter because
(1) Mud is super conductor of heat (2) Mud is good conductor of heat
(3) Mud is bad conductor of heat (4) None of these

64. Two walls of thicknesses d_1 and d_2 and the thermal conductivity k_1 and k_2 are in contact. In the steady state, if the temperatures at the outer surface are T_1 and T_2, the temperature at the common wall is-

(1) $\frac{K_1T_1d_2 + K_2T_2d_1}{K_1d_2 + K_2d_1}$ (2) $\frac{K_1T_1 + K_2T_2}{d_1 + d_2}$

(3) $\left(\frac{K_1d_1 + K_2d_2}{T_1 + T_2}\right)T_1T_2$ (4) $\frac{K_1d_1T_1 + K_2d_2T_2}{K_1d_1 + K_2d_2}$

65. In which the following phenomenon heat convection does not take place .
(1) land and sea breeze
(2) boiling of water I
(3) heating of glass surface due to filament of the bulb
(4) air around the furance

66. In natural convection, a heated portion of a liquid moves because :
(1) Its modular motion becomes aligned
(2) Of molecular collisions within it
(3) Its density is less than that of the surrounding fluid.
(4) Of currents of the surrounding fluid

67. 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

RADIATION

68. A spherical body of area A, and emissivity e = 0.6 is kept inside a black body. What is the rate at which energy is radiated per second at temperature T.
(1) 0.6 σ AT^4 (2) 0.4 σ AT^4 (3) 0.8 σ AT^4 (4) 1.0 σ AT^4

69. Radius of two spheres of same material are 1 & 4 m respectively and their temperature are 4×10^3 and 2×10^3 K respectively. Then ratio of emitted energy of spheres per sec. will be-
(1)1 : 2 (2) 2 : 1 (3) 1 : 1 (4) 4 : 1

70. Cooling rate of a sphere of 600 K at external environment (200K) is R. When the temperature of sphere is reduced to 400K then cooling rate the sphere becomes :
(1) $\frac{3}{16}$ R (2) $\frac{3}{16}$ R (3) $\frac{9}{27}$ R (4) None

71. Temperature of a body is 400°C. Assuming the surrounding temperature to be negligible. At what temperature will body emit double energy radiation?
(1) 200°C (2) 200 K (3) 800°C (4) 800 K

72. If temperature of ideal black body increased by 10%, then percentage increase in quantity of radiation emitted from it's surface will be :-
(1) 10% (2) 40% (3) 46% (4) 100%

73. The rectangular surface of area 8 cm × 4 cm of a black body at a temperature of 127°C emits energy at the rate of E. If the length and breadth of the surface are each reduced to half of the initial value and the temperature is raised to 327°C, the rate of emission of energy will become.
(1) $\frac{3}{8}$E (2) $\frac{81}{16}$E (3) $\frac{9}{16}$E (4) $\frac{81}{64}$E

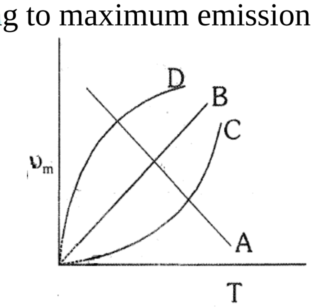
74. The rate of emission of radiation of a black body at 273°C is E, then the rate of emission of radiation of this body at 0°C will be
(1) $\frac{E}{16}$ (2) $\frac{E}{4}$ (3) $\frac{E}{8}$ (4) 0

75. If a liquid takes 30 s in cooling from 95°C to 90°C and 70 s in cooling from 55°C to 50°C then temperature of room is -
(1) 16.5°C (2) 22.5°C (3) 28.5°C (4) 32.5°C

76. The thermal capacities of two bodies are in the ratio of 1:4. If the rate of loss of heat are equal for the two bodies under identical conditions of surroundings, then the ratio of rate of fall of temperature of the two bodies is -
(1) 1 : 4 (2) 4 : 1 (3) 1 : 8 (4) 8 : 1

77· 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 latent of liquids (4) Latent beat of liquids

78. The υ_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

79. 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

80. The temperature of a furnace is 2324°C and the intensity is maximum is its radiation spectrum nearly at 12000 A°. If the intensity in the spectrum of nearly at 12000A°. If the intensity in the spectrum of a star is maximum nearly at 48000 A°, then the surface temperature of star is
(1) 84000°C (2) 7200°C (3) 6219.5°C (4) 5900°C

81. There is a black spot on a body. If the body is heated and carried in a dark room then it glows more. This can be explained on the basis of –
(1) Newton's law of cooling (2) Wein's law
(3) Kirchhoff's low (4) Stefan's law

82. The colour of a star is an indication of its-
(1) Weight (2) Distance (3) Temperature (4) Size

83. If a carved black utensil is heated to high temperature and then brought in dark then :
(1) Both utensil and its carving will shine (2) Only carving will shine
(3) Only utensil will shine (4) None of the utensil and carving will shine

84. According to Newton's law of cooling, the rate of cooling of a body is proportional to :-
(1) Temperature of the body
(2) Temperature of the surrounding
(3) Fourth power of the temperature of body
(4) Difference of the temperature of the body and the surrounding.

85. The original temperature of a black body is 727°C. Calculate temperature at which total radiant energy from this black body becomes double :
(1) 971 K (2) 1190 K (3) 2001 K (4) 1458 K

86. Calculate the energy radiated per minute from the filament of an incandescent lamp at 2000K surface area is 5×10^{-5} m^2 and its relative emittance is 0.85, $\sigma = 5.7 \times 10^{-8}$ MKS units :
(1) 1230 J (2) 2215 J (3) 2115 J (4) 2325 J

87. Ratio of radius of curvature of cylindrical emitters of same material is 1:4 and their temperature are in ratio 2:1. Then ratio of amount of heat emitted by them is – (For Cylinder length = radius)
(1) 2 : 1 (2) 1 : 1 (3) 4 : 1 (4) 1 : 4

88. The ideal black body is :
(1) Hot coal at high temperature (2) Surface of glass printed with coaltar
(3) Metal surface (4) A hollow container painted with black colour

89. The energy emitted per second by a black body at 27°C is 10 J. If temperature of the black body is increased to 327°C, the energy emitted per second will be :-
(1) 20 J (2) 40 J (3) 80 J (4) 160 J

90. Energy is being emitted from the surface of black body at 127°C at the rate of 1.0×10^6 J/s m^2. The temperature of black body at which the rate of energy id 16.0×10^6 J/s m^2 will be :
(1) 754°C (2) 527°C (3) 257°C (4) 508°C

91. Solar constant for earth is 2 cal/min cm^2, if distance of mercury from sun is 0.4 times than distance of earth from sun then solar constant for mercury will be?

(1) 12.5 cal/min cm^2 (2) 25 cal/min cm^2
(3) 0.32 cal/min cm^2 (4) 2 cal/min cm^2

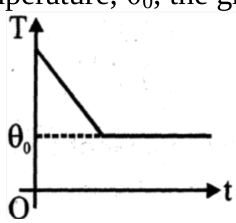
92. Two spherical bodies A (radius 6 cm) and B (radius 18 cm) are at temperature T_1 and T_2 respectively. The maximum intensity in the emission spectrum of A is at 500 nm and in that of B is at 1500 nm. Considering them to be black bodies, what will be the ratio of the rate of total energy radiated by A to that of B ?

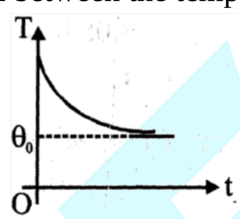
(1) 9 (2) 6 (3) 12 (4) 3

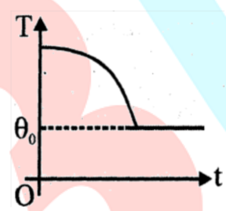
93. Star S_1 emits maximum radiation of wavelength 420 nm and the star S_2 emits maximum radiation of wavelength 560 nm, what is the ratio of the temperature of S_1 and S_2 :

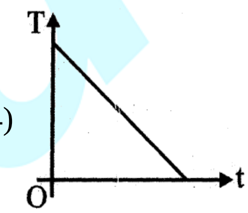
(1) 4/3 (2) $(4/3)^{1/4}$ (3) 3/4 (4) $(3/4)^{1/2}$

94. 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

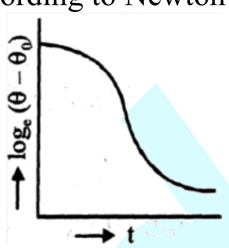
(1) 

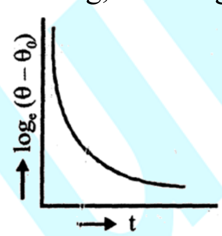
(2) 

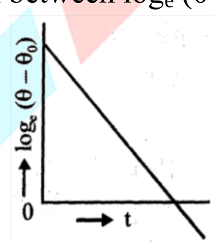
(3) 

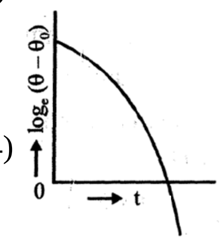
(4) 

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

(1) 

(2) 

(3) 

(4) 

96. A bucket full of hot water cools from 75°C to 70°C in time T_1, from 70° to 65°C in time T_2 and from 65°C to 60°C in time T_3, then

(1) $T_1 = T_2 = T_3$ (2) $T_1 > T_2 > T_3$
(3) $T_1 < T_2 < T_3$ (4) $T_1 > T_2 < T_3$

97. The Wein's displacement law express relation between:-

(1) Wavelength corresponding to maximum energy and temperature .
(2) Radiation energy and wavelength
(3) Temperature and wavelength
(4) Colour of light and temperature

98. Four identical calorimeters painted in different colours, are heated to same temperature and then allowed to cool in vacuum. Which will cool fastest?

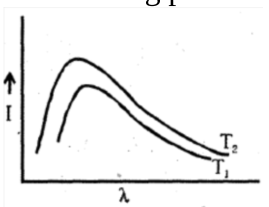
(1) One which is painted bright (2) One which is painted thick white
(3) One which is painted thick black (4) One Which is painted bright white

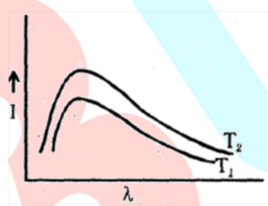
99. A body cools from 60°C to 50°C in minutes, If the room temperature is 25°C and assuming Newton's cooling law holds good, the temperature of the body at the end of next 10 minutes is:
(l) 45°C (2) 42.85°C (3) 40°C (4) 38.5°C

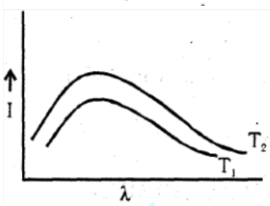
100. As compared to the person with white skin, the person with black skin will experience
(1) Less heat aid more cold (2) More heat and more cold
(3) More heat and less cold (4) Less heat and less cold

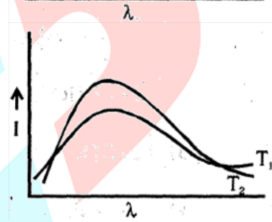
101. We consider the radiation emitted by the human body. Which of the following statements is true ?
(1) The radiation is emitted during the summers and absorbed during the winters
(2) The radiation emitted lies in the Ultraviolet region and hence is not visible
(3) The radiation emitted is in the infra-red region
(4) The radiation is emitted only during the day

102. Shown below are the black body radiation curves at temperatures T_1 and T_2 ($T_2 > T_1$). Which of the following plots is correct :-

(1) 

(2) 

(3) 

(4) 

103. The radii of two spheres made of same metal are r and 2r. These are heated to the same temperature and placed in the same surrounding. The ratio of rates of decrease of their temperature will be
(1) 1 : 1 (2) 4 : 1 (3) 1 : 4 (4) 2 : 1

104. If E is the total energy emitted by a body at a temperature T K and $E_{\lambda max}$ is the maximum spectral energy emitted by it at the same temperature, then-
(1) $E \propto T^4$; $E_{\lambda max} \propto T^5$ (2) $E \propto T^4$; $E_{\lambda max} \propto T^{-5}$
(3) $E \propto T^{-4}$; $E_{\lambda max} \propto T^4$ (4) $E \propto P$; $E_{\lambda max} \propto T^4$

105. 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) $e_\lambda = E_\lambda / a_\lambda$

106. A liquid takes 5 min. to cool from 80°C to 50°C. How much time it will take to cool from 60°C to 30°C. Temperature of surroundings is 20°C-
(1) 15 min. (2) 20 min. (3) 100 min. (4) 9 min.

107. 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 :

(1) 50 sec. (2) 90 sec (3) 60 sec. (4)48 sec.

108. If λ_m denotes the wavelength at which the radiation emission from a black body at a temperature T K is maximum then :
(1) $\lambda_m \alpha T$ (2) $\lambda_m \alpha T^2$ (3) $\lambda_m \alpha T^{-1}$ (4) $\lambda_m \alpha T^{-2}$

109. A body is in thermal equilibrium with the surrounding :
(1) It will stop emitting heat radiation
(2) Amount of radiation emitted and absorbed by it will be equal
(3) It will emit heat radiation at faster rate
(4) It will emit heat radiation slowly

110. Which of the following statement is correct for ideal black body:
(1) This absorbs visible radiation only
(2) This absorbs infrared radiation only
(3) This absorbs half of radiation only and reflects the half
(4) This totally absorbs heat radiation of all the wavelengths

111. Two spheres P and Q of same colour having radii 8 cm and 2 cm are maintained at temperatures 127°C and 527°C respectively. The ratio of energy radiated by P and Q is-
(1) 0.054 (2) 0.0034 (3) 1 (4) 2

112. On increasing the temperature of a black body, wavelength for maximum emission.
(1) Shifts toward smaller wavelength (2) Shifts towards greater wavelength
(3) Does not shift (4) Depends on the shape of source

113. A solid cube and sphere are made of same substance and both have same surface area. If the temperature of both bodies 120°C then :
(1) Both will loss of Heat by same rate
(2) Rate of loss of Heat 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

114. 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

115. A black body at 200 K is found to emit maximum energy at a wavelength 14 μm. When its temperature is raised to 1000 K, then wavelength at which maximum energy emitted is :
(1) 14 μm (2) 15 μm (3) 2.8 μm (4) 28 μm

116. The spectrum from a black body radiation is a :
(l) line spectrum (2) band spectrum
(3) continuous spectrum (4) line & band both

117. The temperature of a perfect black body is 727°C and its area is 0.1 m^2. If stefan's constant is 5.67×10^{-8} watt/m^2–K^4, then heat radiated by it in 1 minute is
(1) 8100 cal (2) 81000 cal (3) 810 cal (4) 81 cal

118. A black body radiates energy at the rate of E watt/m^2 at a high temperature T K. When the temperature is reduced to $\frac{T}{2}$ K, the radiant energy will be

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

119. In solar spectrum fraunhoffer's lines are presents because:
(1) Definite absorption takes place in photosphere of sun.
(2) Definite absorption takes place in chromospheres of sun.
(3) These wave lengths are not at all emitted by sun.
(4) Nuclear reactions take place in sun.

120. On reducing temperature of surface to one third, amount of radiation becomes :-

(1) $\frac{1}{27}$ (2) $\frac{1}{81}$ (3) $\frac{1}{9}$ (4) $\frac{1}{3}$

121. The absorptive power of a perfectly black body is
(1) zero (2) infinity (3) 1.5 (4) 1.0

KTG & GAS LAWS AND IDEAL GAS EQUATION

122. Find the approximate number of molecules contained in a vessel of volume 7 litres at 0°C at 1.3×10^5 pascals
(1) 2.4×10^{23} (3) 6×10^{23} (2) 3×10^{23} (4) 4.8×10^{23}

123. A real gas behaves like an ideal gas if its
(1) pressure and temperature are both high
(2) pressure and temperature are both low
(3) pressure is high and temperature is low
(4) pressure is low and temperature is high

124. The lowest pressure (the best vaccum) that can be created in laboratory at 27°C is 10^{-11} mm of Hg. At this pressure, the number of ideal gas molecules per cm^3 will be:-
(1) 3.22×10^{12} (3) 3.21×10^6 (2) 1.61×10^{12} (4) 3.22×10^5

125. Two gases of equal molar amount are in thermal equilibrium. If P_a P_b and V_a, V_b are their respective pressures and volumes, then which relation is true:-
(1) $P_a \neq P_b$, $V_a = V_b$ (2) $V_a = V_b$, $V_a \neq V_b$
(3) $P_a / V_b = P_b / V_b$ (4) $P_aV_a = P_bV_b$

126. 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 gases will have same number of molecules

127. Gases obey vander - waal's equation at :
(1) Only normal temperature and pressure
(2) Only high temperature and high pressure

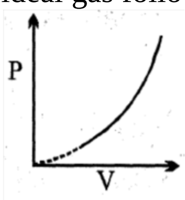
(3) Only high temperature and low pressure
(4) All temperature and pressure

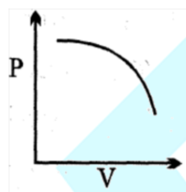
128. A box contains N molecules of a gas. If the number of molecules is doubled, then the pressure will :-
(1) Decrease (2) Be same (3) Be doubled (4) Get tripled

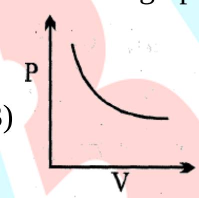
129. An ideal gas mixture filled inside a balloon expands according to the relation $PV^{2/3}$ = constant. The temperature inside the balloon is
(1) increasing (2) decreasing (3) constant (4) can't be said

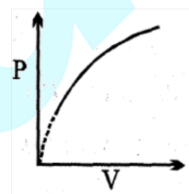
130. A rigid contains 35 kg of nitrogen at 6 atm. Sufficient quantity of oxygen is supplied to increase the pressure to 9 atm, while the temperature remains constant Amount of oxygen supplied to the tank is :
(1) 5 kg (2) 10 kg (3) 20 kg (4) 40 kg

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

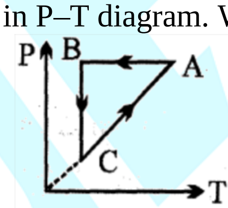
(1) 

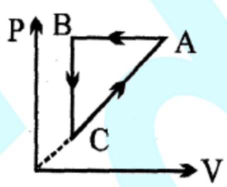
(2) 

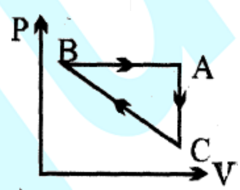
(3) 

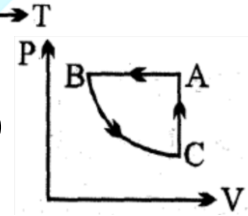
(4) 

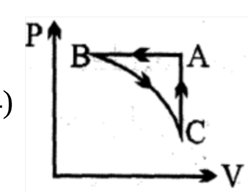
132. A cyclic process ABCA is shown in P–T diagram. When presented on P–V, it would



(1) 

(2) 

(3) 

(4) 

133. 28 g 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 g (2) 80/11 g (3) 5/6.3 g (4) 63/5 g

134. When temperature of a gas, contained in closed vessel is increased by 5°C, its pressure Increases by 1%. The original temperature of the gas was approximately :
(1) 500°C (2) 273°C (3) 227°C (4) 50°C

135. During an experiment an ideal gas obeys an addition equation of state P^2V = constant. The initial temperature and volume of gas are T and V respectively. When it expands to volume 2V, then its temperature will be :

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

136. 250 liter of an ideal gas is heated at constant pressure from 27°C such that its volume becomes 500 liters. The final temperature is :
(1) 54°C (2) 300°C (3) 327°C (4) 600°C

137. A balloon contain 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

138. A vessel has 6 g 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

139. Relation PV = RT is given for following condition for real gas -
(1) High temperature and high density (2) Low temperature and low density
(3)High temperature and low density (4) Low temperature and high density

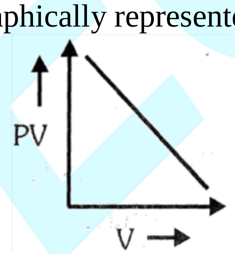
140. A container of 5 litre has a gas at pressure of 0.8 m column of Hg. This is joined to an evacuated container of 3 litre capacity. The resulting will be :- (At constant temp.)
(1) 4/3 (2) 0.5 m (3) 2.0 m (4) 3/4 m

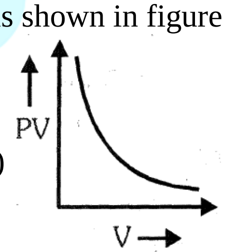
141. At a given temperature, the pressure of an ideal gas of density ρ is proportional to –
(1) $\frac{1}{\rho^2}$ (2) $\frac{1}{\rho}$ (3) ρ^2 (4) ρ

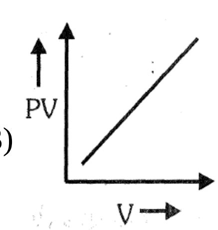
142. O_2 gas is filled in a cylinder. When pressure is increased 2 times, temperature becomes four times. then how much times their density will become :
(1) 2 (2) 4 (3) $\frac{1}{4}$ (4) $\frac{1}{2}$

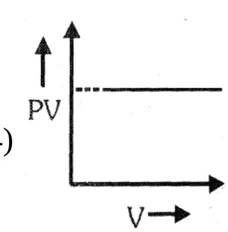
143. On increasing the temperature of a gas filled in a closed container by 1 °C its pressure increases by 0.4%, then initial temperature of the gas is-
(1) 25°C (2) 250°C (3) 250 K (4) 2500°C

144. The variation of PV graph with V of a fixed mass of a ideal gas at constant temperature is graphically represented as shown in figure :

(1) 

(2) 

(3) 

(4) 

145. The number of oxygen molecules in a cylinder of volume 1 m^3 at a temperature of 27°C and pressure 13.8 Pa is :
(Boltzmaan's constant k = 1.38×10^{-23} JK^{-1})
(1) 6.23×10^{26} (2) 0.33×10^{28} (3) 3.3×10^{21} (4) None of these

146. A cylinder contains 10 kg of gas at pressure of 10^7 N/m^2. When final pressure is reduce to 2.5×10^6 N/m^2 then quantity of gas taken out of the cylinder will be :
(temperature of gas is constant)
(1) 15.2 kg (2) 3.7 kg (3)zero (4) 7.5 kg

147. Hydrogen and helium gases of volume V at same temperature T and same pressure P are mixed to have same volume V. The resulting pressure of the mixture will be :
(1) P / 2 (2) P
(3) 2P (4) Depending on the relative mass of the gases

148. The equation of state for 5g of oxygen at a pressure P and temperature T 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 = (5/32) RT

149. In kinetic theory of gases, it is assumed that molecules :-
(1) Have same mass but can have different volume
(2) Have same volume but masses can be different
(3) Have both mass and volume different
(4) Have same mass but negligible volume

150. The volume of an ideal gas is V at pressure P and temperature T. The mass of each molecule of the gas in m. The density of gas will be :-
(K is Boltzmann's constant)
(1) mKT (2) Pm / KT (3) P / KTV (4) P / KT

151. the thermodynamic variables of a jar filled with gas A are P. V and T and another jar B filled with another gas are 2P, V/4 and 2T, where the symbols have their usual meaning. The ratio of the number of molecules of jar A to those of jar B is :
(1) 4 : 1 (2) 2 : 1 (3) 1 : 2 (4) 1 : 1

152. At N.T.P. volume of a gas is changed to one fourth volume, at constant temperature then the new pressure will be :
(1) 2 atm. (2) $2^{5/3}$ atm. (3) 4 atm. (4) 1 atm.

153. A gas contained in a box of 0.1 m^3 at atmospheric pressure is connected to another vessel of 0.09 m^3. Consequent change in pressure is X mm of Hg. Then X in meter is-
(1) 0.4 (2) 0.5 (3) 0.36 (4) 0.3

154. Find the correct relation in given P-V diagram :
(1) $T_1 = T_2$ (2) $T_1 > T_2$ (3) $T_1 < T_2$ (4) $T_1 \lessgtr T_2$

155. Simple behaviour under all conditions of real gas is governed by the equation :-
(1) $PV = \mu RT$ (2) $\left(P + \frac{a}{V^2}\right)(V - b) = RT$
(3) PV = constant (4) PV^γ = constant

VARIOUS SPEEDS, DEGREE OF FREEDOM, SPECIFIC HEAT CAPACITIES OF GASES AND MEAN FREE PATH

156. Three particles have speeds of 2u, 10u and 11u. Which of the following statements is correct?
(1) The 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.

157. The root mean square velocity of the molecules of an ideal gas is :-
(1) $\sqrt{RT/M_W}$ (2) $\sqrt{3RT/M_W}$ (3) $\sqrt{3RTM_W}$ (4) $\sqrt{RT/3M_W}$

158. At constant pressure hydrogen is having temperature of 327°C. Till what temperature is to be cooled so that the rms velocity of its molecules becomes half of the earlier value :-
(1) –123°C (2) 123°C (3) –100°C (4) 0°C

159. The rms velocity of gas molecules of a given amount of a gas at 27°C and 1.0×10^5 N m^{-2} pressure is 200 m sec^{-1}. If temperature and pressure are respectively 127°C and 0.5×10^5 N m^{-2}, the rms velocity will be :-
(1) $400/\sqrt{3}$ ms^{-1} (2) $100\sqrt{2}$ ms^{-1}
(3) $100\sqrt{2}/3$ ms^{-1} (4) $50\sqrt{\frac{2}{3}}$ ms^{-1}

168. Two containers of same volume are filled with atomic Hydrogen and Helium respectively at l and 2 atm pressure. If the temperature of both specimen are same then average speed $< C_H >$ for hydrogen atoms will be –
(1) $\langle C_H \rangle = \sqrt{2}\,\langle C_{He} \rangle$ (2) $\langle C_H \rangle = \langle C_{He} \rangle$
(3) $\langle C_H \rangle = 2\,\langle C_{He} \rangle$ (4) $\langle C_H \rangle = \frac{\langle C_{He} \rangle}{2}$

16l. The r.m.s. speed of a gas molecule is 300 m/s. Calculate the r.m.s. speed if the molecular weight is doubled while the temperature is halved~
(1) 300 m/s (2) 150 m/s (3) 600 m/s (4) 75 m/s

162. The root mean square velocity of hydrogen molecules at 300 K is 1930 m/s. Then the r.m.s. velocity of oxygen molecules at 1200 K will' be :
(1) 482.5 m/s (2) 965.0 m/s (3) 1930 m/s (4) 3860 m/s.

163. The rms velocity of H_2 is 2×10^3 m/s. What will be the rms velocity of O_2 molecules at the same temperature :-
(1) 10^3 m/s (2) 500 m/s (3) 0.5×10^4 m/s (4) 3×10^3 m/s

164. 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) $< v^5 >$

165. The temperature at which root mean square velocity of molecules of helium is equal to root mean square velocity of hydrogen at N.T.P is-
(1) 273°C (2) 273 K (3) 546°C (4) 844 K

166. If the pressure of a gas is doubled at constant temperature, then the mean square velocity will become:-
(1) No change (2) double (3) Four times (4) None of the above

167. 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

168. The speeds of 5 molecules of a gas (in arbitrary units) are as follows 2, 3, 4, 5, 6 The root mean square speed for these molecules is -
(1) 2.91 (2) 3.52 (3) 4.00 (4) 4.24

169. The root mean square speed of the molecules of a gas is :
(1) Independent of its pressure but directly proportional to its Kelvin temperature
(2) Directly proportional to the square roots of both its pressure and its Kelvin temperature
(3) Independent of its pressure but directly proportional to the square root of its Kelvin temperature
(4) Directly proportional to both its pressure and its Kelvin temperature

170. At 0°C temperature root mean square speed of which of the following gases will be maximum:
(1) H_2 (2) N_2 (3) O_2 (4) SQ_2

171. The root mean square speed of hydrogen molecules of an ideal hydrogen gas kept in a gas chamber is 3180 m/s. The pressure of the hydrogen gas is:-
(Density of hydrogen gas = 8.99×10.2 Kg/m^3,1 atmosphere = 1.01×10^5 N/m^2)
(1) 1.0 atmosphere (2) 1.5 atmosphere
(3) 2.0 atmosphere (4) 3.0 atmosphere

172. If the rms velocity of molecules of a gas in a container is doubled then the pressure will:-
(1) Become four times (2) Also get doubled
(3) Be same (4) Become one half

173. The root mean square velocity of a gas molecule of mass m at a given temperature is proportional to-
(1) m^0 (2) m (3) $\sqrt{m}$ (4) $\frac{1}{\sqrt{m}}$

174. v_{rms}, v_{av} and v_{mp} are root mean square, average and most probable speeds of molecules of a gas obeying Maxwell's velocity distribution. Which of the following statements is correct
(1) $v_{rms} < v_{av} < v_{mp}$ (2) $v_{rma} > v_{av} > v_{mp}$ (3) $v_{mp} < v_{rms} < v_{av}$ (4) $v_{mp} > v_{rms} > v_{av}$

175. If the r.m.s. velocity of hydrogen becomes equal to the escape velocity from the earth surface, then the temperature of hydrogen gas would be-
(1) 1060 K (2) 5030 K (3) 8270 K (4) 10^4 K

176. The pressure exerted by a gas in P_0. If the mass of molecules becomes half and their velocities become double, then pressure will become
(1) $\frac{P_0}{2}$ (2) P_0 (3) $2P_0$ (4) $4P_0$

177. 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

178. 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) 94 K

179. The root mean square and most probable speed of the molecules in a gas are :

(1) same (2) different
(3) cannot say (4) depends on nature of the gas

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

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

181. The ratio of average translational kinetic energy to rotational kinetic energy of a diatomic molecule at temperature T is

(1) 3 (2) 7 / 5 (3) 5 / 3 (4) 3 / 2

182. For hydrogen gas $c_P - c_V = a$ and for 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

183. 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

184. The average kinetic energy of a gas molecule at 27°C is 6.21×10^{-21} J. Its average kinetic energy at 227°C will be

(1) 52.2×10^{-21} J (2) 5.22×10^{-21} J (3) 10.35×10^{-21} J (4) 11.35×10^{-21} J

185. Two containers A and B contain molecular gas at same temperature with masses of molecules are m_A and m_B, then relation of momentum P_A and P_B will be-

(1) $P_A = P_B$ (2) $P_A = \left(\frac{m_A}{m_B}\right)^{1/2} P_B$

(3) $P_A = \left(\frac{m_B}{m_A}\right)^{1/2} P_B$ (4) $P_A = \left(\frac{m_A}{m_B}\right) P_B$

186. A cylinder of 200 litre capacity is containing H_2. The total translational kinetic energy of molecules is 1.52×10^5 J. The pressure of H_2 in the cylinder will be in N m^2 :-

(1) 2×10^5 (2) 3×10^5 (3) 4×10^5 (4) 5×10^5

(187-188) Five moles of helium are mixed with two moles of hydrogen to form a mixture. Take molar mass of helium $M_1 = 4$g and that of hydrogen $M_2 = 2$g

187. The equivalent molar mass of the mixture is

(1) 6 g (2) $\frac{13g}{7}$ (3) $\frac{18g}{7}$ (4) $\frac{24g}{7}$

188. The equivalent value of γ in the above question is

(1) 1.59 (2) 1.53 (3) 1.56 (4) none

189. Two monoatomic ideal gas at temperature T_1 and T_2 are mixed. There is no loss of energy. If the mass of molecules of the two gases are m_1 and m_2 and number of their molecules are n_1 and n_2 respectively, then temperature of the mixture will be:

(1) $\frac{T_1+T_2}{n_1+n_2}$ (2) $\frac{T_1}{n_1}+\frac{T_2}{n_2}$ (3) $\frac{n_2T_1+n_1T_2}{n_1+n_2}$ (4) $\frac{n_1T_1+n_2T_2}{n_1+n_2}$

190. The total kinetic energy of 1 mole of N_2 at 27°C will be approximately :-

(1) 1500 J (2) 1500 calorie (3) 1500 kilo calorie (4) 1500 erg.

191. Mean kinetic energy (or average energy) per gm. Molecule of a monoatomic gas is given by :

(1) 3RT/2 (2) kT/2 (3) RT/3 (4) 3kT/2

192. 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) $f = 2(\gamma - 1)$

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

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

194. On mixing 1 g mole of a monoatomic with 1 g mole of a diatomic gas the specific heat of mixture at constant volume will be:-

(1) R (2) 3/2 R (3) 2 R (4) 5/2 R

195. Absolute zero temperature is one at which-

(1) All liquids convert into solid (2) All gases convert to solid
(3) All matter is in solid state (4) The K.E. of molecules becomes zero

196. For a gas $\frac{R}{C_V} = 0.67$. This gas is made up of molecules which are :

(1) Diatomic
(2) Mixture of diatomic and polyatomic molecules
(3) Monoatomic
(4) Polyatomic

197. If the total number of H_2 molecules is double that of the O_2 molecules then ratio of total kinetic energies of H_2 to that of O_2 at 300 K is :

(1) 1 : 1 (2) 1 : 2 (3) 2 : 1 (4) 1 : 16

198. At which of the following temperature any gas has average molecular kinetic energy double that of at 20°C

(1) 40°C (2) 80°C (3) 313°C (4) 586°C

199. When temperature is increased from 0°C to 273°C, in what ratio of final to initial the average kinetic energy of molecules change ?

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

200. The kinetic energy associated with per degree of freedom of a molecule is –

(1) $\frac{1}{2}MC_{rms}^2$ (2) kT (3) kT / 2 (4) 3 kT / 2

201. 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) $\frac{5}{7}$

202. 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.

203. Gas exerts pressure on the walls of container because the molecules-

(1) Are loosing their Kinetic energy

(2) Are getting stuck to the walls

(3) Are transferring their momentum to walls

(4) Are accelerated towards walls.

204. For a diatomic gas, change in internal energy for unit change in temperature at constant pressure and volume is U_1 and U_2 respectively then $U_1 : U_2$ is:

(1) 5 : 3 (2) 7 : 5 (3) 1 : 1 (4) 5 : 7

205. 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

206. The specific heat of a gas :

(1) Has only two value Cp and Cv (2) Has a unique value at a given temperature

(3) Can have any value between 0 and ∞ (4) Depends upon the mass of the gas

207. 22 g of CO_2 at 27°C is mixed with 16 g of O_2 at 37°C. The temperature of the mixture is :-
(At room temperature, degrees of freedom of CO_2 = 7 and degrees of freedom of O_2 = 5)

(1) 31.16°C (2) 27°C (3) 37°C (4) 30°C

208. At 27°C temperature, the kinetic energy of an ideal gas is E_1. If the temperature is increased to 327°C, then kinetic energy would be

(1) $2\,E_1$ (2) $\frac{1}{2}E_1$ (3) $\sqrt{2}\,E_1$ (4) $\frac{1}{\sqrt{2}}E_1$

209. Oxygen and hydrogen gases are at temperature T. Then K.E of molecules of oxygen gas is equal to how many times of average K.E. of molecules of hydrogen gas :-

(1) 16 times (2) 8 times (3) Equal (4) 1/16 times

210. The average energy of the molecules of a monoatomic gas at temperature T is :-
(K = Boltzmann constant)

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

211. A diatomic molecule has

(1) 1 degree of freedom (2) 3 degree of freedom
(3) 5 degree of freedom (4) 6 degree of freedom

212. Two moles of monoatomic gas are mixed with 1 mole of a diatomic gas. Then y for the mixture is:

(1) 1.4 (2) 1.55 (3) 1.62 (4) 1.67

ZEROTH AND FIRST LAW OF THERMODYNAMICS, HEAT, WORK AND INTERNAL ENERGY

213. The first law of thermodynamics is based on :-

(1) Law of conservation of energy
(2) Law of conservation of mechanical energy
(3) Law of conservation of gravitational P.E.
(4) None of the above·

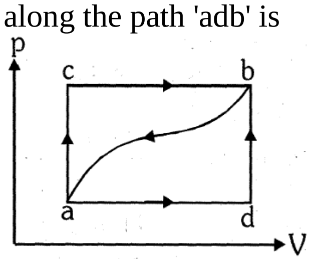
214. In a process, 500 calories of heat is given to a system and at the same time 100 joules of work is done on the ·system. The increase in the internal energy of the system is :- ·

(1) 40 calories (2) 1993 joules (3) 219 joules (4) 82 calories

215. In a thermodynamic process pressure of a fixed mass of a gas is changed in such a manner that the gas releases 20 joules of heat and 8 joules of work was done on the gas. If the initial internal energy of the gas was 30 joules, then the final internal energy will be :-

(1) 2 J (2) 42 J (3) 18 J (4) 58 J

216. 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) 6 J (2) 12 J (3) 18 J (4) 24 J

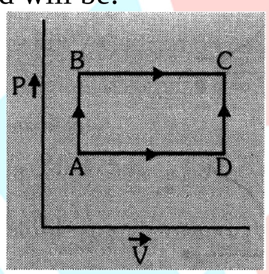
217. In the above question, if the work done on the system along the curved path 'ba' is 52J, heat absorbed is :
(1) –140 J (2) –172 J (3) 140 J (4) 172 J

218. In question No. 217, if $U_a = 40J$, value of U_b will be
(1) –50 J (2) 100 J (3) –120 J (4) 160 J

219. In question No. 217, if $U_d = 88J$, heat absorbed for the path 'db' is
(1) –72 J (2) 72 J (3) 144 J (4) –144 J

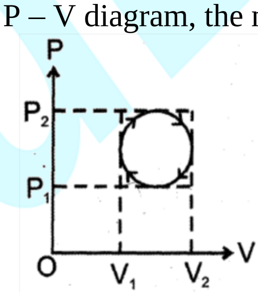
220. 1 kg of a gas does 20 kJ of work and receives 16 kJ of heat when it is expanded between two states. A second kind of expansion can be found between the same initial and final state which requires a heat input of 9 kJ. The work done by the gas in the second expansion is :
(1) 32 kJ (2) 5 kJ (3) –4 kJ (4) 13 kJ

221. As shown in the figure the amount of heat absorbed along the path ABC is 90 J and the amount of work done by the system is 30 J. If the amount of work done along the path ADC is 20 J then amount of heat absorbed will be:-



(1) 80 J (2) 90 J (3) 110 J (4) 120 J

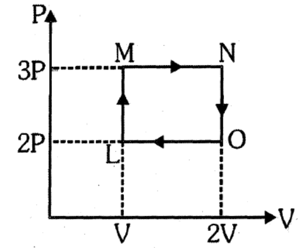
222. In a cyclic process shown on the P – V diagram, the magnitude of the work done is :



(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) $\pi(P_2V_2 - P_1V_1)$

223. The work by an ideal monoatomic gas along the cyclic path LMNOL is



(1) PV (2) 2 PV (3) 3 PV (4) 4 PV

224. For a gas C_v = 4.96 cal/mole K, the increase in internal energy of 2 mole gas in heating from 340 K to 342 K will be :-

(1) 27.80 cal (2) 19.84 cal (3) 13.90 cal (4) 9.92 cal

225. When a system changes from one to another state the value of work done :-

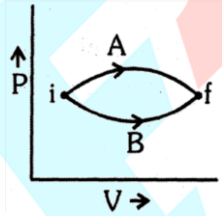
(1) Depends on the force acting on the system

(2) Depends on the nature of material present in a system

(3) Does not depend on the path

(4) Depends on the path

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



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

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

227. If the heat of 110 J is added to a gaseous system and change in internal energy is 40 J, then the amount of external work done is :

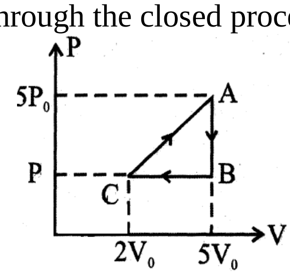
(1) 180 J (2) 70 J (3) 110 J (4) 30 J

228. If amount of heat supplied is Q, work done is W and change in internal energy is $mC_V\,dT$, then relation among them is. (C_v = gram specific heat)

(1) $mC_VdT = Q + W$ (2) $Q = W + mC_VdT$

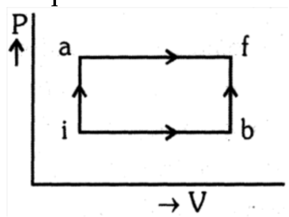
(3) $Q + mC_VdT = W$ (4) None of these.

229. The work done by a gas taken through the closed process ABCA is



(1) $6P_0V_0$ (2) $4P_0v_0$ (3) P_0V_0 (4) zero

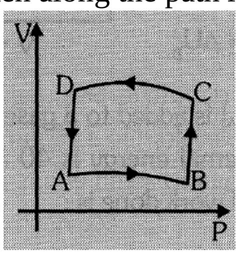
230. In the given figure the initial and final states of a gas are shown by points i and f. The internal energy of the gas at i is 10 J. For the path iaf : dQ = 50 J and dW = 20 J. For the path ibf, if dQ = 36 J the value of dW will be equal to

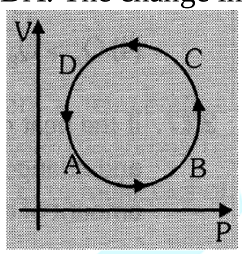


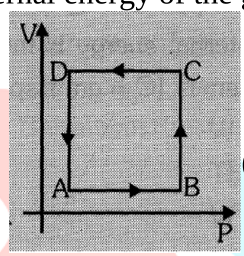
(1) 4 J (2) 12 J (3) 18 J (4) 6 J

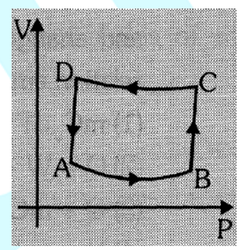
CYCLIC,ISOCHORIC, ISOBARIC, ISOTHERMAL, ADIABATIC AND POLYTROPIC PROCESS

231. In the diagrams (i) to (iv) of variation of volume with changing pressure is shown. A gas is taken along the path ABCDA. The change in internal energy of the gas will be:-

(i) 

(ii) 

(iii) 

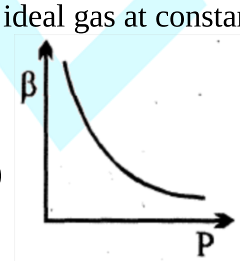
(iv) 

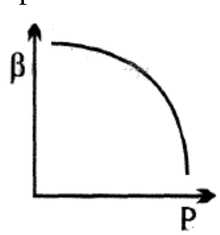
(1) Positive in all cases (i) to (iv)
(2) Positive in cases (i), (ii) and (iii) but zero in case (iv)
(3) Negative in cases (i), (ii) and (iii) but zero in case (iv)
(4) Zero in all the four cases

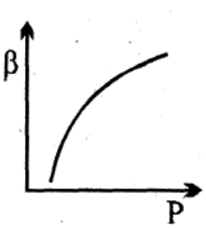
232. The temperature of 5 moles of a gas which was held at constant volume was changed from 100°C to 120°C. The change in internal energy was found to be 80 joules. The total heat capacity of the gas at constant volume will be equal to:-
(1) 8 J/K (2) 0.8 J/K (3) 4.0 J/K (4) 0.4 J/K

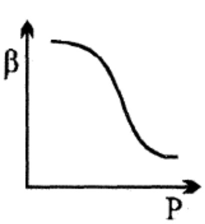
233. Monoatomic, diatomic and triatomic gases whose initial volume and pressure are same, are compressed till their volume become half the initial volume.
(1) If the compression is adiabatic then monoatomic gas will have maximum final pressure.
(2) If the compression is adiabatic then triatomic gas will have maximum final pressure.
(3) If the compression is adiabatic then their final pressure will be same.
(4) If the compression is isothermal then their final pressure will be different.

234. 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) 

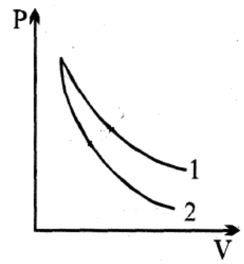
(4) 

235. The adiabatic Bulk modulus of a diatomic gas at atmospheric pressure is
(1) $0\ Nm^{-2}$ (2) $1\ Nm^{-2}$ (3) $1.4 \times 10^{4}\ Nm^{-2}$ (4) $1.4 \times 10^{5}\ Nm^{-2}$

236. A given quantity of an ideal gas is at pressure P and absolute temperature T. The isothermal bulk modulus of the gas is :

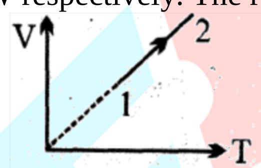
(1) 2P /3 (2) P (3) 3P / 2 (4) 2P

237. 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 N_2

238. 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 $\Delta Q : \Delta W$ is



(1) $\gamma : \gamma - 1$ (2) γ (3) $\gamma - 1$ (4) $\gamma - 1 : \gamma$

239. For an adiabatic expansion of a perfect fas, the value of $\Delta P / P$ is equal to :-

(1) $-\sqrt{\gamma}\ \Delta V / V$ (2) $-\Delta V / V$ (4) $-\gamma\ \Delta V / V$ (4) $-\gamma^2\ \Delta V / V$

240. An ideal gas at 27°C is compressed adiabatically to B/27 of its original volume. If $\gamma = 5/3$, then the rise temperature is:-

(1) 450 K (2) 375 K (3) 675 K (4) 405 K

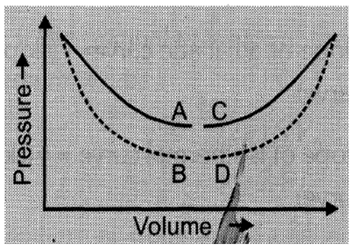
241. For monoatomic gas the relation between pressure of a gas and temperature T is given by $P \propto T^C$. Then value of C will be : (For adiabatic process)

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

242. A gas for which $\gamma = 5/3$ is heated at constant pressure. The percentage of total heat given that will be used for external work is :

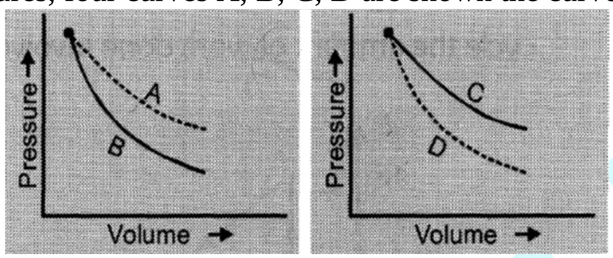
(1) 40% (2) 30% (3) 60% (4) 20%

243. 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

244. In the following figures, four curves A, B, C, D are shown the curves are :-



(1) Isothermal for A and B while adiabatic for C and D
(2) Isothermal for A and C while adiabatic for B and D
(3) Isothermal for A and D
(4) Adiabatic for A and C while isothermal for B and D

245. Equal volumes of a perfect gas are compressed to half of their initial volumes. The first is brought about by isothermal process and the second by adiabatic process then :
(1) Both temperature and pressure will increase in the isothermal process.
(2) In the isothermal process, the temperature will decrease and pressure will increases
(3) Both temperature and pressure will increase in adiabatic process
(4) In the adiabatic process, the temperature will decrease and pressure will increase

246. A vessel contains an ideal monoatomic gas which expands at constant pressure, when heat Q is given to it. Then the work done in expansion is :

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

247. 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) $\frac{1}{5}R(T_2 - T_1)$

248. When an ideal diatomic gas is heated at constant pressure, the fraction of the heat energy supplied which increases the internal energy of the gas is –
(1) 2 / 5 (2) 3 / 5 (3) 3 / 7 (4) 5 / 7

249. Pressure-temperature relationship for an ideal gas undergoing adiabatic change is ($\gamma = C_p / C_v$)
(1) PT^{γ} = constant (2) $PT^{-1+\gamma}$ = constant
(3) $PT^{\gamma-1}T^{\gamma}$ = constant (4) $P^{1-\gamma}T^{\gamma}$ = constant

250. The value of internal energy in an adiabatic process :-
(1) Remains unchanged (2) Only increases

(3) Only diminishes (4) May diminish and may also increase

251. One mole of an ideal monoatomic gas is heated at a constant pressure of one atmosphere from 0°C to 100°C. Then the change in the internal energy is

(1) 20.80×10^2 J (2) 12.48×10^2 J (3) 832×10^2 J (4) 6.25×10^2 J

252. The specific heat of a gas at constant pressure is more than that of the same gas at constant volume because :-

(1) Work is done in the expansion of gas at constant pressure
(2) Work is done in the expansion of the gas at constant volume
(3) The molecular attraction increase under constant pressure
(4) The vibration of molecules increases under constant pressure

253. When a gas is adiabatically compressed then it's temperature increase because :-

(1) Work done is zero (2) Internal energy is increased
(3) Heat is supplied to it (4) No change in pressure .

254. Air is filled in a tube of the wheel of a car at 27°C and 2 atm pressure if the tube is suddenly bursts, the final temperature of air will be :-

($y = 1.5$, $2^{1/3} = 1.251$)

(1) –33°C (2) 0°C (3) 21.6°C (4) 240°C

255. Specific heat of a gas undergoing adiabatic change is :

(1) Zero (2) Infinite (3) Positive (4) Negative

256. A quantity of air ($\gamma = 1.4$) at 27°C is compressed suddenly, the temperature of the air system will:

(1) Fall (2) Rise
(3) Remain unchanged (4) First rise and then fall

257. A gas speciman in one vessel is expended isothermally to double its volume and a similar 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 is less.
(3) In the first vessel, both pressure & work done are more.
(4) In the first vessel, pressure is more, but work done is less

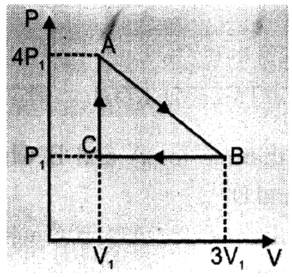
258. If an ideal gas is compressed during isothermal process then :-

(1) No work is done against gas (2) heat is rejected by gas
(3) It's internal energy will increase (4) Pressure does not change

259. Graphs between P–V diagram for isothermal and adiabatic processes are drawn the relation between their slopes will be :-

(1) Slope of adiabatic curve = γ (slope of isothermal curve)
(2) Slope of isothermal curve = γ (slope of adiabatic curve)
(3) Slope of isothermal curve = slope of adiabatic curve
(4) Slope of adiabatic curve-= γ^2 (Slope of isothermal curve)

260. An ideal gas is taken round the cycle ABCA. In the cycle the amount of work done involved is:



(1) 12 P_1V_1 (2) 6 P_1V_1 (3) 3 P_1V_1 (4) P_1V_1

261. One mole ideal gas is compressed adiabatically at 27°C. Its temperature becomes 102°C. The work done in this process will be :- (γ = 1.5)
(1) –625 J (2) 625 J (3) 1245 J (4) –1245 J

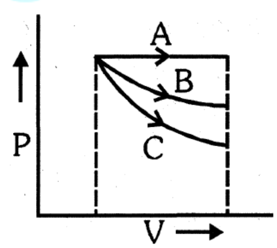
262. In an isometric change :
(1) $\delta Q = dU$ (2) $\delta W = dU$ (3) $\delta Q + \delta W = dU$ (4) None of these

263. The volume of a gas expands by 0.25 m^3 at a constant pressure of 10^3 N/m^2. The work done is equal to
(1) 2.5 erg (2) 250 J (3) 250 W (4) 250 N

264. The process in which the heat given to a system is completely transformed into work is for ideal gas :-
(1) Isobaric process (2) Isometric process
(3) Isothermal process (4) Adiabatic process

265. The volume of a poly-atomic gas $\left(\gamma = \frac{4}{3}\right)$ compressed adiabatically to $\frac{1}{8^{th}}$ of the original volume. If the original pressure of the gas is P_0 the new pressure will be :
(1) 8 P_0 (2) 16 P_0 (3) 6 P_0 (4) 2 P_0

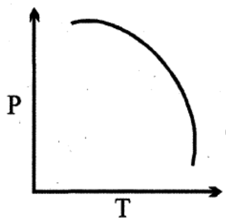
266. During isothermal, isobaric and adiabatic processes, work done for same change in volume will be maximum for :-

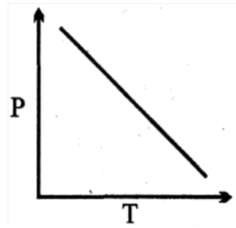


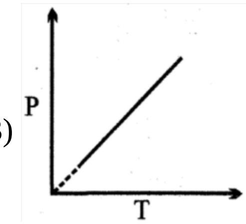
(1) Isothermal (2) Isobaric (3) Adiabatic (4) None of the above

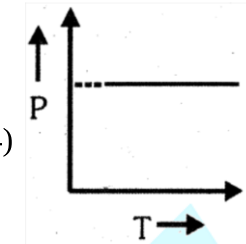
267. In an adiabatic process the quantity which remains constant is :-
(1) Temperature (2) Pressure
(3) Total heat content of the system (4)Volume

268. Graph of isometric process is :-

(1) 

(2) 

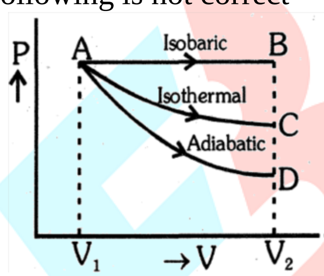
(3) 

(4) 

269. An ideal gas undergoes an adiabatic change in volume (V) with pressure (P). Then :-
(1) $P^{\gamma} V$ = constant (2) PV^{γ} = constant (3) $(PV)^{\gamma}$ = constant (4) PV = constant

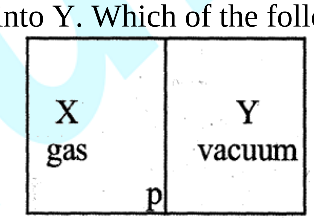
270. 300 calories of heat is supplied to raise the temperature of 50 gm of air from 20°C to 30°C without any change in its volume. Change in internal energy per gram of air is
(1) zero (2) 0.6 calories (3) 1.2 calories (4) 6.0 calories

271. A gas is expanded from volume V_1 to volume V_2 in three processes, shown in the figure. If U_A, U_B, U_C and U_D represent the internal energies of the gas in state A, B, C and D respectively, the which of the following is not correct



(1) $U_B - U_A > 0$ (2) $U_C - U_A = 0$
(3) $U_D - U_A < 0$ (4) $U_B = U_C = U_D$

272. 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

SECOND LAW OF THE THERMODYNMAMICS, HEAT ENGINES AND REFRIGERATORS

273. 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 an cyclic processes we have dQ / T < 0
(4) the reason all heat engine efficiencies are less than 100% is friction, which is unavoidable

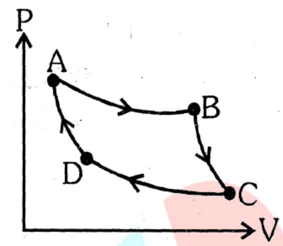
274. "Heat cannot flow by itself from a body at lower temperature to a body at higher temperature" is a statement or consequence of :
(l) second law thermodynamics (2) conservation of momentum

(3) conservation of mass (4) first law of thermodynamics

275. 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

276. 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) $T_H / (T_H - T_C)$

277. In the given graph the isothermal curves are :-



(1) AB and CD (2) AB and AD (3) AD and BC (4) BC and CD

278. In the above question the curve for which the heat is absorbed from the surroundings is :-
(1) AB (2) BC (3) CD (4) DA

279. A Carnot engine shows efficiency of 40% on taking energy at 500 K. To increase the efficiency to 50%, at what temperature it should take energy ?
(1) 400 K (2) 700 K (3) 600 K (4) 800 K

280. A Carnot engine, whose efficiency is 400% takes in heat from a source maintained at a temperature of 500 K. It is desired to have an engine of efficiency 60%. Then, the intake temperature for the same exhaust (sink) temperature must be :
(1) 750 K
(2) 600 K
(3) Efficiency of Carnot engine cannot be made larger then 50% .
(4) 1200 K

281. If the system takes 100 cal. heat and releases 80 cal to sink, if source temperature is 127°C find the sink temperature :-
(1) 47°C (2) 127°C (3) 67°C (4) 107°C

282. A Carnot engine working between 300 K and 600 K has work out put of 800 J per cycle. The amount of heat energy supplied to the engine from source per cycle will be :
(1) 800 J (2) 1600 J (3) 1200 J (4) 900 J

283. The efficiency of Carnot engine is 50% and temperature of sink is 500 K. 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

284. An ideal gas heat engine operates in Carnot cycle between 227°C and 127°C. It absorbs 6×10^4 cal of heat at higher temperature. Then amount of heat converted to work is :
(1) 2.4×10^4 cal (2) 6×10^4 cal (3) 1.2×10^4 cal (4) 4.8 x 104 cal

285. A refrigerator works between temperature –10°C and 27°C, the coefficient of performance is:
(1) 7.1 (2) 1 (3) 8.1 (4) 15.47

ANSWER KEY

EXERCISE-I (Conceptual Questions)

1.	(1)	**2.**	(1)	**3.**	(1)	**4.**	(2)	**5.**	(4)	**6.**	(3)	**7.**	(3)
8.	(1)	**9.**	(2)	**10.**	(2)	**11.**	(2)	**12.**	(1)	**13.**	(3)	**14.**	(4)
15.	(1)	**16.**	(3)	**17.**	(1)	**18.**	(1)	**19.**	(1)	**20.**	(1)	**21.**	(4)
22.	(2)	**23.**	(4)	**24.**	(1)	**25.**	(1)	**26.**	(3)	**27.**	(3)	**28.**	(4)
29.	(3)	**30.**	(1)	**31.**	(4)	**32.**	(4)	**33.**	(3)	**34.**	(1)	**35.**	(2)
36.	(3)	**37.**	(2)	**38.**	(2)	**39.**	(2)	**40.**	(3)	**41.**	(1)	**42.**	(1)
43.	(1)	**44.**	(2)	**45.**	(1)	**46.**	(4)	**47.**	(4)	**48.**	(2)	**49.**	(1)
50.	(3)	**51.**	(2)	**52.**	(2)	**53.**	(2)	**54.**	(4)	**55.**	(2)	**56.**	(3)
57.	(1)	**58.**	(1)	**59.**	(2)	**60.**	(2)	**61.**	(4)	**62.**	(3)	**63.**	(3)
64.	(1)	**65.**	(3)	**66.**	(3)	**67.**	(3)	**68.**	(1)	**69.**	(3)	**70.**	(1)
71.	(4)	**72.**	(3)	**73.**	(4)	**74.**	(1)	**75.**	(2)	**76.**	(2)	**77.**	(3)
78.	(2)	**79.**	(4)	**80.**	(3)	**81.**	(3)	**82.**	(3)	**83.**	(3)	**84.**	(4)
85.	(2)	**86.**	(4)	**87.**	(2)	**88.**	(4)	**89.**	(4)	**90.**	(2)	**91.**	(1)
92.	(1)	**93.**	(1)	**94.**	(2)	**95.**	(3)	**96.**	(3)	**97.**	(1)	**98.**	(3)
99.	(2)	**100.**	(2)	**101.**	(3)	**102.**	(1)	**103.**	(4)	**104.**	(1)	**105.**	(3)
106.	(4)	**107.**	(4)	**108.**	(3)	**109.**	(2)	**110.**	(4)	**111.**	(3)	**112.**	(1)
113.	(1)	**114.**	(2)	**115.**	(3)	**116.**	(3)	**117.**	(2)	**118.**	(1)	**119.**	(2)
120.	(2)	**121.**	(4)	**122.**	(1)	**123.**	(4)	**124.**	(4)	**125.**	(4)	**126.**	(4)
127.	(4)	**128.**	(3)	**129.**	(1)	**130.**	(3)	**131.**	(3)	**132.**	(3)	**133.**	(4)
134.	(3)	**135.**	(2)	**136.**	(3)	**137.**	(3)	**138.**	(2)	**139.**	(3)	**140.**	(2)
141.	(4)	**142.**	(4)	**143.**	(3)	**144.**	(4)	**145.**	(3)	**146.**	(4)	**147.**	(3)
148.	(4)	**149.**	(4)	**150.**	(2)	**151.**	(1)	**152.**	(3)	**153.**	(3)	**154.**	(3)
155.	(2)	**156.**	(1)	**157.**	(2)	**158.**	(1)	**159.**	(1)	**160.**	(3)	**161.**	(2)
162.	(2)	**163.**	(2)	**164.**	(2)	**165.**	(1)	**166.**	(1)	**167.**	(1)	**168.**	(4)
169.	(3)	**170.**	(1)	**171.**	(4)	**172.**	(1)	**173.**	(4)	**174.**	(2)	**175.**	(4)
176.	(3)	**177.**	(4)	**178.**	(1)	**179.**	(2)	**180.**	(4)	**181.**	(4)	**182.**	(1)
183.	(4)	**184.**	(3)	**185.**	(2)	**186.**	(4)	**187.**	(4)	**188.**	(3)	**189.**	(4)
190.	(2)	**191.**	(1)	**192.**	(3)	**193.**	(1)	**194.**	(3)	**195.**	(4)	**196.**	(3)
197.	(3)	**198.**	(3)	**199.**	(4)	**200.**	(3)	**201.**	(2)	**202.**	(4)	**203.**	(3)
204.	(3)	**205.**	(4)	**206.**	(3)	**207.**	(1)	**208.**	(1)	**209.**	(3)	**210.**	(3)
211.	(3)	**212.**	(2)	**213.**	(1)	**214.**	(3)	**215.**	(3)	**216.**	(4)	**217.**	(2)
218.	(4)	**219.**	(2)	**220.**	(4)	**221.**	(1)	**222.**	(3)	**223.**	(1)	**224.**	(2)
225.	(4)	**226.**	(4)	**227.**	(2)	**228.**	(2)	**229.**	(1)	**230.**	(4)	**231.**	(4)
232.	(3)	**233.**	(1)	**234.**	(1)	**235.**	(4)	**236.**	(2)	**237.**	(2)	**238.**	(1)
239.	(3)	**240.**	(2)	**241.**	(4)	**242.**	(1)	**243.**	(2)	**244.**	(2)	**245.**	(3)
246.	(3)	**247.**	(2)	**248.**	(4)	**249.**	(4)	**250.**	(4)	**251.**	(2)	**252.**	(1)
253.	(2)	**254.**	(1)	**255.**	(1)	**256.**	(2)	**257.**	(3)	**258.**	(2)	**259.**	(1)
260.	(3)	**261.**	(4)	**262.**	(1)	**263.**	(2)	**264.**	(3)	**265.**	(2)	**266.**	(2)
267.	(3)	**268.**	(3)	**269.**	(2)	**270.**	(4)	**271.**	(4)	**272.**	(1)	**273.**	(1)

274.	(1)	**275.**	(2)	**276.**	(2)	**277.**	(1)	**278.**	(1)	**279.**	(3)	**280.**	(1)
281.	(1)	**282.**	(2)	**283.**	(3)	**284.**	(3)	**285.**	(1)				