Shiksha Classes, Bhandara

Physics

Subject : Physics **Topic : Kinetic Theory of Gases** **M.M. : 180**

Marking Scheme:
(i) Each question is allotted 4 (four) marks for each correct response.
(ii) ¼ (one fourth) marks will be deducted for indicating incorrect response of each question. No deduction from the total score will be made if no response is indicated for an item in the answer sheet.

Q.1 Two gases of equal molar mass are in thermal equilibrium. If P_a, P_b and V_a and 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) $P_aV_a = P_bV_b$

Q.2 The total kinetic energy of 1 mole of N_2 at 27°C will be approximately :-

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

Q.3 250 litre 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

Q.4 At same temperature the rms velocity of H_2 is 2×10^3 m /sec. What will be the rms velocity of O_2 molecules at the same temperature :

(1) 10^3 m/sec. (2) 500 m/sec.
(3) 0.5×10^4 m/sec. (4) 3×10^3 m / sec

Q.5 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) $< v^5 >$

Q.6 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

Q.7 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

Q.8 If the total number of H_2 molecules is double that of the O_2 molecules then the 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

Q.9 At which temperature of the following, does 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

Q.10 Consider a gas with density ρ and $\bar{c}$ as the root mean square velocity of its molecules contained in a volume. If the system moves as whole with velocity v, then the pressure exerted by the gas is

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

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

Q.11 Root mean square velocity for a certain di-atomic gas at room temperature 27°C is found to be 1930m/s. The gas is -

(1) H_2 (2) O_2
(3) F_2 (4) Cl_2

Q.12 A balloon contains 500 m^3 of helium at 27°C and 1 atmosphere pressure. The volume of the helium at –3°C temperature and 0.5 atmosphere pressure will be-

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

Q.13 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

Q.14 A vessel has 6g of oxygen of 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

Q.15 When temperature is increased from 0°C to 273°C, in what ratio the average kinetic energy of molecules change ?

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

Q.16 For a diatomic gas, change in internal energy for unit change in temperature for constant pressure and volume is U_1 and U_2 respectively. $U_1 : U_2$ is

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

Q.17 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) SO_2

Q.18 22 gm. of CO_2 at 27°C is mixed with 16 gm. of O_2 at 37°C. The temperature of the mixture is :

(1) 31.4°C (2) 27°C
(3) 37°C (4) 30°C

Q.19 A container of 5 liter has a gas at pressure of 0.8m column of Hg. This is joined to an evacuated container of 3 liter capacity. The resulting pressure will be :-
(At constant temperature)

(1) 4/3 (2) 0.5 m
(3) 2.0 m (4) 3/4 m

Q.20 The root mean square speed of hydrogen molecules of an ideal hydrogen gas kept in a gas chamber at 0°C is 3180 m/s. The pressure of the hydrogen gas is :-
(Density of hydrogen gas is 8 .99 x 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

Q.21 Air is filled at 60°C in a vessel of open mouth. The vessel in heated to a temperature T so that $1/4^{th}$ part of air escapes. The value of T is :

(1) 80°C (2) 444°C
(3) 333°C (4) 171°C

Q.22 At a given temperature, the pressure of an ideal gas of density ρ is proportional to -

(1) $1 / \rho^2$ (2) $1 / \rho$
(3) ρ^2 (4) ρ

Q.23 Find the ratio of specific heat at constant pressure to the specific heat at constant volume for NH_3 :

(1) 1.33 (2) 1.44
(3) 1.28 (4) 1.67

Q.24 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}) is

(1) 6.23 × 10^{26} (2) 0.33 × 10^{28}
(3) 3.3 × 10^{21} (4) None of these

Q.25 A cylinder contains 10 kg of gas at pressure of 10^7 N/m^2. The quantity of gas taken out of the cylinder, if final pressure is 2.5 × 10^6 N/m^2, will be: (temperature of gas is constant)

(1) 15.2 kg (2) 3.7 kg
(3) zero (4) 7.5 kg

Q.26 Oxygen and hydrogen gases are at temperature T. Then the K.E of molecules of oxygen gas is equal to how many times of K.E. of molecules of hydrogen gas

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

Q.27 On increasing the temperature of a gas filled in a closed container by 1°C its pressure increases by 0.4%, initial temperature of the gas is-

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

Q.28 The thermodynamic co-ordinates 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) 1 : 4 (2) 2 : 1
(3) 1 : 2 (4) 1 : 1

Q.29 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

Q.30 If one mole of a mono-atomic gas (γ = 5/3) is mixed with one mole of a diatomic gas (γ = 7/5), the value of γ for the mixture is-

(1) 1.4 (2) 1.5
(3) 1.53 (4) 3.07

Q.31 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

Q.32 At N.T.P. the 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.

Q.33 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

Q.34 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 metre is -
(1) 0.4 (2) 0.5
(3) 0.36 (4) 0.3

Q.35 Temperature at which the velocity of sound in O_2 is the same as that on N_2 at 27°C is approximately
(1) 60°C (2) 80°C
(3) 70°C (4) 27°C

Q.36 A gas is at 0°C . Upto what temperature the gas is to be heated so that the root mean square velocity of its molecules be doubled.
(1) 273°C (2) 1092°C
(3) 819°C (4) 100°C

Q.37 The molar specific heat at constant pressure of an ideal gas is (7/2)R. The ratio of specific heat at constant pressure to that at constant volume is
(1) 7/5 (2) 8/7
(3) 5/7 (4) 9/7

Q.38 The equation of state of a gas is given by $\left(P+\frac{aT^2}{V}\right)V^C = (RT + b)$, where a, b, c and R are constants. The isotherms can be represented by $P = AV^m - BV^n$, where A and B depend only on temperature and
(1) m = – c and n = – 1 (2) m = c and n = 1
(3) m = – c and n = 1 (4) m = c and n = – 1

Q.39 At 10°C the value of the density of a fixed mass of an ideal gas divided by its pressure is x. At 110°C this ratio is :-
(1) $\frac{10}{110}x$ (2) $\frac{283}{383}x$
(3) x (4) $\frac{383}{283}x$

Q.40 The rms velocity of gas molecules of a given amount of a gas at 27°C and 1.0×10^5 Nm^{-2} pressure is 200 m/s. If temperature and pressure are respectively 127°C and 0.5×10^5 Nm^2, the rms velocity will be
(1) $400/\sqrt{3}$ m/s (2) $100\sqrt{2}$ m/s
(3) $100\sqrt{2}/3$ m/s (4) $50\sqrt{\frac{2}{3}}$ m/s

Q.41 N molecules of an ideal gas at temperature T_1 and pressure P_1 are contained in a closed box. If the molecules in the box gets doubled, Keeping total kinetic energy as same then if new pressure is P_2 and temperature is T_2, Then :
(1) $P_2 = P, T_2 = T_1$ (2) $P_2 = P_1, T_2 = T_1/2$
(3) $P_2 = 2P_1, T_2 = T_1$ (4) $P_2 = 2P_1, T_2 = T_1/2$

Q.42 The lowest pressure (the best vacuum) 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} (2) 1.61×10^{12}
(3) 3.21×10^6 (4) 3.28×10^5

Q.43 A cylinder of 200 litre capacity is containing H_2. The total average 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

Q.44 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) $P_A = \left(\frac{m_A}{m_B}\right) P_B$

Q.45 If distance between the gas molecules is doubled on constant temperature, then pressure-
(1) P/16 (2) P/8
(3) P/4 (4) P/2