CHAPTER 12

Kinetic Theory

Ideal Gas Equations and Vander Waals Relation

1. The volume occupied by the molecules contained in 4.5 kg water at STP, if the intermolecular forces vanish away is: *(2022)*

a. $5.6\ m^3$ b. $5.6 \times 10^6\ m^3$
c. $5.6 \times 10^3\ m^3$ d. $5.6 \times 10^{-3}\ m^3$

2. A cylinder contains hydrogen gas at pressure of 249 kPa and temperature 27° C.
Its density is : ($R = 8.3\ J\ mol^{-1}\ K^{-1}$) *(2020)*

a. $0.2\ kg/m^3$ b. $0.1\ kg/m^3$
c. $0.02\ kg/m^3$ d. $0.5\ kg/m^3$

3. An ideal gas equation can be written as $P = \frac{\rho RT}{M_0}$ where ρ and M_0 are respectively, *(2020-Covid)*

a. Number density, molar mass
b. Mass density, molar mass
c. Number density, mass of the gas
d. Mass density, mass of the gas

4. Increase in temperature of a gas filled in a container would lead to: *(2019)*

a. Increase in its mass
b. Increase in its kinetic energy
c. Decrease in its pressure
d. Decrease in intermolecular distance

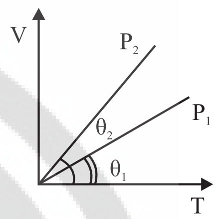
5. A given sample of an ideal gas occupies a volume V at a pressure P and absolute temperature T. The mass of each molecule of the gas is m. Which of the following gives the density of the gas? *(2016 - II)*

a. P/(kTV) b. mkT
c. P/(kT) d. Pm/(kT)

6. Two vessels separately contain two ideal gases A and B at the same temperature, the pressure of A being twice that of B. Under such conditions, the density of A is found to be 1.5 times the density of B. The ratio of molecular weight of A and B is: *(2015 Re)*

a. 1/2 b. 2/3
c. 3/4 d. 2

7. In the given (V-T) diagram, what is the relation between pressures P_1 and P_2? *(2013)*



a. Cannot be predicted b. $P_2 = P_1$
c. $P_2 > P_1$ d. $P_2 < P_1$

Speed of Gas Molecules

8. Match Column-I and Column-II and choose the correct match from the given choices. *(2021)*

	Column-I		Column-II
(A)	Root mean square speed of gas molecules	(P)	$\frac{1}{3}nm\bar{v}^2$
(B)	Pressure exerted by ideal gas	(Q)	$\sqrt{\frac{3RT}{M}}$
(C)	Average kinetic energy of a molecule	(R)	$\frac{5}{2}RT$
(D)	Total internal energy of 1 mole of a diatomic gas	(S)	$\frac{3}{2}k_BT$

a. (A) - (Q), (B) - (R), (C) - (S), (D) - (P)
b. (A) - (Q), (B) - (P), (C) - (S), (D) - (R)
c. (A) - (R), (B) - (Q), (C) - (P), (D) - (S)
d. (A) - (R), (B) - (P), (C) - (S), (D) - (Q)

9. At what temperature will the rms speed of oxygen molecules become just sufficient for escaping from the Earth's atmosphere ? (Given: Mass of oxygen molecule (m) = 2.76×10^{-26} kg, Boltzmann's constant $k_B = 1.38 \times 10^{-23}\ JK^{-1}$) *(2018)*

a. 5.016×10^4 K
b. 8.360×10^4 K
c. 2.508×10^4 K
d. 1.254×10^4 K

10. The molecules of a given mass of a gas have r.m.s velocity of 200 ms^{-1} at 27°C and 1.0×10^5 Nm^{-2} pressure. When the temperature and pressure of the gas are respectively, 127°C and 0.05×10^5 Nm^{-2}, the r.m.s. velocity of its molecules in ms^{-1} is: *(2016 - I)*

a. $100\sqrt{2}$
b. $\frac{400}{\sqrt{3}}$
c. $\frac{100\sqrt{2}}{3}$
d. $\frac{100}{3}$

Variation of Pressure with Depth and Pascal's Law

11. The average thermal energy for a mono-atomic gas is : (k_B) is Boltzmann constant and T is absolute temperature) *(2020)*

a. $\frac{3}{2}k_BT$
b. $\frac{5}{2}k_BT$
c. $\frac{7}{2}k_BT$
d. $\frac{1}{2}k_BT$

12. A gas mixture consists of 2 moles of O_2 and 4 moles of Ar at temperature T. Neglecting all vibrational modes, the total internal energy of the system is: *(2017-Delhi)*

a. 15 RT
b. 9 RT
c. 11 RT
d. 4 RT

13. The molar specific heats of an ideal gas at constant pressure and volume are denoted by C_P and C_V respectively. If $\gamma = \frac{C_P}{C_v}$ and R is the universal gas constant, then C_V is equal to: *(2013)*

a. γR
b. $\frac{1+\gamma}{1-\gamma}$
c. $\frac{R}{(\gamma-1)}$
d. $\frac{(\gamma-1)}{R}$

Specific and Molar Heat Capacity of Gases

14. One mole of an ideal monoatomic gas undergoes a process described by the equation PV^3 = constant. The heat capacity of the gas during this process is: *(2016 - II)*

a. 2 R
b. R
c. $\frac{3}{2}R$
d. $\frac{5}{3}R$

15. The ratio of the specific heats $\frac{C_P}{C_v} = \gamma$ in terms of degrees of freedom (n) is given by: *(2015)*

a. $\left(1+\frac{n}{3}\right)$
b. $\left(1+\frac{2}{n}\right)$
c. $\left(1+\frac{n}{2}\right)$
d. $\left(1+\frac{1}{n}\right)$

16. 4.0 g of a gas occupies 22.4 litres at NTP. The specific heat capacity of the gas at constant volume is 5.0 JK^{-1} mol^{-1}. If the speed of sound in this gas at NTP is 952 ms^{-1}, then the heat capacity at constant pressure is (Take gas constant R = 8.3 J/mol K): *(2015 Re)*

a. 8.5 J/K mol
b. 8.0 J/K mol
c. 7.5 J/K mol
d. 7.0 J/K mol

17. The amount of heat energy required to raise the temperature of 1 g of Helium at NTP, from T_1 K to T_2 K is: *(2013)*

a. $\frac{3}{4}N_Ak_B\left(\frac{T_2}{T_1}\right)$
b. $\frac{3}{8}N_Ak_B(T_2-T_1)$
c. $\frac{3}{2}N_Ak_B(T_2-T_1)$
d. $\frac{3}{4}N_Ak_B(T_2-T_1)$

Mean Free Path

18. The mean free path for a gas, with molecular diameter and number density n can be expressed as: *(2020)*

a. $\frac{1}{\sqrt{2}\,n\pi d^2}$
b. $\frac{1}{\sqrt{2}\,n^2\pi d^2}$
c. $\frac{1}{\sqrt{2}\,n^2\pi^2 d^2}$
d. $\frac{1}{\sqrt{2}\,n\pi d}$

19. The mean free path ℓ for a gas molecule depends upon diameter, d of the molecule as: *(2020-Covid)*

a. $\ell \propto d$
b. $\ell \propto d^2$
c. $\ell \propto \frac{1}{d}$
d. $\ell \propto \frac{1}{d^2}$

20. The mean free path of molecules of a gas, (radius r) is inversely proportional to: *(2014)*

a. r^3
b. r^{-2}
c. r
d. $\sqrt{r}$

Answer Key

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
a	a	b	b	d	c	d	b	b	b	a	c	c	b	b	b	b
18	19	20														
a	d	b														