States of Matter

1. If 10^{-4} dm^3 of water is introduced into a 1.0 dm^3 flask at 300 K, how many moles of water are in the vapour phase when equilibrium is established?

   (Given : Vapour pressure of H_2O at 300 K is 3170 Pa; R = 8.314 J K^{-1} mol^{-1}) **[AIEEE-2010]**

   (1) 1.27×10^{-3} mol (2) 5.56×10^{-3} mol

   (3) 1.53×10^{-2} mol (4) 4.46×10^{-2} mol

2. When r, P and M represent rate of diffusion, pressure and molecular mass, respectively, then the ratio of the rates of diffusion $\left(\frac{r_A}{r_B}\right)$ of two gases A and B, is given as **[AIEEE-2011]**

   (1) $\left(\frac{P_A}{P_B}\right)\left(\frac{M_A}{M_B}\right)^{\frac{1}{2}}$ (2) $\left(\frac{P_A}{P_B}\right)^{\frac{1}{2}}\left(\frac{M_A}{M_B}\right)$

   (3) $\left(\frac{P_A}{P_B}\right)\left(\frac{M_B}{M_A}\right)^{\frac{1}{2}}$ (4) $\left(\frac{P_A}{P_B}\right)^{\frac{1}{2}}\left(\frac{M_B}{M_A}\right)$

3. The molecular velocity of any gas is **[AIEEE-2011]** **[JEE (Main)-2020]**

   (1) Directly proportional to square root of temperature

   (2) Inversely proportional to the square root of temperature

   (3) Inversely proportional to absolute temperature

   (4) Directly proportional to square of temperature

4. The compressibility factor for a real gas at high pressure is **[AIEEE-2012]**

   (1) 1 (2) 1 + pb/RT

   (3) 1 – pb/RT (4) 1 + RT/pb

5. For gaseous state, if most probable speed is denoted by C^*, average speed by $\bar{C}$ and mean square speed by C, then for a large number of molecules the ratios of these speeds are **[JEE (Main)-2013]**

   (1) $C^* : \bar{C} : C = 1.225 : 1.128 : 1$

   (2) $C^* : \bar{C} : C = 1.128 : 1.225 : 1$

   (3) $C^* : \bar{C} : C = 1 : 1.128 : 1.225$

   (4) $C^* : \bar{C} : C = 1 : 1.225 : 1.128$

6. If Z is a compressibility factor, van der Waals equation at low pressure can be written as **[JEE (Main)-2014]**

   (1) $Z = 1 + \frac{RT}{Pb}$ (2) $Z = 1 - \frac{a}{VRT}$

   (3) $Z = 1 - \frac{Pb}{RT}$ (4) $Z = 1 + \frac{Pb}{RT}$

7. The ratio of masses of oxygen and nitrogen in a particular gaseous mixture is 1 : 4. The ratio of number of their molecule is **[JEE (Main)-2014]**

   (1) 1 : 4 (2) 7 : 32

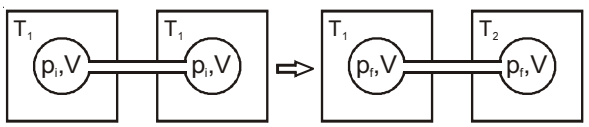
   (3) 1 : 8 (4) 3 : 16

8. The intermolecular interaction that is dependent on the inverse cube of distance between the molecules is **[JEE (Main)-2015]**

   (1) Ion-ion interaction (2) Ion-dipole interaction

   (3) London force (4) Hydrogen bond

9. Two closed bulbs of equal volume (V) containing an ideal gas initially at pressure p_i and temperature T_1 are connected through a narrow tube of negligible volume as shown in the figure below. The temperature of one of the bulbs is then raised to T_2. The final pressure p_f is **[JEE (Main)-2016]**



   (1) $2p_i\left(\frac{T_1}{T_1+T_2}\right)$ (2) $2p_i\left(\frac{T_2}{T_1+T_2}\right)$

   (3) $2p_i\left(\frac{T_1T_2}{T_1+T_2}\right)$ (4) $p_i\left(\frac{T_1T_2}{T_1+T_2}\right)$

10. 0.5 moles of gas A and x moles of gas B exert a pressure of 200 Pa in a container of volume 10 m^3 at 1000 K. Given R is the gas constant in JK^{-1} mol^{-1}, x is **[JEE (Main)-2019]**

(1) $\frac{2R}{4-R}$ (2) $\frac{2R}{4+R}$

(3) $\frac{4-R}{2R}$ (4) $\frac{4+R}{2R}$

11. The volume of gas A is twice than that of gas B. The compressibility factor of gas A is thrice than that of gas B at same temperature. The pressure of the gases for equal number of moles are **[JEE (Main)-2019]**

(1) $P_A = 2P_B$ (2) $P_A = 3P_B$

(3) $3P_A = 2P_B$ (4) $2P_A = 3P_B$

12. An open vessel at 27°C is heated until two fifth of the air (assumed as an ideal gas) in it has escaped from the vessel. Assuming that the volume of the vessel remains constant, the temperature at which the vessel has been heated is **[JEE (Main)-2019]**

(1) 750 °C

(2) 750 K

(3) 500 °C

(4) 500 K

13. Consider the van der Waals constants, a and b, for the following gases.

Gas	Ar	Ne	Kr	Xe
a/(atm dm^6 mol^{-2})	1.3	0.2	5.1	4.1
b/(10^{-2} dm^3 mol^{-1})	3.2	1.7	1.0	5.0

Which gas is expected to have the highest critical temperature? **[JEE (Main)-2019]**

(1) Ne

(2) Kr

(3) Xe

(4) Ar

14. At a given temperature T, gases Ne, Ar, Xe and Kr are found to deviate from ideal gas behaviour. Their equation of state is given as $P = \frac{RT}{V-b}$ at T. Here, b is the van der Waal's constant. Which gas will exhibit steepest increase in the plot of Z (compression factor) vs P? **[JEE (Main)-2019]**

(1) Kr (2) Ar

(3) Xe (4) Ne

15. Consider the following table :

Gas	a/(k Pa dm^6 mol^{-1})	b/(dm^3 mol^{-1})
A	642.32	0.05196
B	155.21	0.04136
C	431.91	0.05196
D	155.21	0.4382

a and b are van der Waals constants. The correct statement about the gases is **[JEE (Main)-2019]**

(1) Gas C will occupy lesser volume than gas A; gas B will be lesser compressible than gas D

(2) Gas C will occupy more volume than gas A; gas B will be more compressible than gas D

(3) Gas C will occupy lesser volume than gas A; gas B will be more compressible than gas D

(4) Gas C will occupy more volume than gas A; gas B will be lesser compressible than gas D

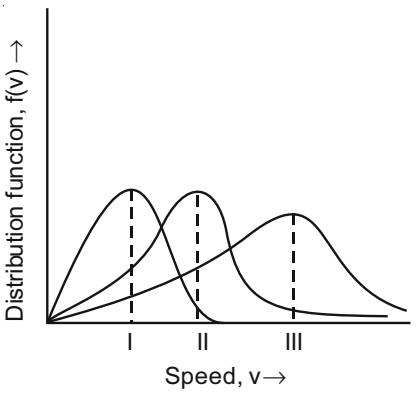
16. At 300 K and 1 atmospheric pressure, 10 mL of a hydrocarbon required 55 mL of O_2 for complete combustion, and 40 mL of CO_2 is formed. The formula of the hydrocarbon is **[JEE (Main)-2019]**

(1) C_4H_{10} (2) C_4H_8

(3) C_4H_6 (4) C_4H_7Cl

17. Points I, II and III in the following plot respectively correspond to

(V_{mp} : most probable velocity)



[JEE (Main)-2019]

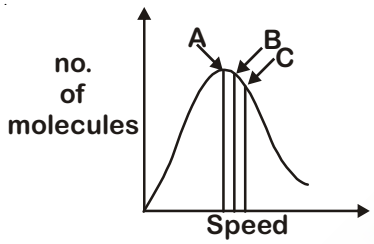
(1) V_{mp} of N_2 (300 K); V_{mp} of O_2 (400 K); V_{mp} of H_2 (300 K)

(2) V_{mp} of H_2 (300 K); V_{mp} of N_2 (300 K); V_{mp} of O_2 (400 K)

(3) V_{mp} of N_2 (300 K); V_{mp} of H_2 (300 K); V_{mp} of O_2 (400 K)

(4) V_{mp} of O_2 (400 K); V_{mp} of N_2 (300 K); V_{mp} of H_2 (300 K)

18. Identify the correct labels of A, B and C in the following graph from the options given below



Root mean square speed (V_{rms}); most probable speed (V_{mp}); Average speed (V_{av})

[JEE (Main)-2020]

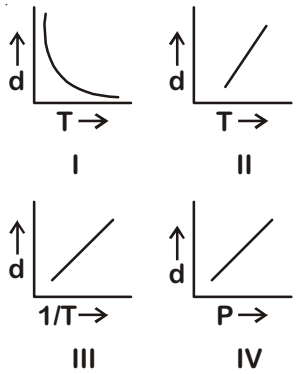
(1) A – V_{av}; B – V_{rms}; C – V_{mp}

(2) A – V_{rms}; B – V_{mp}; C –V_{av}

(3) A – V_{mp}; B – V_{rms}; C – V_{av}

(4) A – V_{mp}; B – V_{av}; C – V_{rms}

19. Which one of the following graphs is not correct for ideal gas?



d = Density, P = Pressure, T = Temperature

[JEE (Main)-2020]

(1) II (2) III

(3) I (4) IV

20. A mixture of one mole each of H_2, He and O_2 each are enclosed in a cylinder of volume V at temperature T. If the partial pressure of H_2 is 2 atm, the total pressure of the gases in the cylinder is

[JEE (Main)-2020]

(1) 14 atm (2) 38 atm

(3) 22 atm (4) 6 atm

21. A spherical balloon of radius 3 cm containing helium gas has a pressure of 48 × 10^{-3} bar. At the same temperature, the pressure, of a spherical balloon of radius 12 cm containing the same amount of gas will be _____ × 10^{-6} bar.

[JEE (Main)-2020]

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