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ARJUNA JEE AIR (2024)

State of Matter

DPP-01

1. The ratio between the r.m.s. velocity of H_2 at 50 K and that of O_2 at 800 K is:
(1) 4 (2) 2
(3) 1 (4) 1/4

2. Helium atom is two times heavier than a hydrogen molecule. At 298 K, the average kinetic energy of a helium atom is
(1) two times that of a hydrogen molecules
(2) same as that of a hydrogen molecules
(3) four times that of a hydrogen molecules
(4) half that of a hydrogen molecules

3. The mass of molecule A is twice that of molecule B. The root mean square velocity of molecule A is twice that of molecule B. If two containers of equal volume have same number of molecules the ratio of pressure P_A/P_B will be :
(1) 8 : 1 (2) 1 : 8
(3) 4 : 1 (4) 1 : 4

4. The R.M.S. speed of the molecules of a gas of density 4 kg m^{-3} and pressure 1.2 x 10^5N m^{-2} is:
(1) 120 m/s (2) 300 m/s
(3) 600 m/s (4) 900 m/s

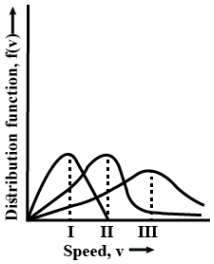
5. If four tubes of a car are filled to the same pressure with H_2, N_2, O_2, and Ne separately, which one will be filled first?
(1) N_2 (1) O_2
(3) H_2 (4) Ne

6. 0.5 mole of each of H_2, SO_2 and CH_4 are kept in a container. A hole was made in the container. After 3 hours, the order of partial pressures in the container will be:
(1) $pSO_2 > pH_2 > pCH_4$
(2) $pSO_2 > pCH_4 > pH_2$
(3) $pH_2 > pSO_2 > pCH_4$
(4) $pH_2 > pCH_4 > pSO_2$

7. A 4 : 1 mixture of helium and methane is contained in a vessel at 10 bar pressure. Due to a hole in the vessel, the gas mixture leaks out.
The composition of mixture effusing out initially is:
(1) 8 : 1 (2) 8 : 3
(3) 4 : 1 (4) 1 : 1

8. If helium and methane are allowed to diffuse out of the container under the similar conditions of temperature and pressure, then the ratio of rate of diffusion of helium to methane is
(1) 2.0 (2) 1.0
(3) 0.5 (4) 4.0

9. Points I, II and III in the following plot respectively correspond to (V_{mp} : most probable velocity)



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

10. The rates of diffusion of SO_3, CO_2, PCl_3 and SO_2 are in the following order -
(1) $PCl_3 > SO_3 > SO_2 > CO_2$
(2) $CO_2 > SO_2 > PCl_3 > SO_3$
(3) $SO_2 > SO_3 > PCl_3 > CO_2$
(4) $CO_2 > SO_2 > SO_3 > PCl_3$

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11. For the reaction $2NH_3(g) \rightarrow N_2(g) + 3H_2(g)$, what is the % of NH_3 converted if the mixture diffuses twice as fast as that of SO_2 under similar conditions.

(1) 3.125 % (2) 31.25 %
(3) 6.25 % (4) 62.5 %

12. The ratio of speeds of diffusion of two gases A and B is 1 : 4. If the mass ratio of A to B present in the given mixture is 2 : 1, then which of the following is the ratio of mole-fraction of A to B in effused gases?

(1) 2 : 3 (2) 1 : 8
(3) 2 : 1 (4) 1 : 2

13. Two flask A and B have equal volumes, A is maintained at 300 K and B at 600 K, while A contains H_2 gas, B has an equal mass of CO_2 gas. Find the ratio of total translational kinetic energy of gases in flask A to that of B.

(1) 1 : 2 (2) 11 : 1
(3) 33 : 2 (4) 55 : 7

14. A rigid container containing 10 gm gas at some pressure and temperature. The gas has been allowed to escape (do not consider any effusion or diffusion) from the container due to which pressure of the gas becomes half of its initial pressure and temperature become $(2/3)^{rd}$ of its initial. The mass of gas (in gms) escaped is

(1) 7.5 (2) 1.5
(3) 2.5 (4) 3.5

15. X ml of H_2 gas effuses through a hole in a container in 5 sec. The time taken for the effusion of the same volume of the gas specified below under identical conditions is:

(1) 10 sec, He (2) 20 sec, O_2
(3) 25 sec, CO (4) 55 sec, CO_2

16. Select the correct option(s) for an ideal gas

(1) Most probable speed increases with increase in temperature
(2) Fraction of particles moving with most probable speed increases with increase in temperature
(3) Fraction of particles moving with most probable speed is more for Cl_2 than H_2 under similar condition of T, P & V.
(4) Both (1) and (3)

17. Two flask A and B of equal volume are taken. Flask A contains H_2 (g) at 27°C and 1 atm pressure. Flask B contain N_2 (g) at 27°C and 2 atm pressure. Then select incorrect statements.

(1) Average kinetic energy per molecule is same for both
(2) Number of molecules in both compartments are same.
(3) Mass of H_2 is more than N_2
(4) Both (2) and (3)

18. **Statement-1 :** Two identical balloons A and B are inflated in open with equal moles of He and Ar respectively will have same volume initially.
Statement-2 : After sometime balloons A will have more number of moles than balloon B.

(1) Statement-1 is true, statement-2 is true and statement-2 is correct explanation for statement-1.
(2) Statement-1 is true, statement-2 is true and statement-2 is NOT the correct explanation for statement-1.
(3) Statement-1 is true, statement-2 is false.
(4) Statement-1 is false, statement-2 is true.

19. The number of effusion steps required to convert a mixture of H_2 and O_2 from 240 : 1600 (by mass) to 3072 : 20 (by mass) is

20. **Statement-1 :** If we increase temperature in a rigid closed vessel mean free path will remain unchanged.
Statement-2 : Mean free path depends on number of gaseous molecules per unit volume.

(1) Statement-1 is true, statement-2 is true and statement-2 is correct explanation for statement-1.
(2) Statement-1 is true, statement-2 is true and statement-2 is NOT the correct explanation for statement-1.
(3) Statement-1 is true, statement-2 is false.
(4) Statement-1 is false, statement-2 is true.

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Answer Key

1. (3)
2. (2)
3. (1)
4. (2)
5. (3)
6. (2)
7. (1)
8. (1)
9. (1)
10 (4)
11. (3)
12. (4)
13. (2)
14. (3)
15. (2)
16. (4)
17. (4)
18. (3)
19. (5)
20. (1)

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