



# ARJUNA JEE AIR (2024)

## State of Matter

**DPP-01**

- The ratio between the r.m.s. velocity of  $H_2$  at 50 K and that of  $O_2$  at 800 K is:
  - 4
  - 2
  - 1
  - 1/4
- Helium atom is two times heavier than a hydrogen molecule. At 298 K, the average kinetic energy of a helium atom is
  - two times that of a hydrogen molecules
  - same as that of a hydrogen molecules
  - four times that of a hydrogen molecules
  - half that of a hydrogen molecules
- 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 and ratio of pressure  $P_A/P_B$  will be :
  - 8 : 1
  - 1 : 8
  - 4 : 1
  - 1 : 4
- The R.M.S. speed of the molecules of a gas of density  $4 \text{ kg m}^{-3}$  and pressure  $1.2 \times 10^5 \text{ N m}^{-2}$  is:
  - 120 m/s
  - 300 m/s
  - 600 m/s
  - 900 m/s
- 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?
  - $N_2$
  - $O_2$
  - $H_2$
  - Ne
- 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:
  - $p_{SO_2} > p_{H_2} > p_{CH_4}$
  - $p_{SO_2} > p_{CH_4} > p_{H_2}$
  - $p_{H_2} > p_{SO_2} > p_{CH_4}$
  - $p_{H_2} > p_{CH_4} > p_{SO_2}$
- 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:
  - 8 : 1
  - 8 : 3
  - 4 : 1
  - 1 : 1
- 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
  - 2.0
  - 1.0
  - 0.5
  - 4.0
- Points I, II and III in the following plot respectively correspond to ( $V_{mp}$  : most probable velocity)
 
  - $V_{mp}$  of  $N_2$  (300K);  $V_{mp}$  of  $O_2$ (400K);  $V_{mp}$  of  $H_2$ (300K)
  - $V_{mp}$  of  $O_2$  (400K);  $V_{mp}$  of  $N_2$ (300K);  $V_{mp}$  of  $H_2$ (300K)
  - $V_{mp}$  of  $H_2$  (300K);  $V_{mp}$  of  $N_2$ (300K);  $V_{mp}$  of  $O_2$ (400K)
  - $V_{mp}$  of  $H_2$  (300K);  $V_{mp}$  of  $N_2$ (300K);  $V_{mp}$  of  $O_2$ (400K)
- The rates of diffusion of  $SO_3$ ,  $CO_2$ ,  $PCl_3$  and  $SO_2$  are in the following order -
  - $PCl_3 > SO_3 > SO_2 > CO_2$
  - $CO_2 > SO_2 > PCl_3 > SO_3$
  - $SO_2 > SO_3 > PCl_3 > CO_2$
  - $CO_2 > SO_2 > SO_3 > PCl_3$



11. For the reaction  $2\text{NH}_3(\text{g}) \rightarrow \text{N}_2(\text{g}) + 3\text{H}_2(\text{g})$ , what is the % of  $\text{NH}_3$  converted if the mixture diffuses twice as fast as that of  $\text{SO}_2$  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  $\text{H}_2$  gas, B has an equal mass of  $\text{CO}_2$  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  $(2/3)^{\text{rd}}$  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  $\text{H}_2$  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,  $\text{O}_2$   
(3) 25 sec, CO                    (4) 55 sec,  $\text{CO}_2$
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  $\text{Cl}_2$  than  $\text{H}_2$  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  $\text{H}_2(\text{g})$  at  $27^\circ\text{C}$  and 1 atm pressure. Flask B contain  $\text{N}_2(\text{g})$  at  $27^\circ\text{C}$  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  $\text{H}_2$  is more than  $\text{N}_2$   
(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  $\text{H}_2$  and  $\text{O}_2$  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.



## 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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