PRACTICE PAPER TARGET JEE CHEMISTRY STATES OF MATTER SOLUTION 26 AUGUST 2019

1. **D**

2. (a) *m. wt.* of $NH_3 = 17$; *m.wt.* of $N_2 = 28$

m.wt. of $CO_2 = 44$; *m.wt.* of $O_2 = 32$

beacuse NH_3 is lightest gas out of these gases

$$\left[r \propto \frac{1}{\sqrt{\text{Molecular Weight}}} \right]$$

3. **A**

4. **C**

5. (a) $\frac{r_g}{r_{He}} = \sqrt{\frac{M_{He}}{M_g}} \therefore M_g = M_{He} . \frac{r^2_{He}}{r^2_g} = \frac{4}{(1.4)^2} = \frac{4}{1.96} = 2$

$[Note : 1.4 = \sqrt{2}]$

6. (a) $r_g = \frac{1}{5} . r_{H_2}$

$$\frac{M_g}{M_{H_2}} = \left[\frac{r_{H_2}}{r_g} \right]^2 = (5)^2 = 25 \; ; \; M_g = 2 \times 25 = 50$$

7. (b) $r_g = \frac{1}{6} r_{H_2} \; ; \; M_g = M_{H_2} . \left[\frac{r_{H_2}}{r_g} \right]^2 = 2 \times 6^2 = 2 \times 36 = 72$

8. (a) $M_1 = 64 \; ; \; r_2 = 2r_1$

$$M_2 = M_1 \left[\frac{r_1}{r_2} \right]^2 = 64 \times \frac{1}{4} = 16$$

9. (b) $r_O = r_H \sqrt{\frac{d_H}{d_O}} = 1 \sqrt{\frac{0.09}{1.44}} = \sqrt{\frac{1}{16}} = \frac{1}{4}$

10. (a) $r_a = 5r_b \; ; \; \frac{d_a}{d_b} = \left[\frac{r_b}{r_a} \right]^2 = \left(\frac{1}{5} \right)^2 = \frac{1}{25}$

11. (b) $\frac{d_1}{d_2} = \frac{1}{16} \; ; \; \frac{r_1}{r_2} = \sqrt{\frac{d_2}{d_1}} = \sqrt{16} = \frac{4}{1}$

12. (d) $\frac{D_A}{D_B} = \sqrt{\frac{\rho_B}{\rho_A}} = \left[\frac{\rho_B}{\rho_A} \right]^{\frac{1}{2}} \; ; \; \therefore D_A = D_B \left(\frac{\rho_B}{\rho_A} \right)^{\frac{1}{2}}$

13. (c) Gases may be separated by this process because of different rates of diffusion due to difference in their densities.

14. (b) NH_4Cl ring will first formed near the HCl bottle because rate of diffusion of NH_3 is more than that of HCl because $M_{NH_3} : M_{HCl} = 17 : 36.5)$. SO NH_3 will reach first to the HCl bottle & will react there with HCl to form NH_4Cl ring

15. (d) Because both NO and C_2H_6 have same molecular weights $\left[M_{NO} = M_{C_2H_6} = 30 \right]$ and rate of diffusion $\propto$ molecular weight.

16. **B**

17. (d) $\frac{M_A}{M_B} = \left(\frac{r_B}{r_A} \right)^2 \because r_A = 2r_B \; \therefore \frac{r_B}{r_A} = \frac{1}{2} \; = \frac{1}{(2)^2} \; = \frac{1}{4} = .25$

18. (a) $r_H = \frac{2gm}{10 \min}$ if $r_O = \frac{xgm}{10 \min}$ $\qquad r_O = r_H \sqrt{\frac{M_{H_2}}{M_{O_2}}} = \frac{2}{10} \sqrt{\frac{2}{32}}$

$$\frac{x}{10} = \frac{2}{10 \times 4} = \frac{1}{2} gm. = .5gm$$

19. (a) $r_{CH_4} = 2r_g$

$$M_g = M_{CH_4}\left(\frac{r_{CH_4}}{r_g}\right)^2 = 16 \times 2^2 = 64$$

20. (b) $r \propto \frac{1}{\sqrt{M}}$ $\quad \because r = \frac{Volume\ effused}{time\ taken} = \frac{V}{t}$

$\frac{V}{t} \propto \frac{1}{\sqrt{M}}$ $\therefore$ for same volumes (V constant)

$t \propto \sqrt{M} \therefore \frac{t_1}{t_2} = \sqrt{\frac{M_1}{M_2}}$

$t_{He} = t_{H_2}\sqrt{\frac{M_{He}}{M_{H_2}}} = 5\sqrt{\frac{4}{2}} = 5\sqrt{2}s.$

$t_{O_2} = t = 5\sqrt{\frac{32}{2}} = 20s$

$t_{CO} = 5\sqrt{\frac{28}{2}} = 5\sqrt{14}s$; $t_{CO_2} = 5\sqrt{\frac{44}{2}} = 5\sqrt{22}s$

21. (c) $\frac{r_{N_2}}{r_{SO_2}} = \frac{V_{rms}N_2}{V_{rms}SO_2} = \sqrt{\frac{T_{N_2}}{T_{SO_2}} \cdot \frac{M_{So_2}}{M_{N_2}}} = \sqrt{\frac{T_{N_2}}{323} \times \frac{64}{28}}$

$1.625 = \sqrt{\frac{T_{N_2}}{323} \cdot \frac{16}{7}}$

$T_{N_2} = \frac{(1.625)^2 \times 323 \times 7}{16} = 373^o K$

22. (a) $C + H_2O \rightarrow CO_{(g)} + H_{2(g)}$

$12gm \rightarrow 1mol + 1mol$

12 *gm C* produces 2*mole* of gases (1*mole CO* & 1 *mole* of H_2)

$\therefore 48$ *gm C* may produce $\frac{48}{12} \times 2 = 4 \times 2 = 8mole$

$= 22.4 \times 8$ *L* gases $= 179.2$ *L* gas.

23. (d) Molecular weight = $\frac{mRT}{PV} = \frac{4.4 \times .082 \times 273}{1 \times 2.24} = 44$

So the gas should be CO_2

24. (c) $PV = nRT$

$P = \frac{n}{V}RT$ $\quad \because \frac{n}{V} = C \Rightarrow$ $P = CRT$

$T = \frac{P}{CR} = \frac{1}{1 \times .821} = 12^o K$

25. (a) 6.02×10^{22} molecules of each N_2, O_2 and H_2

$= \frac{6.02 \times 10^{22}}{6.02 \times 10^{23}}$ *moles* of each

Weight of mixture = weight of 0.1 *mole* N_2 + weight of 0.1 *mole* H_2 + weight of 0.1 mole of O_2

$= (28 \times 0.1) + (2 \times 0.1) + (32 \times 0.1) = 6.2gm$

26. (c) *M.wt* of CO_2 = 12 + 16 + 16 = 44

Volume of 44 *gm* of CO_2 at NTP = 22.4 *litre*

1 *gm* of CO_2 at NTP = $\frac{22.4}{44}$

4.4 *gm* of CO_2 at N.T.P

$\Rightarrow \frac{22.4}{44} \times 4.4$ *litre* $= 2.24$ *litre*

27. **D**

28. (b) No. of moles of CO_2 present in 200 *ml* solution

= molarity $\times$ Volume (in *lt.*) $= 0.1 \times \frac{200}{1000} = .02$

Volume of 0.02 mole of $CO_2 = 22.4 \times .02lt. = 0.448lit.$

29. (b) Molecular weight = $V.d. \times 2 = 11.2 \times 2 = 22.4$

Volume of 22.4 *gm* Substance of NTP = 22.4 *litre*

1 *gm* substance at NTP = $\frac{22.4}{22.4}$ *litre*

11.2 *gm* substance of NTP = 11.2 *litre*

30. (b) $\frac{M.wt.of\ O_2}{M.wt.of\ SO_2} \Rightarrow \frac{M_1}{M_2} \Rightarrow \frac{32}{64} = \frac{1}{2}$

The weight of oxygen will be $\frac{1}{2}$ that of SO_2

31. (b) For HI has the least volume because of greater molecular weight $V \propto \frac{1}{M}$

32. **D**

33. (c) Since no. of molecules is halved so pressure should also be halved.

34. (c) H_2 will be filled first because of lower molecular weight

35. (a) Mixture of SO_2 and Cl_2 are reacted chemically and forms SO_2Cl_2. That is why mixture of these gases is not applicable for Dalton's law.

36. **(**d) According to Boyle's law

$P_1V_1 = P_2V_2 \Rightarrow P_1 \times 60 = 720 \times 100$

$P_1 = \frac{720 \times 100}{60} = 1200mm$

37. (a) Rate of diffusion $\propto \frac{1}{\sqrt{\text{Molecular Mass}}}$

that is why H_2 gas diffuse first

38. (a) Solution level will rise, due to absorption of CO_2 by sodium hydroxide.

$2NaOH + CO_2 \rightarrow Na_2CO_3 + H_2O$

39. (c) $\underset{(40+12+16\times3)=100gm}{CaCo_3} \xrightarrow{\wedge} CaO + \underset{22.4litre}{CO_2} \uparrow$

$\because$ At S.T.P. 100*g* $CaCO_3$ produce= 22.4*litre* of CO_2

$\therefore$ At S.T.P. 1*g* $CaCO_3$ produce = $\frac{22.4}{100} = .224litre$ of CO_2

40. (c) The density of gas $= \frac{Molecular\ wt.Of\ Metal}{Volume} = \frac{45}{22.4}$

= $2gmlitre^{-1}$

41. (a) $M_1 = 32g$ for O_2, $M_2 = 2g$ for H_2

$\frac{r_1}{r_2} = \sqrt{\frac{M_2}{M_1}}$; $\frac{r_1}{r_2} = \sqrt{\frac{2}{32}} = \sqrt{\frac{1}{16}} = \frac{1}{4}$

42. (c) In 22.4*l* of H_2 maximum number of molecules $= 6.023 \times 10^{23}$

In 1*l* of H_2 maximum number of molecules $= \frac{6.023 \times 10^{23}}{22.4}$

In 15*l* of H_2 maximum number of molecules $= \frac{6.023 \times 10^{23}}{22.4} \times 15 = 4.03 \times 10^{23}$ molecules.

43. (a) $22.4l\ O_2$ at S.T.P. $= 32gm$ of O_2

$1l\ O_2$ at S.T.P. $= \frac{32}{22.4} = 1.43gm$ of O_2

44. **B**

45 (a) We know that molecular mass of hydrogen $M_1 = 2$ and that of helium $M_2 = 4$, we also know that Graham's law of diffusion

$\frac{r_1}{r_2} = \sqrt{\frac{M_2}{M_1}} = \sqrt{\frac{4}{2}} = \sqrt{2} = 1.4$ **;** $r_1 = 1.4m$

46. (a) $\frac{r_A}{r_H} = \sqrt{\frac{M_H}{M_A}} = \frac{r}{6r} = \sqrt{\frac{2}{M_A}}$

$M_A = 6 \times 6 \times 2 = 72g$

47. (d) Given that:

$V_1 = 100ml, P_1 = 720mm, V_2 = 84ml, P_2 = ?$

By using $P_1V_1 = P_2V_2$ [According to the Boyle's law]

$$P_2 = \frac{P_1V_1}{V_2} = \frac{720 \times 100}{84} = 857.142$$

Hence, $P_2 = 857.14mm$

48. (b) According to gas law

$$PV = nRT,\ n = \frac{PV}{RT}$$

$$\frac{n_A}{n_B} = \frac{\frac{P_1V_1}{RT_1}}{\frac{P_2V_2}{RT_2}};\ \frac{n_A}{n_B} = \frac{P_1V_1}{T_1} \times \frac{T_2}{P_2V_2}$$

$$\frac{n_A}{n_B} = \frac{2P \times 2V}{2T} \times \frac{T}{PV};\ \frac{n_A}{n_B} = \frac{2}{1}$$

49. (e) No. of molecules $= 2 \times V.d$

$2 \times 38.3 = 76.3$

wt. of $NO_2 = x$

So that *wt.* of $N_2O_4 = 100 - x$

Hence, $\frac{x}{46} + \frac{100-x}{92} = \frac{100}{76.6} = \frac{2x+100-x}{92} = \frac{100}{76.6}$

x = 20.10, no. of mole. of $NO_2 = \frac{20.10}{46} = 0.437$

50. (a) Given that

$P_1 = 76cm$ of Hg (Initial pressure at N.T.P.)

$P_2 = ?,\ V_1 = 5litre,\ V_2 = 30 + 5 = 35litres$

According to Boyle's law

$P_1V_1 = P_2V_2;\ 76 \times 5 = P_2 \times 35$

$$P_2 = \frac{76 \times 5}{35} \Rightarrow P_2 = 10.8cm \text{ of } Hg$$