MAHESH TUTORIALS SCIENCE

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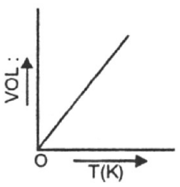
Hints & Solutions

PART B - CHEMISTRY

46. **c)** **Energy per unit volume**
Pressure is force per unit area or energy per unit volume.

47. **c)** **V vs P**
V vs P at constant T is a parabola (because PV = constant).

48. **c)**



Charles's law is $\frac{V}{T}$ = const. Hence, plot of V vs T is a straight line passing through the origin.

49. **c)** **Boltzmann constant**
$k = \frac{R}{N_0}$.

50. **b)** **273^{0}C and 2 atm. pressure**
$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$. When $V_1 = V_2$, $\frac{P_1}{T_1} = \frac{P_2}{T_2}$.
But $\frac{P_1}{T_1} = \frac{1}{273}, \frac{P_2}{T_2} = \frac{1}{273}$ for (b).

51. **b)** **11.2 L**
V.D. = 11.2, Mol. wt. = 22.4.
Hence, 22.4 g = 22.4 L.
$\therefore$ 11.2 g = 11.2 L.

52. **a)** $\mathbf{P_{N_2} = P_{CO}}$
CO = N_2 = w g $\quad \therefore n_1(CO) = \frac{w}{28}$,
$n_2(N_2) = \frac{w}{28}$. Hence, $P_{N_2} = P_{CO}$.

53. **b)** **mole fraction of the component**
Partial pressure of a gaseous component in a mixture = Mole fraction of that component × Pressure of the mixture.

54. **a)** $\mathbf{NH_3}$
Rate of diffusion $\propto \sqrt{1/\text{Mol. mass}}$.

55. **c)** **282.68 g**
$PV = nRT = \frac{w}{M}RT$, $w = \frac{PVM}{RT}$
$= \frac{2 \times 100 \times 34}{0.0821 \times 293} = 282.68$ g

56. **c)** **89.6 L**
PV = RT,
$V = \frac{RT}{P} = \frac{0.0821 \times (819 + 273)}{1}$
= 89.6 L

57. **c)** **3 atmosphere**
$d = \frac{PM}{RT}$. At constant temperature
$\frac{d_2}{d_1} = \frac{P_2}{P_1}$ i.e., $3 = \frac{P_2}{P_1}$ or P_2 = 3 atm.

58. **a)** **2 litres**
$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}, \frac{P \times 2}{T} = \frac{2P \times V_2}{2T}$
V_2 = 2 litres

59. **c)** **1.30 g L^{-1}**

$$d = \frac{PM}{RT} = \frac{2\times16}{0.082\times300} = 1.30 \text{ g L}^{-1}$$

60. **c)** **721.2 mm Hg**

$P_{\text{dry gas}} = 745 - 23.8 = 721.2$ mm

61. **d)** **$p(O_2) = 0.875\ p(N_2)$**

$$n(O_2) = \frac{w}{32},\ n(N_2) = \frac{w}{28};$$

$$p(O_2) = \frac{w/32}{w/32 + w/28}\times P$$

$$p(N_2) = \frac{w/28}{w/32 + w/28}\times P$$

$$p(O_2) : p(N_2) = \frac{w}{32} : \frac{w}{28} = 28 : 32 = 7 : 8$$

$$\text{or } p(O_2) = \frac{7}{8}p(N_2) = 0.875\ p(N_2)$$

62. **c)** **1.51 atm**

PV = nRT

$$n\text{ (total)} = \frac{PV}{RT} = \frac{2\times10}{0.0821\times300} = 0.8 \text{ mol.}$$

$n(CO_2) = 0.8 - 0.2 = 0.6$ mol.

$$p(CO_2) = \frac{0.6}{0.8}\times 2 = 1.5 \text{ atm.}$$

63. **a)** **180 mm**

$$p(CH_4) = \frac{16/16}{5/28 + 44/44 + 16/16}\times720$$

$$= \frac{1}{2+1+1}\times720 = \frac{1}{4}\times720$$

= 180 mm.

64. **c)** **Gases like liquids possess definite volumes.**

Gases do not have any definite volume. Their volume is equal to the volume of the container.

65. **d)** **8 g**

$$\frac{r_{H_2}}{r_{O_2}} = \frac{\upsilon_{H_2}}{\upsilon_{O_2}} = \frac{n_{H_2}}{n_{O_2}} = \sqrt{\frac{M_{O_2}}{M_{H_2}}}$$

$$\frac{2/2}{w/32} = \sqrt{\frac{32}{2}}$$

$$\frac{32}{w} = 4,\ w = 8 \text{ g.}$$

66. **a)** $\mathbf{\frac{45^2}{18^2}\times32}$

$$\frac{r_{O_2}}{r_X} = \sqrt{\frac{M_X}{M_{O_2}}}$$

As volumes are in the same ratio as the no. of moles,

$$\frac{n/18}{n/45} = \sqrt{\frac{M_X}{32}},\ \frac{45}{18} = \sqrt{\frac{M_X}{32}},$$

$$M_X = \frac{45^2}{18^2}\times32$$

67. **b)** **4**

$$\frac{r_X}{r_{O_2}} = \sqrt{\frac{M_{O_2}}{M_X}}$$

$$\frac{\upsilon/2}{\upsilon/5.65} = \sqrt{\frac{32}{M_X}},\ \frac{5.65}{2} = \sqrt{\frac{32}{M_X}},$$

$M_X = 4$

68. **d)** **80**

$$\frac{r_A}{r_B} = \sqrt{\frac{M_B}{M_A}},\ \frac{50/t}{40/t} = \sqrt{\frac{M_B}{64}},$$

$$\frac{50}{40} = \sqrt{\frac{M_B}{64}}$$

or $M_B = 80$

69. **d)** **A > B > C**

According to Graham's law of diffusion,

$$\text{rate of diffusion} \propto \frac{1}{\sqrt{\text{molecular weight}}}$$

As the molecular weight of the gas increases, rate of diffusion decreases.

70. **a)** **68**

$$\text{Rate of diffusion, } r_X = \left(\frac{r_{NH_3}}{2}\right)\text{(given)}$$

Molecular mass of NH_3, MNH_3 = (N) + 3(H)

= 14 + 3(1) = 17

Molecular mass of X, M_X = ?

By Graham's law of diffusion

$$\therefore \frac{r_{NH_3}}{r_X} = \sqrt{\frac{M_X}{M_{NH_3}}} \quad \text{or} \quad 2 = \sqrt{\frac{M_X}{M_{NH_3}}}$$

$\therefore 4 \times M_{NH_3} = M_X \Rightarrow M_X = 4 \times 17 = 68.$

71. **c)** **2 gm/litre**

The density of gas

$$= \frac{\text{Molecular wt. of Metal}}{\text{Volume}} = \frac{45}{22.4}$$

= 2 gmlitre^{-1}

72. **d)** **CO_2**

Molecular weight

$$= \frac{mRT}{PV} = \frac{4.4 \times 082 \times 273}{1 \times 2.24} = 44$$

So the gas should be CO_2

73. **c)** **373 K**

$$\frac{r_{N_2}}{r_{SO_2}} = \frac{V_{rms}N_2}{V_{rms}SO_2} = \sqrt{\frac{T_{N_2}}{T_{SO_2}} \cdot \frac{M_{SO_2}}{M_{N_2}}}$$

$$= \sqrt{\frac{T_{N_2}}{323} \times \frac{64}{28}}$$

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

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

74. **b)** **1 g**

$$\frac{n_o}{n_H} = \sqrt{\frac{M_H}{M_o}} \Rightarrow \frac{4/32}{\omega_H/2} = \sqrt{\frac{2}{32}}$$

$$\frac{4}{32} \times \frac{2}{\omega_H} = \frac{1}{4} \Rightarrow \omega_H = 1 \text{ gm}$$

75. **a)** **50**

$$r_g = \frac{1}{5} \cdot r_{H_2}$$

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

Mg = 2 × 25 = 50

76. **a)** **1/25**

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

77. **a)** **Barometer is used for measurement of pressure of a gas**

Manometer and not barometer is used for the measurement of pressure of a gas.

78. **d)** **HI**

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

79. **a)** **1.43 g**

22.4/O_2 at S.T.P. = 32gm of O_2

1/ O2 at S.T.P. = $\frac{32}{22.4}$ = 1.43 gm of O_2

80. **a)** **Avogadro's law**

81. **c)** **400 K**

At constant pressure

$$V \propto nT \propto \frac{m}{M}T$$

$$\frac{V_1}{V_2} = \frac{m_1T_1}{m_2T_2} \therefore \frac{T_1}{T_2} = \frac{V_1}{m_1} \times \frac{m_2}{V_2} = \frac{d_2}{d_1}$$

$$\Rightarrow \frac{300K}{T_2} = \frac{0.75d}{d}$$

$$T_2 = \frac{300}{0.75} = 400K$$

82. **c)** **282.4 g**

$$n = \frac{PV}{RT} = \frac{m}{M}$$

$$m = \frac{MPV}{RT} = \frac{34 \times 2 \times 100}{0.082 \times 293} = 282.4 \text{ gm}$$

83. **b)** **11.2 litres**

$$V = \frac{nRT}{P} = \frac{0.5 \times 0.082 \times 273K}{1} = 11.2 \text{ lit}$$

84. **a)** **2 atm**

$$P = \frac{nRT}{V} = \frac{2 \times 0.0821 \times 546}{44.8l} = 2 \text{ atm.}$$

85. **a)** $\mathbf{20 \times \frac{1}{50}}$

At constant T, $P_1V_1 = P_2V_2$

$1 \times 20 = P_2 \times 50$; $P_2 = \frac{20}{50} \times 1$

86. **a)** **The product of pressure and volume of fixed amount of a gas is independent of temperature**

PV = constant at constant temperature. As temperature changes, the value of constant also changes.

87. **b)** **the collisions between the molecules increase**

On compressing the gas, pressure increase and hence the collisions between the molecules increase.

88. **c)** **180 atm**

First of all we have to calculate the number of moles.

Number of moles of $N_2 = \frac{56}{28} = 2$

Number of moles of $CO_2 = \frac{44}{44} = 1$

Number of moles of $CH_4 = \frac{16}{16} = 1$

$\therefore$ Total number of moles = 2 + 1 + 1 = 4

$\therefore$ mole fraction of $CH_4 = \frac{1}{4}$

$\therefore$ partial pressure of CH_4

= mole fraction of CH_4 × total pressure

$= \frac{1}{4} \times 720 = 180$ atm.

89. **a)** **1.5 lit**

90. **d)** **Mass of the gas cannot be determined by weighing a container in which it is enclosed**

The mass of gas can be determined by weighing the container, filled with gas and again weighing this container after removing the gas. The difference between the two weights gives the mass of the gas.