Ejercicios Tema 1: la actividad científica

①

$V_1 = 0'5\,L$

$T_1 = 100°C + 273 = 373K$

$V_2 = ?$

$T_2 = 0°C + 273 = 273K$

$P = cte$

para pasar de °C a K se suma 273

$PV = nRT$

$\frac{T_1}{V_1} = \frac{T_2}{V_2} \rightarrow T_1 V_2 = T_2 V_1$

$V_2 = \frac{T_2 V_1}{T_1}$

$V_2 = \frac{273 \cdot 0'5}{373} \rightarrow \boxed{V_2 = 0'36\,L}$

②

$T_1 = 25°C = 298K$

$P_1 = 12\,atm$

$P_2 = ?$

$T_2 = 100°C = 373\,K$

$V = cte$

$PV = nRT$ → Ley de los gases ideales

$\frac{P_1}{T_1} = \frac{P_2}{T_2} \rightarrow P_2 = \frac{P_1 T_2}{T_1}$

$P_2 = \frac{12 \cdot 373}{298} \rightarrow \boxed{P_2 = 15'02\,atm}$

③

$T = 25°C$

$P_{H_2} = 0'200\,atm$

$P_{CO_2} = 0'150\,atm$

$P_{CH_4} = 0'320\,atm$

$P_{C_2H_2} = 0'105\,atm$

$P_T = ?$

$P_T = \Sigma P_i$

$P_T = P_{H_2} + P_{CO_2} + P_{CH_4} + P_{C_2H_2}$

$P_T = 0'200 + 0'150 + 0'320 + 0'105$

$\boxed{P_T = 0'775\,atm}$

④

$m_{Ar} = 15g$

$T = 90°C = 363K$

$P = 0'967\,atm$

$M_{a\,Ar} = 39'95\,g/mol$

$V = ?$

$R = 0'082\,\frac{atm \cdot L}{mol\,K}$

$15\,gr\,Ar \cdot \frac{1\,mol\,Ar}{39'95\,g\,Ar} = 0'37\,mol\,Ar$

$PV = nRT$

$V = \frac{nRT}{P}$

$V = \frac{0'37 \cdot 0'082 \cdot 363}{0'967} \rightarrow \boxed{V = 11'389\,L}$

⑤

$V_1 = 10\,L$

$P_1 = 1'5\,atm$

$V_2 = ?$

$P_2 \rightarrow$ Condiciones estándar $\rightarrow P_2 = 1\,atm$

Condiciones estándar $<$ $P = 1\,atm$, $T = 0°C$

Condiciones normales $<$ $P = 1\,atm$, $T = 25°C$

$T = cte$

$PV = nRT$

$P_1 V_1 = P_2 V_2$

$V_2 = \frac{P_1 V_1}{P_2}$

$V_2 = \frac{1'5 \cdot 10}{1} \rightarrow \boxed{V_2 = 15\,L}$

⑥

Recipiente N_2 $\begin{cases} V = 20\,mL = 0'02\,L \\ T = 25°C = 298\,K \\ P = 0'8\,atm \end{cases}$

$20\,mL \cdot \frac{1\,L}{1000\,mL} = 0'02\,L$

recipiente He $\begin{cases} V = 50\,mL = 0'05\,L \\ T = 25°C = 298\,K \\ P = 0'4\,atm \end{cases}$

a) Datos

$Mm_{N_2} = 28\,g/mol$

$Ma_{He} = 4\,g/mol$

¿ n_{N_2}, n_{He} ?

¿ moléculas N_2 y He ?

$1\,mol = N_A$ moléculas

$1\,mol = 6'023 \cdot 10^{23}$ moléculas

$PV = nRT$

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

$n_{N_2} = \frac{0'8 \cdot 0'02}{0'082 \cdot 298} \rightarrow \boxed{n_{N_2} = 6'55 \cdot 10^{-4}\,moles\,N_2}$

$6'55 \cdot 10^{-4}\,mol\,N_2 \cdot \frac{6'023 \cdot 10^{24}\,moléculas\,N_2}{1\,mol\,N_2} = \boxed{3'94 \cdot 10^{20}\,moléculas\,N_2}$

$n_{He} = \frac{0'4 \cdot 0'05}{0'082 \cdot 298} \rightarrow \boxed{n_{He} = 8'18 \cdot 10^{-4}\,moles\,He}$

$8'18 \cdot 10^{-4}\,mol\,He \cdot \frac{6'023 \cdot 10^{23}\,moléculas\,He}{1\,mol\,He} = \boxed{4'93 \cdot 10^{20}\,moléculas\,He}$

b) $P_{He} = ?$

$P_{N_2} = ?$

$P_T = ?$

$n_T = n_{N_2} + n_{He} \rightarrow n_T = 6'55 \cdot 10^{-4} + 8'18 \cdot 10^{-4} \rightarrow n_T = 1'47 \cdot 10^{-3}\,moles$

$V_T = V_{He} + V_{N_2} \rightarrow V_T = 0'05 + 0'02 \rightarrow V_T = 0'07\,L$

$PV = nRT \rightarrow P_T = \frac{n_T R T}{V_T} = \frac{1'47 \cdot 10^{-3} \cdot 0'082 \cdot 298}{0'07} \rightarrow \boxed{P_T = 0'51\,atm}$

$P_i = x_i \cdot P_T$

$x_i = \frac{n_i}{n_T} \rightarrow x_{He} = \frac{n_{He}}{n_T} = \frac{8'18 \cdot 10^{-4}}{1'47 \cdot 10^{-3}} = 0'556$

$P_{He} = 0'556 \cdot 0'51 \rightarrow \boxed{P_{He} = 0'283\,atm}$

(6)

b) $\chi_{N_2} = \frac{n_{N_2}}{n_T} = \frac{6'55 \cdot 10^{-4}}{1'47 \cdot 10^{-3}} \rightarrow \chi_{N_2} = 0'445$

$P_{N_2} = 0'445 \cdot 0'51 \rightarrow \boxed{P_{N_2} = 0'227 \text{ atm}}$

c) Al mezclar los gases se convierte en una disolución, donde el N_2 es el soluto y el He el disolvente por las cantidades. $n_{N_2} < n_{He}$.

$\chi_{N_2} = ?$ $\boxed{\chi_{N_2} = 0'445}$ $\boxed{\chi_{He} = 0'556}$

$\chi_{He} = ?$

$\%m = ?$

$$\%m = \frac{m_{soluto}}{m_{disolución}} \cdot 100$$

$6'55 \cdot 10^{-4}$ moles $N_2 \cdot \frac{28 \text{ g } N_2}{1 \text{ mol } N_2} = 1'83 \cdot 10^{-2} \text{ g } N_2$

$8'18 \cdot 10^{-4}$ moles He $\cdot \frac{4 \text{ g He}}{1 \text{ mol He}} = 3'27 \cdot 10^{-3} \text{ g He}$

$m_{soluto} = 1'83 \cdot 10^{-2} \text{ g } N_2$

$m_{disolución} = m_{N_2} + m_{He} = 1'83 \cdot 10^{-2} + 3'27 \cdot 10^{-3} \rightarrow m_{disolu.} = 2'16 \cdot 10^{-2}$

$\%m = \frac{1'83 \cdot 10^{-2}}{2'16 \cdot 10^{-2}} \cdot 100 \rightarrow \boxed{\%m = 84'72\%}$

(7)

Datos

$M_{H_2SO_4} = 6'2 \text{ g}$

$V = 100 \text{ cm}^3 \cdot \frac{1 \text{ dm}^3}{1000 \text{ cm}^3} \cdot \frac{1 \text{ L}}{1 \text{ dm}^3} = 0'1 \text{ L}$

$1 \text{ L} = 1 \text{ dm}^3$

$$M = \frac{\text{mol soluto}}{V_{disolución}}$$

$M_{aH} = 1 \text{ g/mol}$

$M_{aS} = 32 \text{ g/mol}$

$M_{aO} = 16 \text{ g/mol}$

$M_{mH_2SO_4} = 2 \cdot 1 + 1 \cdot 32 + 4 \cdot 16 = 98 \text{ g/mol}$

$6'2 \text{ g } H_2SO_4 \cdot \frac{1 \text{ mol } H_2SO_4}{98 \text{ g } H_2SO_4} = 6'33 \cdot 10^{-2} \text{ mol } H_2SO_4$

$M = \frac{6'33 \cdot 10^{-2}}{0'1} \rightarrow \boxed{M_{H_2SO_4} = 0'633 \text{ mol/L}}$

(8)

a) Falso. En una molécula de O_2 hay dos átomos de O.

$1\,mol\,O_2 = 6'023\cdot10^{23}$ moléculas $O_2 = 2\cdot6'023\cdot10^{23}$ átomos O

$1\,mol\,O_2 = 1'205\cdot10^{24}$ átomos de O

b) nº moleculas H_2O = nº moléculas CO_2

Condiciones normales → P = 1 atm y T = 25ºC = 298K

* $V_{H_2O} = 67'2\,L$

$d = 1\,g/mL \cdot \frac{1000\,mL}{1\,L} = 1000\,g/L$

$M_{m\,H_2O} = 2\cdot1+16 = 18\,g/mol$

$67'2\,L\,H_2O \cdot \frac{1000\,g\,H_2O}{1\,L\,H_2O} \cdot \frac{1\,mol\,H_2O}{18\,g\,H_2O} \cdot \frac{6'023\cdot10^{23}\,\text{moléculas}\,H_2O}{1\,mol\,H_2O} = 2'25\cdot10^{27}$ moléculas H_2O

* $m_{CO_2} = 132\,g$

$M_{m\,CO_2} = 1\cdot12+2\cdot16 = 44\,g/mol$

$132\,g\,CO_2 \cdot \frac{1\,mol\,CO_2}{44\,g\,CO_2} \cdot \frac{6'023\cdot10^{23}\,\text{moléculas}\,CO_2}{1\,mol\,CO_2} = 1'81\cdot10^{24}$ moléculas CO_2

=> Falso, el nº de moléculas de H_2O es mayor al de CO_2

(9)

Disolución ácido sulfúrico

$\%\,m = 44\%$

$d_{H_2SO_4} = 1'343\,g/cm^3 = 1'343\,\frac{g}{mL}$

$V_{H_2SO_4} = 25\,cm^3 = 25\,mL$

$V_{H_2} = ?$ → en Condiciones normales ($P = 1\,atm$ y $T = 298K$)

$H_2SO_4 + Zn \longrightarrow H_2 + ZnSO_4$

$M_{m\,H_2SO_4} = 2\cdot1+1\cdot32+4\cdot16 = 98\,g/mol$

1º_ Ajustar reacción
2º_ Calcular la cantidad H_2SO_4
3º_ Calcular n_{H_2} por estequiometría
4º_ Calcular V_{H_2} con gases ideales

$25\,mL\,H_2SO_4 \cdot \frac{1'343\,g\,H_2SO_4}{1\,mL\,H_2SO_4} \cdot \frac{44\,g\,H_2SO_4}{100\,g\,H_2SO_4(don)} \cdot \frac{1\,mol\,H_2SO_4}{98\,g\,H_2SO_4} = 0'145\,mol\,H_2SO_4$

$0'145\,mol\,H_2SO_4 \cdot \frac{1\,mol\,H_2}{1\,mol\,H_2SO_4} = 0'145\,mol\,H_2$

$PV = nRT \rightarrow V = \frac{nRT}{P} \rightarrow V_{H_2} = \frac{0'145\cdot0'082\cdot298}{1} \rightarrow \boxed{V_{H_2} = 3'543\,L\,H_2}$