Solución problemas Unidad 5: gases y disoluciones

①

a) $m_{NaOH} = 400\,g$

$M_M(NaOH) = 22'99 + 15'99 + 1'01 = 39'99\ g/mol$

¿n_{NaOH}?

$$400\,g\,NaOH \cdot \frac{1\,mol}{39'99\,g} = \boxed{10\ moles\ NaOH}$$

b) $m_{piedra} = 100\,g$

Riqueza = 74% ↔ 100 g piedra / 74 g $CaCO_3$

$n_{CaCO_3} = ?$

$M_M(CaCO_3) = 40'08 + 12 + 3 \cdot 15'99 = 100'05\ g/mol$

$$100\,g\,piedra \cdot \frac{74\,g\,CaCO_3}{100\,g\,piedra} = 74\,g\,CaCO_3$$

$$74\,g\,CaCO_3 \cdot \frac{1\,mol}{100'05\,g} = \boxed{0'74\,mol\,CaCO_3}$$

c) $V_{H_2SO_4} = 490\,mL = 0'49\,L$ $\quad 490\,mL \cdot \frac{1\,L}{1000\,mL} = 0'49\,L$

$M = 2\,M = 2\,mol/L$

$n_{H_2SO_4} = ?$

Forma 1: por factor de conversión

$$0'49\,L\,H_2SO_4 \cdot \frac{2\,mol}{1\,L} = \boxed{0'98\,mol\,H_2SO_4}$$

Forma 2: por fórmula

$$M = \frac{n_{soluto}}{V\,(L)} \rightarrow n_{H_2SO_4} = M \cdot V\,(L) = 2 \cdot 0'49 \rightarrow \boxed{n_{H_2SO_4} = 0'98\ mol}$$

d)

$V_{O_2} = 250\,L$

$T = 298\,K$

$P = 704\,mmHg \cdot \frac{1\,atm}{760\,mmHg} = 0'93\,atm$

$n_{O_2} = ?$

Ecuación de gases ideales → $PV = nRT$ $\quad R = 0'082\ \frac{atm \cdot L}{mol \cdot K}$

$$PV = nRT \rightarrow n = \frac{PV}{RT} = \frac{0'93 \cdot 250}{0'082 \cdot 298} \rightarrow \boxed{n = 9'51\,mol\,O_2}$$

e)

$V_{HNO_3} = 1\,L$

Riqueza = 36'7 % $\left\langle \begin{matrix} 100\,g\ bote \\ 36'7\,g\ HNO_3 \end{matrix} \right.$

$d = 1225\,g/L$

$n_{HNO_3} = ?$

$M_m(HNO_3) = 1'01 + 14'01 + 3 \cdot 15'99 = 62'99\,g/mol$

Forma 1: por factor de conversión

(densidad) $1\,L\,HNO_3 \cdot \frac{1225\,g}{1\,L} = 1225\,g\,HNO_3\,(bote)$

(riqueza) $1225\,g\,HNO_3\,(bote) \cdot \frac{36'7\,g\,HNO_3}{100\,g\,bote} = 449'57\,g\,HNO_3$

(Mm) $449'57\,g\,HNO_3 \cdot \frac{1\,mol}{62'99\,g} = \boxed{7'14\,mol\,HNO_3}$

Forma 2: por fórmula

$d = \frac{m}{V} \rightarrow m = d \cdot V = 1225 \cdot 1 = 1225\,g\,HNO_3\,(bote)$

$1225\,g\,(bote) \cdot \frac{36'7\,g\,HNO_3}{100\,g\,bote} = 449'57\,g\,HNO_3$

$n = \frac{m}{Mm} = \frac{449'57}{62'99} \rightarrow \boxed{n = 7'14\,mol\,HNO_3}$

(2)

a)

$m_{CaCO_3} = 100g$

$Mm(CaCO_3) = 40+12+3\cdot16 = 100 g/mol$

$n = ?$

$$100g\,CaCO_3 \cdot \frac{1\,mol}{100g\,CaCO_3} = \boxed{1\,mol\,CaCO_3}$$

b)

$m_{pirita} = 115g$

riqueza = 60% $\left\langle \begin{matrix} 100g\ pirita \\ 60g\ FeS_2 \end{matrix} \right.$

$n_{FeS_2} = ?$

$Mm(FeS_2) = 56+2\cdot32 = 120 g/mol$

$$115g\,pirita \cdot \frac{60g\,FeS_2}{100g\,pirita} = 72g\,FeS_2$$

$$72g\,FeS_2 \cdot \frac{1\,mol}{120g} = \boxed{0'6\,mol\,FeS_2}$$

c)

$V_{H_2SO_4} = 250mL = 0'25\,L$

$d = 1840\,g/L$

riqueza = 96'4% $\left\langle \begin{matrix} 96'4\,g\,H_2SO_4 \\ 100g\ bote \end{matrix} \right.$

$Mm(H_2SO_4) = 2\cdot1+32+4\cdot16 = 98\,g/mol$

$$0'25\,L\,H_2SO_4 \cdot \frac{1840g}{1L} = 460g\,H_2SO_4\ (bote)$$

$$460g\ (bote) \cdot \frac{96'4g\,H_2SO_4}{100g\ (bote)} = 443'44g\,H_2SO_4$$

$$443'44g\,H_2SO_4 \cdot \frac{1\,mol}{98g} = \boxed{4'52\,mol\,H_2SO_4}$$

d)

$V(O_2) = 50L$

$$P = 704\,mmHg \cdot \frac{1\,atm}{760\,mmHg} = 0'93\,atm$$

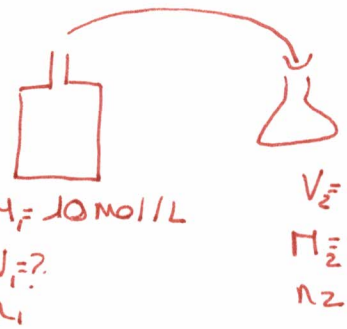
$T = 25°C = 298K$

$$PV = nRT \rightarrow n = \frac{PV}{RT} = \frac{0'93\cdot50}{0'082\cdot298} \rightarrow \boxed{n = 1'90\,mol\,O_2}$$

③ Datos

preparar
$V_2 = 20\,mL = 0'02\,L$
$M_2 = 5\,mol/L$

frasco
$M_1 = 10\,mol/L$
$V_1 = ?$



Los moles con los que preparo la disolución son los mismos que cojo del frasco.

$$M_1 = \frac{n_1}{V_1} \rightarrow n_1 = M_1 V_1$$
$$M_2 = \frac{n_2}{V_2} \rightarrow n_2 = M_2 V_2$$
$$\Big\} \; n_1 = n_2 \Rightarrow M_1 V_1 = M_2 V_2$$

$$V_1 = \frac{M_2 \cdot V_2}{M_1} = \frac{5 \cdot 0'02}{10} = 0'01\,L$$

$V_1 = 0'01\,L \rightarrow \boxed{V_1 = 10\,mL}$

Solución: Hay que coger 10 mL del frasco del laboratorio

④ Datos

$m_{N_2} = 98\,g$
$m_{CO_2} = 44\,g$
$T = 30\,^{\circ}C = 303\,K$
$P_T = 14\,atm$

a) $\chi_{N_2} = ?$
$\chi_{CO_2} = ?$

$$\chi_i = \frac{\text{moles } i}{\text{moles totales}}$$

$M_m(N_2) = 2 \cdot 14 = 28\,g/mol$
$M_m(CO_2) = 12 + 2 \cdot 16 = 44\,g/mol$

$$98\,g\,N_2 \cdot \frac{1\,mol}{28\,g} = 3'5\,mol\,N_2$$
$$44\,g\,CO_2 \cdot \frac{1\,mol}{44\,g} = 1\,mol\,CO_2$$

$n_T = n_{N_2} + n_{CO_2} = 3'5 + 1 = 4'5\,moles$

$$\chi_{N_2} = \frac{n_{N_2}}{n_T} = \frac{3'5}{4'5} \rightarrow \boxed{\chi_{N_2} = 0'78}$$
$$\chi_{CO_2} = \frac{n_{CO_2}}{n_T} = \frac{1}{4'5} \rightarrow \boxed{\chi_{CO_2} = 0'22}$$

(5)

a) Datos

$M_{HCl} = ?$

$d = 1'2\ g/cm^3$ $\quad cm^3 = mL$ $\quad d = 1'2\ \frac{g}{mL} \cdot \frac{1000\ mL}{1\ L} = 1200\ g/L$

% peso = 60% $\left\{ \begin{array}{l} 60\ g\ HCl \\ 100\ g\ disolución \end{array} \right.$

$M_m(HCl) = 1 + 35'5 = 36'5\ g/mol$

"Como el problema no dice nada, se supone $V = 1\ L$ de disolución"

"La densidad siempre es de la disolución"

$1\ L\ disolución \cdot \frac{1200\ g\ disolución}{1\ L\ disolución} = 1200\ g\ disolución$

$1200\ g\ disolución \cdot \frac{60\ g\ HCl}{100\ g\ disolución} = 720\ g\ HCl$

$720\ g\ HCl \cdot \frac{1\ mol}{36'5\ g} = 19'73\ mol\ HCl$

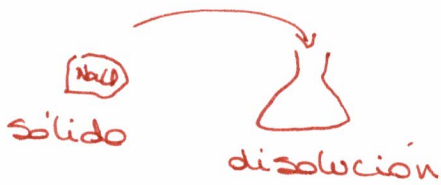
$M = \frac{n_{soluto}}{V_{disolución}\ (L)} \rightarrow M = \frac{19'73}{1} \rightarrow M = 19'73\ mol/L$

b) Datos

Preparar

$V_{NaCl} = 100\ mL = 0'1\ L$

$M = 0'5\ mol/L$



Muestra

$M_m(NaCl) = 23 + 35'5 = 58'5\ g/mol$

riqueza = 70% $\left\{ \begin{array}{l} 70\ g\ NaCl \\ 100\ g\ muestra \end{array} \right.$

quiero saber cuánto hay que coger del sólido para preparar la disolución NaCl que me piden

1º Calcular los moles que necesito en la disolución

$0'1\ L\ NaCl \cdot \frac{0'5\ mol}{1\ L} = 0'05\ mol\ NaCl$

2º Calcular la masa de NaCl (sólido) que cojo

$0'05\ mol\ NaCl \cdot \frac{58'5\ g}{1\ mol} = 2'92\ g\ NaCl$

$2'92\ g\ NaCl \cdot \frac{100\ g\ muestra}{70\ g\ NaCl} = \underline{4'18\ g\ muestra}$

⑥ Datos

$m_{NaOH} = 12\,g$

$V = 250\,mL = 0'25\,L$

a) $n_{NaOH} = ?$

$M_m(NaOH) = 23 + 16 + 1 = 40\,g/mol$

$$12\,g\,NaOH \cdot \frac{1\,mol}{40\,g} = \boxed{0'3\,mol\,NaOH}$$

b) $M = ?$

$$M = \frac{mol(soluto)}{V_{disolución}(L)} = \frac{0'3}{0'25} = \boxed{1'2\,mol/L}$$

⑦ Datos

$m = 2\,g$

$V = 100\,cm^3 = 100\,mL = 0'1\,L$

$P = 1'31\,atm$

$T = 0°C = 273\,K$

$M_m = ?$

$PV = nRT$

$1'31 \cdot 0'1 = n\,0'082 \cdot 273$

$0'131 = 22'39\,n$

$$n = \frac{0'131}{22'39} = 0'0058\,mol$$

$$n = \frac{m}{M_m}$$

$$M_m = \frac{m}{n} = \frac{2}{0'0058} \rightarrow \boxed{M_m = 341'83\,g/mol}$$

⑧ Datos

$$P_1 = 970\,mmHg \cdot \frac{1\,atm}{760\,mmHg} = 1'28\,atm$$

$T_1 = 25°C = 298\,K$

$T_2 = ?$

$$P_2 = 760\,mmHg \cdot \frac{1\,atm}{760\,mmHg} = 1\,atm$$

Ley Gay-Lussac (V = cte)

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

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

$$T_2 = \frac{1 \cdot 298}{1'28} \rightarrow \boxed{T_2 = 233'48\,K}$$

⑨ Datos

$P = ?$

gas ideal $\rightarrow PV = nRT$

$n = 0'532$

$V = 4390\,mL = 4'39\,L$

$T = 183'93\,K$

$PV = nRT$

$$P = \frac{nRT}{V} = \frac{0'532 \cdot 0'082 \cdot 183'93}{4'39}$$

$$\boxed{P = 1'83\,atm}$$

⑩ Datos

$V_1 = 2'5\,L$

$P_1 = 1'2\,atm$

$T_1 = 25°C + 273 = 298\,K$

$T_2 = 23°C = 296\,K$

$P_2 = 3'00 \cdot 10^{-3}\,atm$

$V_2 = ?$

El gas es el mismo dentro del globo $\rightarrow n_1 = n_2 = n$

$P_1 V_1 = nRT_1$

$$n = \frac{P_1 V_1}{RT_1} = \frac{1'2 \cdot 2'5}{0'082 \cdot 298} = 0'12\,mol$$

$P_2 V_2 = nRT_2$

$$V_2 = \frac{nRT_2}{P_2}$$

$$V_2 = \frac{0'12 \cdot 0'082 \cdot 296}{3'00 \cdot 10^{-3}} \rightarrow \boxed{V_2 = 970'88\,L}$$