

PROBLEMAS RESUELTOS DE CÁLCULOS QUÍMICOS

$$1) M = 2 \cdot 14 + 8 \cdot 1 + 2 \cdot 52 + 7 \cdot 16 = 252 \frac{\text{g}}{\text{mol}}$$

a)

$$n = \frac{m}{M} = \frac{378}{252} = 1.5 \text{ mol}$$

$$\begin{aligned} b) \quad N: 1.5 \cdot 2 &= 3 \text{ mol} \\ H: 1.5 \cdot 8 &= 12 \text{ mol} \\ Cr: 1.5 \cdot 2 &= 3 \text{ mol} \\ O: 1.5 \cdot 7 &= 10.5 \text{ mol} \end{aligned}$$

$$\begin{aligned} c) \quad N: 3 \cdot 14 &= 42 \text{ g} \\ H: 12 \cdot 1 &= 12 \text{ g} \\ Cr: 3 \cdot 52 &= 156 \text{ g} \\ O: 10.5 \cdot 16 &= 168 \text{ g} \end{aligned}$$

$$d) N = n \cdot N_A = 1.5 \cdot 6.022 \cdot 10^{23} = 9.03 \cdot 10^{23} \text{ moléculas}$$

$$\begin{aligned} e) \quad N: 3 \cdot 6.022 \cdot 10^{23} &= 1.81 \cdot 10^{24} \text{ átomos} \\ H: 12 \cdot 6.022 \cdot 10^{23} &= 7.23 \cdot 10^{24} \text{ ''} \\ Cr: 3 \cdot 6.022 \cdot 10^{23} &= 1.81 \cdot 10^{24} \text{ ''} \\ O: 10.5 \cdot 6.022 \cdot 10^{23} &= 6.32 \cdot 10^{24} \text{ ''} \end{aligned}$$

$$(2) \quad M = 2 \cdot 55'85 + 3 \cdot 16 = 159'7 \frac{\text{g}}{\text{mol}}$$

$$m_{\text{Fe}} = 150 \text{ g oligisto} \cdot \frac{75 \text{ g Fe}_2\text{O}_3}{100 \text{ g oligisto}}$$

$$\cdot \frac{2 \cdot 55'85 \text{ g Fe}}{159'7 \text{ g Fe}_2\text{O}_3} = \boxed{78'7 \text{ g Fe}}$$

$$(3) \quad m_{\text{N}_2} = 28 \frac{\text{g}}{\text{mol}} \cdot \frac{1 \text{ mol}}{6'022 \cdot 10^{23} \text{ moléculas}} = \boxed{4'65 \cdot 10^{-23} \frac{\text{g}}{\text{molécula}}}$$

$$m_{\text{H}} = 1 \frac{\text{g}}{\text{mol}} \cdot \frac{1 \text{ mol}}{6'022 \cdot 10^{23} \text{ átomos}} = \boxed{1'66 \cdot 10^{-24} \frac{\text{g}}{\text{átomo}}}$$

$$(4) \quad M = 4 \cdot 12 + 10 \cdot 1 + 16 = 74 \frac{\text{g}}{\text{mol}}$$

$$m = d \cdot V = 0'713 \frac{\text{g}}{\text{cm}^3} \cdot 250 \text{ cm}^3 = \boxed{178 \text{ g}}$$

$$n = \frac{m}{M} = \frac{178}{74} = \boxed{2'41 \text{ mol}}$$

$$N = n \cdot N_A = 2'41 \cdot 6'022 \cdot 10^{23} = \boxed{1'45 \cdot 10^{24} \text{ moléculas}}$$

$$\textcircled{5} \quad M = 2 \cdot 27 + 3 \cdot 16 = 102 \frac{\text{g}}{\text{mol}}$$

$$a) \quad n_{\text{Al}} = 1 \text{ ton mineral} \cdot \frac{10^6 \text{ g mineral}}{1 \text{ ton mineral}}$$

$$\cdot \frac{60 \text{ g Al}_2\text{O}_3}{100 \text{ g mineral}} \cdot \frac{1 \text{ mol Al}_2\text{O}_3}{102 \text{ g Al}_2\text{O}_3} \cdot \frac{2 \text{ mol Al}}{1 \text{ mol Al}_2\text{O}_3} =$$

$$= \boxed{1'18 \cdot 10^4 \text{ mol Al}}$$

$$b) \quad m = n \cdot M = 1'18 \cdot 10^4 \cdot 27 = \boxed{3'18 \cdot 10^5 \text{ g Al}}$$

$$c) \quad N = n \cdot N_A = 1'18 \cdot 10^4 \cdot 6'022 \cdot 10^{23} = \boxed{7'11 \cdot 10^{27} \text{ átomos Al}}$$

$$\textcircled{6} \quad M = 3 \cdot 55'85 + 2 \cdot 31 + 8 \cdot 16 = 357'6 \frac{\text{g}}{\text{mol}}$$

$$a) \quad n = \frac{m}{M} = \frac{80}{357'6} = \boxed{0'224 \text{ mol}}$$

$$b) \quad N = n \cdot N_A = 0'224 \cdot 6'022 \cdot 10^{23} = \boxed{1'35 \cdot 10^{23} \text{ moléculas}}$$

$$c) \quad \begin{array}{l} \text{Fe: } 0'224 \cdot 3 = 0'672 \text{ mol} \\ \text{P: } 0'224 \cdot 2 = 0'448 \text{ mol} \\ \text{O: } 0'224 \cdot 8 = 1'79 \text{ mol} \end{array}$$

$$d) \quad \begin{array}{l} \text{Fe: } 0'672 \cdot 55'85 = 37'5 \text{ g} \\ \text{P: } 0'448 \cdot 31 = 13'9 \text{ g} \\ \text{O: } 1'79 \cdot 16 = 28'6 \text{ g} \end{array}$$

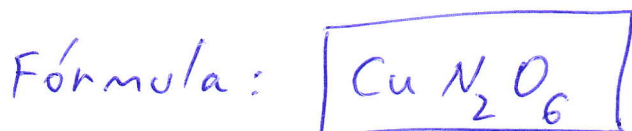
$$e) \quad \begin{array}{l} \text{Fe: } 0'672 \cdot 6'022 \cdot 10^{23} = 4'05 \cdot 10^{23} \text{ átomos} \\ \text{P: } 0'448 \cdot 6'022 \cdot 10^{23} = 2'70 \cdot 10^{23} \text{ ''} \\ \text{O: } 1'79 \cdot 6'022 \cdot 10^{23} = 1'08 \cdot 10^{24} \text{ ''} \end{array}$$

$$\textcircled{7} \quad m_0 = 1'07 - 0'36 - 0'16 = 0'55 \text{ g O}$$

$$\text{Cu: } \frac{0'36}{63'54} = 5'67 \cdot 10^{-3} \rightarrow \frac{5'67 \cdot 10^{-3}}{5'67 \cdot 10^{-3}} = 1$$

$$\text{N: } \frac{0'16}{14} = 0'0114 \rightarrow \frac{0'0114}{5'67 \cdot 10^{-3}} \approx 2$$

$$\text{O: } \frac{0'55}{16} = 0'0344 \rightarrow \frac{0'0344}{5'67 \cdot 10^{-3}} \approx 6$$

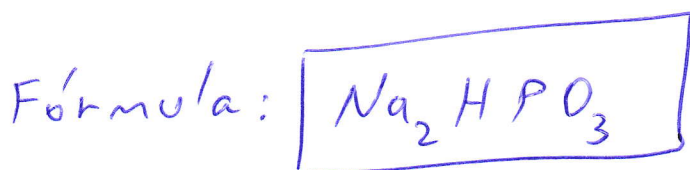


$$\textcircled{8} \quad \text{H: } \frac{0'8}{1} = 0'8 \rightarrow \frac{0'8}{0'793} \approx 1$$

$$\text{Na: } \frac{36'5}{23} = 1'58 \rightarrow \frac{1'58}{0'793} \approx 2$$

$$\text{P: } \frac{24'6}{31} = 0'793 \rightarrow \frac{0'793}{0'793} = 1$$

$$\text{O: } \frac{38'1}{16} = 2'38 \rightarrow \frac{2'38}{0'793} \approx 3$$



9) Fórmula semidesarrollada:



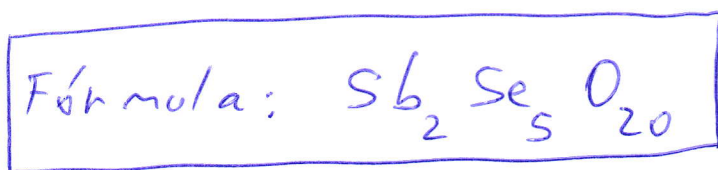
Fórmula molecular: $\text{C}_6\text{H}_{10}\text{O}_4\text{N}_2$

Fórmula empírica: $\text{C}_3\text{H}_5\text{O}_2\text{N}$

10) Sb: $\frac{25'4}{121'76} = 0'209 \rightarrow \frac{0'209}{0'209} = 1 \xrightarrow{\times 2} 2$

Se: $\frac{41'2}{78'96} = 0'522 \rightarrow \frac{0'522}{0'209} \approx 2'5 \xrightarrow{\times 2} 5$

O: $\frac{33'4}{16} = 2'09 \rightarrow \frac{2'09}{0'209} = 10 \xrightarrow{\times 2} 20$



11) $M = 3 \cdot 112'41 + 2 \cdot 31 + 8 \cdot 16 = 527'2 \frac{\text{g}}{\text{mol}}$

Cd: $\frac{3 \cdot 112'41 \cdot 100}{527'2} = \boxed{64\%}$

P: $\frac{2 \cdot 31 \cdot 100}{527'2} = \boxed{11'8\%}$

O: $100 - 64 - 11'8 = \boxed{24'2\%}$

(6)

$$(12) \quad M = 2 \cdot 58'69 + 3 \cdot 12 + 9 \cdot 16 = 297'4 \frac{\text{g}}{\text{mol}}$$

$$N_i: \quad \frac{2 \cdot 58'69 \cdot 100}{297'4} = \boxed{39'5\%}$$

$$C: \quad \frac{3 \cdot 12 \cdot 100}{297'4} = \boxed{12'1\%}$$

$$O: \quad 100 - 39'5 - 12'1 = \boxed{48'4\%}$$

(13) Como no hay ningún dato de masa ni de volumen, hay que suponerlo:

$$40\% \rightarrow \begin{cases} 40 \text{ g HClO}_4 \\ 100 \text{ g disolución} \end{cases}$$

$$M = 1 + 35'5 + 16 \cdot 4 = 100'5 \frac{\text{g}}{\text{mol}}$$

$$n_s = \frac{m}{M} = \frac{40}{100'5} = 0'398 \text{ mol}; \quad V_D = \frac{m_D}{d_D} = \frac{100}{1'2} = 83'3 \text{ mL}$$

$$a) \quad c_M = \frac{n_s}{V_D} = \frac{0'398 \text{ mol}}{0'0833 \text{ L}} = \boxed{4'78 \text{ M}}$$

$$b) \quad c = \frac{m_s}{V_D} = \frac{40 \text{ g}}{0'0833 \text{ L}} = \boxed{480 \frac{\text{g}}{\text{L}}}$$

14) Como no hay ningún dato de masa ni de volumen, hay que suponerlo:

$$28\% \rightarrow \begin{cases} 28 \text{ g } H_2SO_4 \\ 100 \text{ g disolución} \end{cases}$$

$$M = 2 \cdot 1 + 32 + 4 \cdot 16 = 98 \frac{\text{g}}{\text{mol}}; \quad n_s = \frac{m_s}{M_s} = \frac{28}{98} = 0,286 \text{ mol}$$

$$V_D = \frac{m_D}{d_D} = \frac{100}{1,25} = 80 \text{ mL} = 0,080 \text{ L}$$

$$a) \quad c_M = \frac{n_s}{V_D} = \frac{0,286 \text{ mol}}{0,080 \text{ L}} = \boxed{3,57 \text{ M}}$$

$$b) \quad c = \frac{m_s}{V_D} = \frac{28 \text{ g}}{0,080 \text{ L}} = \boxed{350 \frac{\text{g}}{\text{L}}}$$

15) a) $m_s = n_s \cdot M_s = 0,5 \cdot 98 = 49 \text{ g } H_2SO_4$

$$m_D = \frac{m_s \cdot 100}{\text{Perc.}} = \frac{49 \cdot 100}{53} = 92,4 \text{ g}$$

$$V_D = \frac{m_D}{d_D} = \frac{92,4 \text{ g}}{1,1 \text{ g/cm}^3} = \boxed{84 \text{ cm}^3}$$

$$b) \quad m_D = d_D \cdot V_D = 1,1 \frac{\text{g}}{\text{cm}^3} \cdot 40 \text{ mL} = 44 \text{ g disolución}$$

$$m_s = \frac{\text{Perc.} \cdot m_D}{100} = \frac{53 \cdot 44}{100} = \boxed{23,3 \text{ g soluto}}$$

(8)

$$(16) \quad m_D = m_s + m_d = 40 + 80 = 120 \text{ g disolución}$$

$$V_D = \frac{m_D}{d_D} = \frac{120 \text{ g}}{1.12 \text{ g/mL}} = 107 \text{ mL} = 0.107 \text{ L}$$

$$V_d = \frac{m_d}{d_d} = \frac{80 \text{ g}}{1 \text{ g/mL}} = 80 \text{ mL}$$

$$V_s = V_D - V_d = 107 - 80 = 27 \text{ mL}$$

$$M_s = 23 + 35.5 = 58.5 \frac{\text{g}}{\text{mol}}$$

$$n_s = \frac{m_s}{M_s} = \frac{40 \text{ g}}{58.5 \frac{\text{g}}{\text{mol}}} = 0.684 \text{ mol}$$

* Porcentaje en masa:

$$\text{Porc. masa} = \frac{m_s \cdot 100}{m_D} = \frac{40 \cdot 100}{120} = \boxed{33.3\%}$$

* Masa por unidad de volumen:

$$c = \frac{m_s}{V_D} = \frac{40 \text{ g}}{0.107 \text{ L}} = \boxed{373 \frac{\text{g}}{\text{L}}}$$

* Porcentaje en volumen:

$$\text{Porc. volumen} = \frac{V_s \cdot 100}{V_D} = \frac{27 \cdot 100}{107} = \boxed{25.2\%}$$

* Molaridad:

$$c_M = \frac{n_s}{V_D} = \frac{0.684 \text{ mol}}{0.107 \text{ L}} = \boxed{6.38 \text{ M}}$$

(9)

17) Como no tenemos datos de masa ni de volumen, hay que suponerlo:

$$2 M \rightarrow \begin{cases} n_s = 2 \text{ mol } H_2SO_4 \\ V_D = 1 \text{ L disolución} \end{cases}$$

$$M_s = 2 \cdot 1 + 32 + 4 \cdot 16 = 98 \frac{\text{g}}{\text{mol}}$$

$$m_s = n_s \cdot M_s = 2 \text{ mol} \cdot 98 \frac{\text{g}}{\text{mol}} = 196 \text{ g}$$

$$m_D = d_D \cdot V_D = 1 \frac{\text{kg}}{\text{L}} \cdot 1 \text{ L} = 1 \text{ kg} = 1000 \text{ g disolución}$$

* Porcentaje en masa:

$$\text{Porc. masa} = \frac{m_s \cdot 100}{m_D} = \frac{196 \cdot 100}{1000} = \boxed{19.6\%}$$

* Masa por unidad de volumen:

$$c = \frac{m_s}{V_D} = \frac{196 \text{ g}}{1 \text{ L}} = \boxed{196 \frac{\text{g}}{\text{L}}}$$

18) * Masa de disolución:

$$m_D = \frac{m_s \cdot 100}{\text{Porc.}} = \frac{50 \cdot 100}{60} = 83\bar{3} \text{ g disolución}$$

* Volumen de disolución:

$$V_D = \frac{m_D}{d_D} = \frac{83\bar{3} \text{ g}}{1\bar{3} \frac{\text{g}}{\text{cm}^3}} = \boxed{64\bar{1} \text{ cm}^3}$$

$1\bar{3} \frac{\text{kg}}{\text{L}}$ es lo mismo que $1\bar{3} \frac{\text{g}}{\text{cm}^3}$

19) * Número de moles del gas:

$$n = 0\text{'}175 \text{ L} \cdot \frac{1 \text{ mol}}{22\text{'}4 \text{ L}} = 7\text{'}81 \cdot 10^{-3} \text{ mol}$$

* Masa molecular del gas:

$$n = \frac{m}{M} \Rightarrow M = \frac{m}{n} = \frac{0\text{'}625 \text{ g}}{7\text{'}81 \cdot 10^{-3} \text{ mol}} = \boxed{80 \frac{\text{g}}{\text{mol}}}$$

$$20) \frac{P_1 \cdot V_1}{T_1} = \frac{P_2 \cdot V_2}{T_2}; T = \text{cte} \Rightarrow T_1 = T_2 \Rightarrow P_1 \cdot V_1 = P_2 \cdot V_2 \Rightarrow$$

$$\Rightarrow V_2 = \frac{P_1 \cdot V_1}{P_2} = \frac{1 \cdot 60}{5} = \boxed{12 \text{ L}}$$

$$(21) \quad P \cdot V = n \cdot R \cdot T \Rightarrow V = \frac{n \cdot R \cdot T}{P}$$

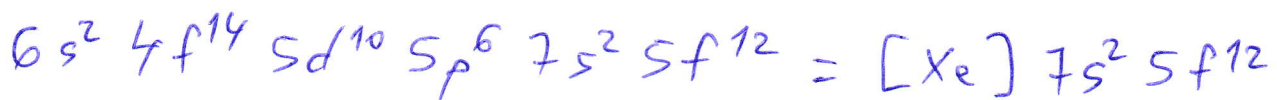
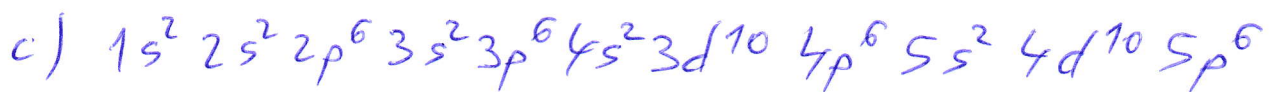
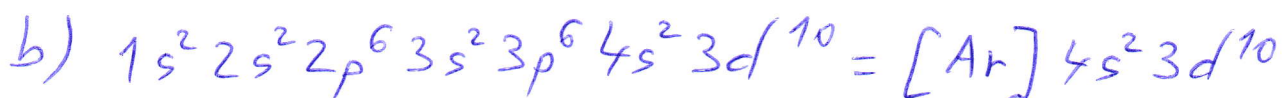
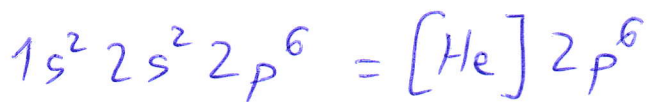
$$n = \frac{m}{M} = \frac{50}{32} = 1.56 \text{ mol}; \quad T_K = T_C + 273 = -30 + 273 = 243 \text{ K}$$

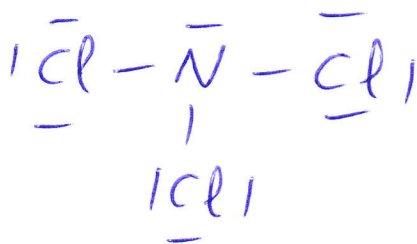
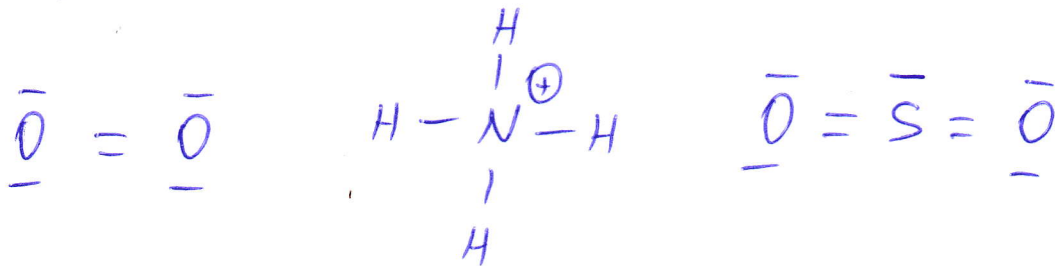
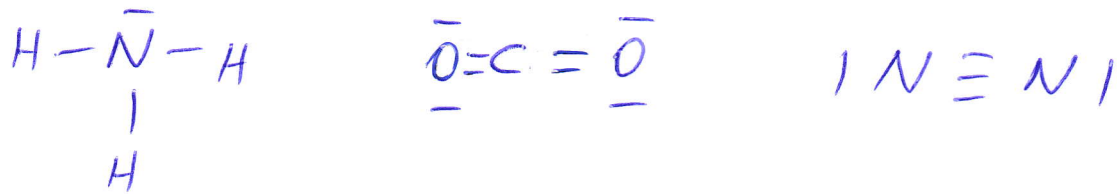
$$V = \frac{n \cdot R \cdot T}{P} = \frac{1.56 \cdot 0.082 \cdot 243}{2} = \boxed{15.6 \text{ L}}$$

$$(22) \quad \frac{P_1 \cdot V_1}{T_1} = \frac{P_2 \cdot V_2}{T_2} \Rightarrow V_2 = \frac{P_1 \cdot V_1 \cdot T_2}{P_2 \cdot T_1} =$$

$$= \frac{3 \cdot 20 \cdot (273 + 40)}{1 \cdot (273 + 25)} = \frac{60 \cdot 313}{298} = \boxed{63 \text{ L}}$$

(23) a)





$$\textcircled{26} \quad T_K = T_C + 273 = 20 + 273 = 293 \text{ K}$$

$$P = \frac{300}{760} = 0.395 \text{ atm}$$

* Número de moles:

$$n = \frac{P \cdot V}{R \cdot T} = \frac{0.395 \cdot 5}{0.082 \cdot 293} = 0.822 \text{ mol } O_2$$

* Número de moléculas de O_2 :

$$N = n \cdot N_A = 0.822 \cdot 6.022 \cdot 10^{23} = 4.95 \cdot 10^{22} \text{ moléculas } O_2$$

* Número de átomos de O:

$$N = 4.95 \cdot 10^{22} \text{ moléculas } O_2 \cdot \frac{2 \text{ átomos O}}{1 \text{ molécula } O_2} =$$

$$= \boxed{9.9 \cdot 10^{22} \text{ átomos O}}$$

27) * Número de moles del compuesto:

$$n = \frac{P \cdot V}{R \cdot T} = \frac{1'5 \cdot 40}{0'082 \cdot 293} = 2'5 \text{ mol}$$

* Masa molecular:

$$n = \frac{m}{M} \Rightarrow M_{\text{molecular}} = \frac{m}{n} = \frac{345 \text{ g}}{2'5 \text{ mol}} = 138 \frac{\text{g}}{\text{mol}}$$

* Masa de la fórmula empírica:

$$M_{\text{empírica}} = 2 \cdot 12 + 6 + 16 = 46 \frac{\text{g}}{\text{mol}}$$

* Coeficiente por el que hay que multiplicar la fórmula empírica:

$$x = \frac{M_{\text{molecular}}}{M_{\text{empírica}}} = \frac{138}{46} = 3$$

Fórmula molecular: $\boxed{\text{C}_6 \text{H}_{18} \text{O}_3}$

* Masas moleculares:

$$(28) M_{\text{NaNO}_3} = 23 + 14 + 16 \cdot 3 = 85 \frac{\text{g}}{\text{mol}}$$

$$M_{\text{KNO}_3} = 39 + 14 + 16 \cdot 3 = 101 \frac{\text{g}}{\text{mol}}$$

* Porcentajes de N:

$$\text{En el NaNO}_3: \frac{14 \cdot 100}{85} = 16.5\%$$

$$\text{En el KNO}_3: \frac{14 \cdot 100}{101} = 13.8\%$$

Solución: $\boxed{\text{NaNO}_3}$