ANSWERS TO SECTION 4.5 QUESTIONS

Try yourself 4.5a

⇒ 1.0 $mol.dm^{-3}$ HCl – solution

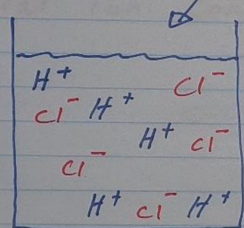
$[H^+] = 1.0\ mol.dm^{-3}$
$[Cl^-] = 1.0\ mol.dm^{-3}$

Because:
$1HCl \rightleftarrows 1H^+(aq) + 1Cl^-(aq)$
all ratios = 1:1

Total ion concentration = 2 $mol.dm^{-3}$

Because:

5 $mol.dm^{-3}$ HCl



There are 5 H^+ – ions
There are 5 Cl^- – ions
In total there are 10 ions $(5H^+ + 5Cl^-)$

⇒ 0.500 $mol.dm^{-3}$ Na_2SO_4 – solution

$Na_2SO_4(s) \rightleftarrows 2Na^+(aq) + SO_4^{2-}(aq)$

$\therefore [Na^+] = 2[Na_2SO_4] = 2(0.500) = 1.00\ M$

$\therefore [SO_4^{2-}] = 0.500\ M$

Total ion Concentr. = 1.50 M

Try yourself 4.5a

⇒ 0.500 $mol.dm^{-3}$ ammonium phosphate sol.

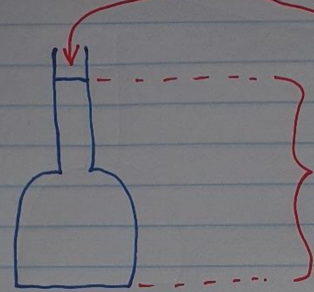
$(NH_4)_3PO_4(s) \rightleftarrows 3NH_4^+(aq) + PO_4^{3-}(aq)$

$\therefore [NH_4^+] = 3[(NH_4)_3PO_4] = 3(0.500) = 1.500\ M$

$\therefore [PO_4^{3-}] = 0.500\ M$

Total ion Concentr. = 2.00 M

Try yourself 4.5 b



$2.335\,g\ K_2Cr_2O_7$

~~0.500~~ 500 mL = 0.500 L = 0.500 dm^3

$[K_2Cr_2O_7] = ?$ | $[K^+] = ?$ | $[Cr_2O_7^{2-}] = ?$

$$n_{K_2Cr_2O_7} = \frac{m}{M} = \frac{2.335\,g}{294.2\,g.mol^{-1}}$$

$$= 0.00794\ mol\ K_2Cr_2O_7$$

$$(7.94 \times 10^{-3}\ mol)$$

$$\therefore C = \frac{n}{V} = \frac{7.94\times10^{-3}\ mol}{0.5\ L}$$

$$= 0.0159\ mol.L^{-1}\ (M)$$

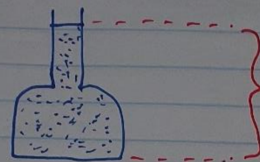
$$\approx 0.016\ M\ K_2Cr_2O_7$$

$$K_2Cr_2O_{7(s)} \rightleftarrows 2K^+(aq) + Cr_2O_7^{2-}(aq)$$

$$\therefore [K^+] = 2[K_2Cr_2O_7] = 2(0.016) = 0.032\ M$$

$$[Cr_2O_7^{2-}] = 0.016\ M$$

Try yourself 4.5 c



100mL of a 1.023×10^{-3} M Na_3PO_4

* mass of solute (Na_3PO_4) = ?

→ molar concentrations of Na^+ and PO_4^{3-} = ?

* $c_{Na_3PO_4} = \frac{n}{V}$

$$\therefore n_{Na_3PO_4} = c \times V$$
$$= (1.023 \times 10^{-3}\ mol.dm^{-3})(0.100dm^3)$$
$$= 1.023 \times 10^{-4}\ mol\ Na_3PO_4$$

$$m_{Na_3PO_4} = n \times M$$
$$= (1.023 \times 10^{-4}\ mol)(164\ g.mol^{-1})$$
$$= 0.0167\ g$$
$$\approx 0.017\ g$$

→ Na_3PO_4 was dissolved in enough water to yield a 100 mL solution with a concentration of 1.023×10^{-3} M Na_3PO_4.

→ $[Na^+] = 3[Na_3PO_4] = 3(1.023 \times 10^{-3})$
$= 3.07 \times 10^{-3}$ M

$[PO_4^{3-}] = 1.023 \times 10^{-3}$ M

Try yourself 4.5 d

* mol fraction ethylene glycol (ET):

$$\text{mol fraction ET} = \frac{\text{mol ET}}{\text{mol } H_2O + \text{mol ET}}$$

mol ET = 1 mol

$$\text{mol } H_2O = \frac{m}{M} = \frac{250\text{g}}{18.02\text{g}\cdot\text{mol}^{-1}} = 13.87 \text{ mol } H_2O$$

$$\text{mol fration ET} = \frac{1 \text{ mol}}{1 \text{ mol} + 13.87 \text{ mol}}$$

$$= \frac{1 \text{ mol}}{14.87 \text{ mol}}$$

$$= 0.067$$

* Molality of ET:

$$\text{Molality, } m = \frac{\text{mol solute}}{\text{mass of solvent in kg}}$$

$$= \frac{1 \text{ mol}}{0.250 \text{ kg}}$$

$$= 4 \text{ m (4 molal)}$$

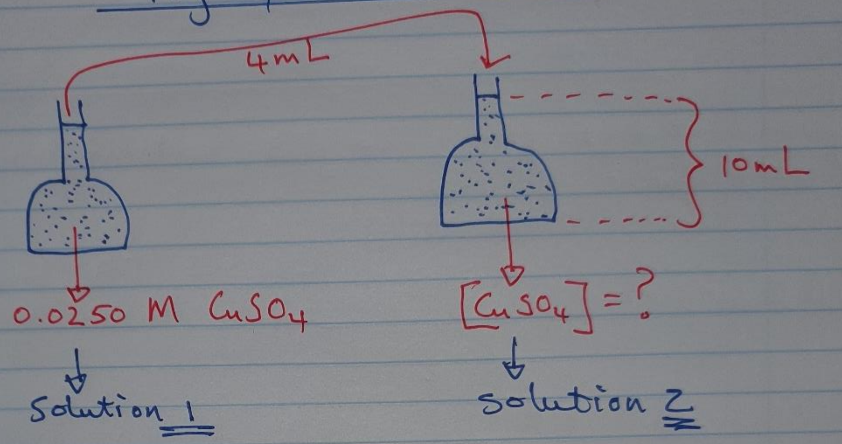
* weight % ET:

$$\text{weight \% ET} = \frac{\text{weight ET}}{\text{weight } H_2O + \text{weight ET}} \times \frac{100}{1}$$

$$= \frac{62.1\text{g}}{250\text{g} + 62.1\text{g}} \times \frac{100}{1}$$

$$= 19.897\ \% \approx 19.90\%$$

Try yourself 4.5 e



$C_1V_1 = C_2V_2$

$C_1 = 0.0250\,M$ ✓
$V_1 = 4\,mL$ ✓
$C_2 = ?$
$V_2 = 10\,mL$ ✓

$\therefore C_2 = \dfrac{C_1V_1}{V_2}$

$= \dfrac{(0.0250M)(0.004\,dm^3)}{0.001\,dm^3}$

$= 0.100\,mol.dm^{-3}$

$\therefore [CuSO_4]$ in solution 2 = $0.100\,M$

Correction: V_2 should be 0.01 dm^3 and not 0.001 dm^3. This will give a final answer of 0.01 $mol.dm^{-3}$.