

Diploma of Health Sciences
Diploma of Science
SLE155 Chemistry for the Professional Sciences

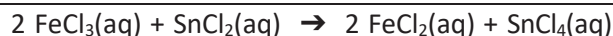
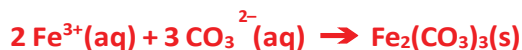
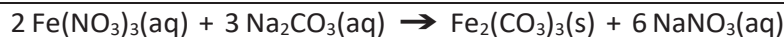
Q1 Chemical reactions and stoichiometry

[3 + 3 = 6 marks]

- a) For the following balanced equations write a **net ionic equation**.
Make sure that you include **states**.

1 mark each, deduct ½ mark for each mistake or omission

[3 × 1 = 3 marks]



- b) Calculate the volume of 0.300 M $\text{FeCl}_3(\text{aq})$ solution needed to react completely with 20.0 mL of 0.0450 M $\text{AgNO}_3(\text{aq})$ solution to give a precipitate of AgCl .
The net ionic equation is:



[3 marks]

Concentration $\text{Cl}^{-}(\text{aq})$ ions is 0.900 M because 3 mole Cl^{-} ions for every one mole $\text{FeCl}_3(\text{aq})$

1 mark

Molarity = $\frac{\text{amount of solute}}{\text{volume of solution in litres}}$

. amount $\text{Ag}^{+}(\text{aq})$ ions = $0.0450 \times 0.0200 = 0.000900 \text{ mol}$

½ mark

1 mole Ag^{+} requires 1 mole Cl^{-} (from chemical equation)

. amount $\text{Cl}^{-}(\text{aq})$ required is 0.000900 mol

½ mark

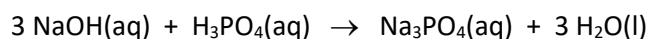
. volume $\text{Cl}^{-}(\text{aq})$ is $\frac{0.000900}{0.900}$ (from volume of solution = $\frac{\text{amount}}{\text{molarity}}$)

**. volume 0.300 M FeCl_3 required is 0.00100 L
= 1.00 mL to 3 significant figures**

1 mark

Answer can be in mL or L but should be 3 significant figures.

- c) Sodium hydroxide, NaOH reacts with phosphoric acid, H₃PO₄ to form sodium phosphate, Na₃PO₄, used in food processing, and water.



Data: $M_r \text{ Na}_3\text{PO}_4 = 163.94 \text{ g mol}^{-1}$ $M_r \text{ H}_3\text{PO}_4 = 97.994 \text{ g mol}^{-1}$
 $M_r \text{ NaOH} = 39.997 \text{ g mol}^{-1}$ $M_r \text{ H}_2\text{O} = 18.015 \text{ g mol}^{-1}$

- i) Determine the limiting reagent if 35.60 g of NaOH is reacted with 30.80 g of H₃PO₄.

[3 marks]

Using amount sodium hydroxide = $\frac{\text{mass}}{\text{molar mass}}$,
 Amount sodium hydroxide = $35.60 / 39.997$
 = 0.8901 mol 1 mark

Amount phosphoric acid = $30.80 / 97.994$
 = 0.3143 mol 1 mark

One mol phosphoric acid requires 3 mol sodium hydroxide, so 0.3143 mol phosphoric acid requires
 $3 \times 0.3143 \text{ mol} = 0.9429 \text{ mol NaOH}$.
 Limiting reagent is NaOH. 1 mark

- ii) Calculate the theoretical yield in grams of Na₃PO₄ when 35.60 g of NaOH is reacted with 30.80 g of H₃PO₄.

[2 marks]

Using balanced equation above, 0.8901 mol of NaOH will produce $\frac{1}{3} \times 0.8901 \text{ mol}$
 = 0.2967 mol of Na₃PO₄ 1 mark

Using amount substance = $\frac{\text{mass}}{\text{molar mass}}$,
 Mass Na₃PO₄ = $0.2967 \text{ mol} \times 163.94 \text{ g mol}^{-1}$
 = 48.63918 g
 = 48.63 g (4 significant figures) 1 mark

- iii) Calculate the percentage yield of Na₃PO₄ if only 28.50 g Na₃PO₄ is obtained from the reaction.

[1 mark]

Percentage yield = $\frac{\text{actual yield}}{\text{theoretical yield}} \times 100$
 = $\frac{28.50}{48.63} \times 100$
 = 58.59% (4 significant figures) 1 mark

If answer to part ii) above was incorrect, give ½ mark if percentage yield was calculated correctly using an incorrect answer from above but not if answer is >100%!