Foundations in chemistry

(Acids)

Total mark – 20

Question: 1

1. A student carries out experiments using acids, bases and salts.

Calcium nitrate, $Ca(NO_3)_2$, is an example of a salt.

The student prepares a solution of calcium nitrate by reacting dilute nitric acid, HNO_3, with the base calcium hydroxide, $Ca(OH)_2$.

(i) Why is calcium nitrate an example of a salt?

.....

.....

[1]

(ii) Write the equation for the reaction between dilute nitric acid and calcium hydroxide. Include state symbols.

.....

[2]

(iii) Explain how the hydroxide ion in aqueous calcium hydroxide acts as a base when it neutralises dilute nitric acid.

.....

.....

.....

[1]

[Total 4 marks]

Question: 2

2. (a) A student carries out a titration to find the concentration of some sulfuric acid.

The student finds that 25.00 cm^3 of 0.0880 mol dm^{-3} aqueous sodium hydroxide, NaOH, is neutralised by 17.60 cm^3 of dilute sulfuric acid, H_2SO_4.

$$H_2SO_4(aq) + 2NaOH(aq) \rightarrow Na_2SO_4(aq) + 2H_2O(l)$$

(i) Calculate the amount, in moles, of NaOH used.

answer = ... mol

[1]

(ii) Determine the amount, in moles, of H_2SO_4 used.

answer = ... mol

[1]

(iii) Calculate the concentration, in mol dm^{-3}, of the sulfuric acid.

answer = ... mol dm^{-3}

[1]

(b) After carrying out the titration in (a), the student left the resulting solution to crystallise. White crystals were formed, with a formula of $Na_2SO_4 \cdot \boldsymbol{x}\ H_2O$ and a molar mass of 322.1 g mol^{-1}.

(i) What term is given to the '$\cdot \boldsymbol{x}\ H_2O$' part of the formula?

.....

[1]

(ii) Using the molar mass of the crystals, calculate the value of ***x***.

answer = ...

[2]

[Total 6 marks]

Question: 3

3. Ammonium compounds such as ammonium sulfate, $(NH_4)_2SO_4$, can be used as fertilisers.

(i) Write a balanced equation to show how ammonium sulfate could be formed by the reaction between aqueous ammonia and sulfuric acid.

.....

[1]

(ii) Ammonium sulfate is an example of a salt formed when an acid is neutralised by a base.

Explain what is meant by the term *salt*.

.....

.....

[1]

(iii) Why is ammonia acting as a base in this neutralisation?

.....

.....

[1]

(iv) What is the relative formula mass of $(NH_4)_2SO_4$?

Give your answer to **one** decimal place.

.....

[1]

[Total 4 marks]

Question: 4

4. Epsom salts can be used as bath salts to help relieve aches and pains.

Epsom salts are crystals of hydrated magnesium sulfate, $MgSO_4 \cdot xH_2O$.

A sample of Epsom salts was heated to remove the water. 1.57 g of water was removed leaving behind 1.51 g of anhydrous $MgSO_4$.

(i) Calculate the amount, in mol, of anhydrous $MgSO_4$ formed.

amount = ... mol

[2]

(ii) Calculate the amount, in mol, of H_2O removed.

amount = ... mol

[1]

(iii) Calculate the value of ***x*** in $MgSO_4 \cdot xH_2O$.

x = ...

[1]

[Total 4 marks]

Question: 5

5. Calcium oxide reacts with water and with nitric acid.

State the formula of the calcium compound formed when:

(i) calcium oxide reacts with water, ...

[1]

(ii) calcium oxide reacts with nitric acid. .....

[1]

[Total 2 marks]