Q1

20.0 cm^3 of H_2SO_4 reacts with 25.0 cm^3 of 0.200 mol/dm^3 NaOH.

The equation for the reaction is shown.

$$H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H_2O$$

Calculate the concentration of H_2SO_4 using the following steps.

- Calculate the number of moles in 25.0 cm^3 of 0.200 mol/dm^3 NaOH.

..... mol

- Determine the number of moles of H_2SO_4 that react with the NaOH.

..... mol

- Calculate the concentration of H_2SO_4.

..... mol/dm^3
[3]

Q2

Ester **Y** has the following composition by mass:

C, 48.65%; H, 8.11%; O, 43.24%.

Calculate the empirical formula of ester **Y**.

empirical formula = ... [3]

Ester **Z** has the empirical formula C_2H_4O and a relative molecular mass of 88.

Determine the molecular formula of ester **Z**.

molecular formula = ... [1]

Q3

Fluorine reacts with sulfur to form a compound which has 25.2% sulfur by mass and a relative molecular mass of 254.

Determine the molecular formula of this compound.

molecular formula = ... [3]

Q4

The equation for the reaction is shown.

$$Ca(OH)_2 + 2HCl \rightarrow CaCl_2 + 2H_2O$$

$20.0\,cm^3$ of $0.0500\,mol/dm^3$ HCl reacts with the $25.0\,cm^3$ of $Ca(OH)_2$.

Determine the concentration of $Ca(OH)_2$ in g/dm^3. Use the following steps.

- Calculate the number of moles in $20.0\,cm^3$ of $0.0500\,mol/dm^3$ HCl.

..... mol

- Determine the number of moles of $Ca(OH)_2$ in $25.0\,cm^3$ of the limewater.

..... mol

- Calculate the concentration of $Ca(OH)_2$ in mol/dm^3.

..... mol/dm^3

- Determine the concentration of $Ca(OH)_2$ in g/dm^3.

..... g/dm^3

[5]

Q5

When hydrated sodium sulfate crystals, $Na_2SO_4 \cdot \boldsymbol{x}H_2O$, are heated, they give off water.

$$Na_2SO_4 \cdot \boldsymbol{x}H_2O(s) \rightarrow Na_2SO_4(s) + \boldsymbol{x}H_2O(g)$$

In an experiment, 1.61 g of $Na_2SO_4 \cdot \boldsymbol{x}H_2O$ is heated until all the water is given off. The mass of Na_2SO_4 remaining is 0.71 g.

[M_r: Na_2SO_4,142; H_2O,18]

Determine the value of ***x*** using the following steps.

- Calculate the number of moles of Na_2SO_4 remaining.

..... mol

- Calculate the mass of H_2O given off.

..... g

- Calculate the number of moles of H_2O given off.

..... mol

- Determine the value of ***x***.

x = ...

[4]

6

Many organic compounds contain carbon, hydrogen and oxygen only.

(a) An organic compound **V** has the following composition by mass.

C, 48.65%; H, 8.11%; O, 43.24%

Calculate the empirical formula of compound **V**.

empirical formula = ... [3]

7

Barium carbonate decomposes when heated.

$$BaCO_3(s) \rightarrow BaO(s) + CO_2(g)$$

(a) A student heated a 10.0 g sample of barium carbonate until it was fully decomposed.

(i) Calculate the number of moles of barium carbonate the student used.

moles of barium carbonate = ... mol [2]

(ii) Calculate the volume of carbon dioxide gas produced at room temperature and pressure. Give your answer in dm^3.

volume of carbon dioxide = ... dm^3 [1]

(b) The student added 2.00 g of the barium oxide produced to water.

$$BaO + H_2O \rightarrow Ba(OH)_2$$

Calculate the mass of barium hydroxide that can be made from 2.00 g of barium oxide. The M_r of $Ba(OH)_2$ is 171.

mass of barium hydroxide = ... g [1]

(ii) Calculate the concentration of the hydrochloric acid used.

concentration of hydrochloric acid = ... mol/dm^3 [2]

[Total: 7]

8

Hydrolysis of a polymer gave a compound with the following composition by mass: C, 34.61%; H, 3.85%; O, 61.54%.

(i) Calculate the empirical formula of the compound.

empirical formula = ... [3]