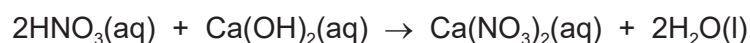


Paper 4

Questions are applicable for extended candidates only

1 This question is about acids, bases and alkalis.

(g) Dilute nitric acid, $\text{HNO}_3(\text{aq})$, reacts with aqueous calcium hydroxide, $\text{Ca}(\text{OH})_2(\text{aq})$, as shown.



20.0 cm³ of 0.0150 mol/dm³ $\text{Ca}(\text{OH})_2(\text{aq})$ reacts with 25.0 cm³ of $\text{HNO}_3(\text{aq})$.

Calculate the concentration of $\text{HNO}_3(\text{aq})$ in g/dm³.

Use the following steps.

- Calculate the number of moles of $\text{Ca}(\text{OH})_2(\text{aq})$ used.

..... mol

- Determine the number of moles of $\text{HNO}_3(\text{aq})$ which react with the $\text{Ca}(\text{OH})_2(\text{aq})$.

..... mol

- Calculate the concentration of $\text{HNO}_3(\text{aq})$ in mol/dm³.

..... mol/dm³

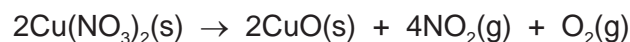
- Calculate the concentration of $\text{HNO}_3(\text{aq})$ in g/dm³.

..... g/dm³

[5]

2 Copper is element 29 in the Periodic Table.

(e) Copper(II) oxide is formed when copper(II) nitrate, $\text{Cu}(\text{NO}_3)_2$, is heated.



(i) State the class of oxide to which copper(II) oxide belongs.

..... [1]

(ii) State the meaning of the Roman numeral (II) in the name copper(II) oxide.

..... [1]

(iii) 0.0200 moles of $\text{Cu}(\text{NO}_3)_2$ is heated.

Calculate the mass of 0.0200 moles of $\text{Cu}(\text{NO}_3)_2$.

mass = g [2]

(iv) Calculate the **total** volume of gas, in dm^3 at r.t.p., produced when 0.0200 moles of $\text{Cu}(\text{NO}_3)_2$ is heated.

volume = dm^3 [2]

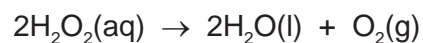
(v) Powdered aluminium reduces copper(II) oxide.

Write the symbol equation for this reaction.

..... [2]

- 3** Oxygen is produced by the decomposition of aqueous hydrogen peroxide. Manganese(IV) oxide, MnO_2 , is a catalyst for this reaction.

(d) The equation for the decomposition of aqueous hydrogen peroxide, $\text{H}_2\text{O}_2(\text{aq})$, is shown.



50.0 cm³ of a 0.200 mol/dm³ solution of $\text{H}_2\text{O}_2(\text{aq})$ is used.

Calculate the mass of O_2 that forms.

Use the following steps.

- Calculate the number of moles of H_2O_2 used.

..... mol

- Determine the number of moles of O_2 produced.

..... mol

- Calculate the mass of O_2 produced.

..... g
[3]

4 This question is about sodium and compounds of sodium.

(c) A student determines the concentration of a solution of dilute sulfuric acid, H_2SO_4 , by titration with aqueous sodium hydroxide, NaOH .

step 1 25.0 cm^3 of 0.200 mol/dm^3 NaOH is transferred into a conical flask.

step 2 Three drops of methyl orange indicator are added to the conical flask.

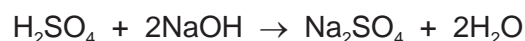
step 3 A burette is filled with H_2SO_4 .

step 4 The acid in the burette is added to the conical flask until the indicator changes colour. The volume of acid is recorded. This process is known as titration.

step 5 The titration is repeated several times until a suitable number of results is obtained.

(iv) 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.



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 .

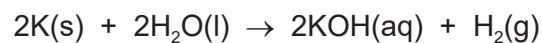
..... mol

- Calculate the concentration of H_2SO_4 .

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

5 Potassium is a Group I element.

- (c) When potassium is added to water, it reacts vigorously and a coloured flame is seen. The equation for the reaction is shown.



- (iv) Calculate the volume, in cm^3 , of hydrogen gas formed when 2.34 g of potassium is added to excess water at room temperature and pressure.

Use the following steps.

- Calculate the number of moles of potassium added.

= mol

- Determine the number of moles of hydrogen gas formed.

= mol

- Calculate the volume of hydrogen gas formed.

volume = cm^3
[3]

- 6 (e)** Calcium nitrate crystals are hydrated and have the formula $\text{Ca}(\text{NO}_3)_2 \cdot x\text{H}_2\text{O}$ where x is a whole number of molecules of water.

The student heats the crystals to remove the molecules of water.



- (ii)** The student heats a sample of $\text{Ca}(\text{NO}_3)_2 \cdot x\text{H}_2\text{O}$ and forms 2.46 g of $\text{Ca}(\text{NO}_3)_2$ and 0.0600 moles of H_2O .

Determine the value of x . Use the following steps.

- Calculate the M_r of $\text{Ca}(\text{NO}_3)_2$.

$$M_r = \dots\dots\dots$$

- Determine the number of moles of $\text{Ca}(\text{NO}_3)_2$ formed.

$$\text{moles of } \text{Ca}(\text{NO}_3)_2 \text{ formed} = \dots\dots\dots$$

- Determine the value of x in $\text{Ca}(\text{NO}_3)_2 \cdot x\text{H}_2\text{O}$.

$$x = \dots\dots\dots$$

[3]