

Paper 3

Questions are applicable for both core and extended candidates

1 A list of substances is shown.

brass
calcium oxide
carbon monoxide
diamond
glucose
hydrogen
litmus
magnesium bromide
methyl orange
sodium chloride
stainless steel
thymolphthalein
water
zinc oxide

Answer the following questions about these substances.
Each substance may be used once, more than once or not at all.

State which substance:

(e) is a salt that contains a positive ion with a charge of 1+

..... [1]

2 This question is about metals and compounds of metals.

(b) Choose the metal chloride that is insoluble in water.

Tick (✓) **one** box.

magnesium chloride	<input type="checkbox"/>
potassium chloride	<input type="checkbox"/>
silver chloride	<input type="checkbox"/>
sodium chloride	<input type="checkbox"/>

[1]

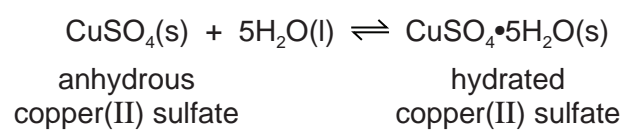
3 This question is about iron.

(c) Rust is hydrated iron(III) oxide.

(i) Define the term hydrated.

.....
..... [1]

4 (d) Copper(II) sulfate can be used to test for the presence of water.



(i) State the meaning of the term hydrated.

..... [1]

(ii) Describe how hydrated copper(II) sulfate is changed to anhydrous copper(II) sulfate.

..... [1]

5 (c) Zinc chloride is soluble in water.

Choose one **other** compound that is soluble in water.

Tick (✓) **one** box.

calcium carbonate	<input type="checkbox"/>
lead(II) chloride	<input type="checkbox"/>
silver chloride	<input type="checkbox"/>
sodium nitrate	<input type="checkbox"/>

[1]

6 A list of substances is shown.

ammonium nitrate
carbon monoxide
copper(II) chloride
ethane
ethene
litmus
methane
methyl orange
sodium chloride
sodium sulfate
sulfur dioxide
thymolphthalein

Answer the following questions using only the substances from the list.
Each substance may be used once, more than once or not at all.

Give the name of the substance that:

(c) is a salt which has a negative ion with a charge of 2-

..... [1]

7 (b) Which one of these salts is soluble in water?

Tick **one** box.

barium sulfate

calcium carbonate

ammonium sulfate

iron(II) hydroxide

[1]

Paper 4

Questions are applicable for both core and extended candidates unless indicated in the question

8 The Haber process is used to manufacture ammonia.

(c) Ammonia reacts with an acid to form ammonium sulfate, $(\text{NH}_4)_2\text{SO}_4$.

(i) State the formula of the acid used.

..... [1]

(ii) State **one** use of ammonium sulfate.

..... [1]

(iii) Calculate the percentage composition by mass of nitrogen in $(\text{NH}_4)_2\text{SO}_4$.

percentage of nitrogen = % [2]

9 Copper is element 29 in the Periodic Table.

(d) Hydrated copper(II) sulfate is a coloured compound. It exists as hydrated crystals which contain water molecules.

(i) State the term given to water molecules present in hydrated crystals.

..... [1]

(ii) State the colour of hydrated copper(II) sulfate crystals.

..... [1]

(iii) Write the formula of hydrated copper(II) sulfate.

..... [2]

10 (g) Propanoic acid reacts with aqueous sodium carbonate to form a salt.

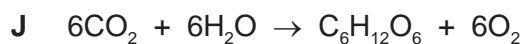
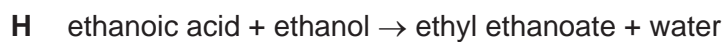
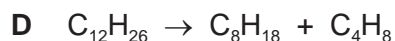
(i) Suggest the name of the salt formed.

..... [1]

(ii) Suggest the formula of the anion in this salt.

..... [1]

11 Some symbol equations and word equations, **A** to **J**, are shown.



Use the equations to answer the questions that follow.

Each equation may be used once, more than once, or not at all.

Give the letter, **A** to **J**, for the equation that represents: **(extended only)**

(b) a precipitation reaction [1]

12 Magnesium, calcium and strontium are Group II elements.

(e) Aqueous silver nitrate is added to aqueous magnesium chloride.

A white precipitate forms.

Write an ionic equation for this reaction. Include state symbols. **(extended only)**

..... [2]

13 Sulfuric acid has many uses.

(b) Dilute sulfuric acid is used to make salts known as sulfates.

A method consisting of three steps is used to make zinc sulfate from zinc carbonate.

step 1 Add an excess of zinc carbonate to 20 cm³ of 0.4 mol / dm³ dilute sulfuric acid until the reaction is complete.

step 2 Filter the mixture.

step 3 Heat the filtrate until a saturated solution forms and then allow it to crystallise.

(i) Suggest **two** observations which show that the reaction is complete in **step 1**.

1

2

[2]

(ii) State why it is important to add an excess of zinc carbonate in **step 1**.

.....

..... [1]

(iii) Define the term saturated solution.

.....

.....

..... [2]

(iv) Name **another** zinc compound which can be used to make zinc sulfate from dilute sulfuric acid using this method.

..... [1]

(v) Suggest why this method would **not** work to make barium sulfate from barium carbonate and dilute sulfuric acid. **(extended only)**

..... [1]

14 Potassium is a Group I element.

(d) Aqueous potassium hydroxide reacts with a dilute acid to produce aqueous potassium chloride, $KCl(aq)$, which is a salt.

(i) Name the dilute acid used.

..... [1]

(ii) State the type of reaction taking place.

..... [1]

(iii) Name the experimental technique used when salts are made by reacting a dilute acid with an aqueous alkali.

..... [1]

(e) When aqueous silver nitrate, $AgNO_3(aq)$, is added to aqueous potassium chloride, a precipitate is formed.

(i) State the colour of the precipitate formed. **(extended only)**

..... [1]

(ii) Name the precipitate formed. **(extended only)**

..... [1]

(iii) Write the ionic equation for the reaction. Include state symbols. **(extended only)**

..... [3]

15 A student prepares calcium nitrate, $\text{Ca}(\text{NO}_3)_2$, by adding calcium carbonate to dilute nitric acid.

(a) Write the chemical equation for this reaction.

..... [2]

(b) Describe **two** observations during this reaction.

1

2 [2]

(c) The student continues to add calcium carbonate until it is in excess. The student then removes the excess calcium carbonate by filtration and collects the aqueous calcium nitrate.

State the general term given to a solution collected from filtration.

..... [1]

(d) The student gently heats the aqueous calcium nitrate until the solution is saturated.

(i) Suggest what is meant by the term *saturated solution*.

.....
..... [2]

(ii) Describe how crystals are produced from a hot saturated solution.

..... [1]

- (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.



- (i) State the term used to describe the calcium nitrate after the molecules of water have been removed.

..... [1]

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

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

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

$x = \dots\dots\dots$
[3]

- (f) Nitrates decompose on heating.

Write the chemical equation for the reaction when solid sodium nitrate is heated.

..... [2]

[Total: 14]