KS3 Science

Chemical Reactions

Question Paper

Time available: 41 minutes
Marks available: 50 marks

1. A long time ago sulphuric acid was made by heating a substance called **blue vitriol**.
The equations below show how sulphuric acid is produced by this method.

blue vitriol ⟶ copper oxide + sulphur trioxide + water

sulphur trioxide + water ⟶ sulphuric acid

(a) Name **three** elements contained in blue vitriol.

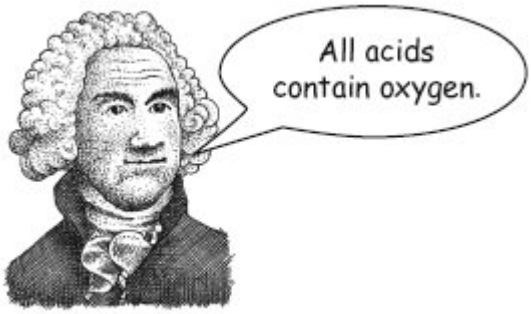
1. .....

2. .....

3. .....

3 marks

(b) (i) Anton Lavoisier was a scientist. He made acids by dissolving oxides like sulphur oxide and nitric oxide in water. They formed two acids; sulphuric acid and nitric acid. From this, he concluded:



Anton Lavoisier

The formulas for these two acids are H_2SO_4 and HNO_3.
How do these formulas support Lavoisier's conclusion about acids?

.....

.....

1 mark

(ii) Some time after Lavoisier's death, hydrochloric acid was identified.
The formula for hydrochloric acid is HCI.

Explain why scientists no longer supported Lavoisier's conclusion about acids.

.....

.....

1 mark

(c) Scientists now agree that **all** acids contain hydrogen.
Look at the two word equations below.

zinc + sulphuric acid ⟶ zinc sulphate + hydrogen

magnesium + nitric acid ⟶ magnesium nitrate + hydrogen

(i) Explain how these equations support the suggestion that acids contain hydrogen.

.....

.....

1 mark

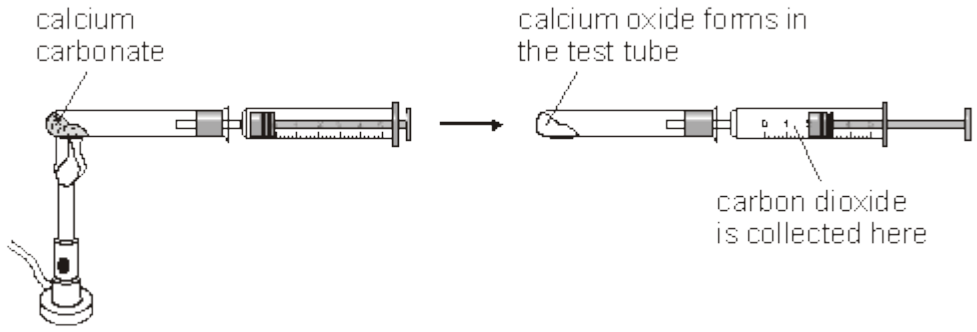
(ii) Complete the equation below for the reaction between iron and hydrochloric acid.

iron + hydrochloric acid ⟶ ..... + ...

1 mark
maximum 7 marks

2. A science teacher showed her class three experiments, A, B and C.
The experiments and the word equations for the reactions that took place are shown below.
All the experiments were done in a fume cupboard.

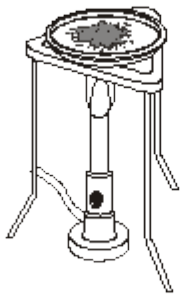
experiment A



word equation calcium carbonate ⟶ calcium oxide + carbon dioxide

experiment B

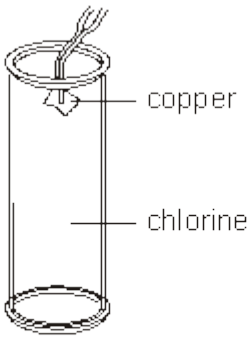
iron filings and sulphur are heated together



word equation iron + sulphur ⟶ iron sulphide

experiment C

hot copper is added to chlorine



piece of copper covered with brownish solid

word equation copper + chlorine ⟶ _____

(a) From the substances in experiments A, B and C, above, give the name of:

(i) **one** metallic element;

.....

1 mark

(ii) **one** non-metallic element;

.....

1 mark

(iii) **two** compounds.

..... and .....

1 mark

(b) In experiment B, the iron filings weighed 2.0 g at the beginning of the experiment and the iron sulphide produced weighed 2.8 g.

Explain this increase in mass.

.....

.....

1 mark

(c) Complete the word equation for the chemical reaction in experiment C.

copper + chlorine ? .....

1 mark

maximum 5 marks

3. (a) Magnesium chloride is formed when magnesium reacts with an acid.

(i) Complete the word equation for the reaction between magnesium and this acid.

magnesium + ...→ magnesium chloride + ...

2 marks

(ii) Suggest why magnesium chloride can be made by mixing magnesium with this acid but copper chloride **cannot** be made by mixing copper with this acid.

.....

.....

1 mark

(b) Copper sulphate is made by adding copper oxide to a different acid.
Give the name of the acid which is used.

.....

1 mark

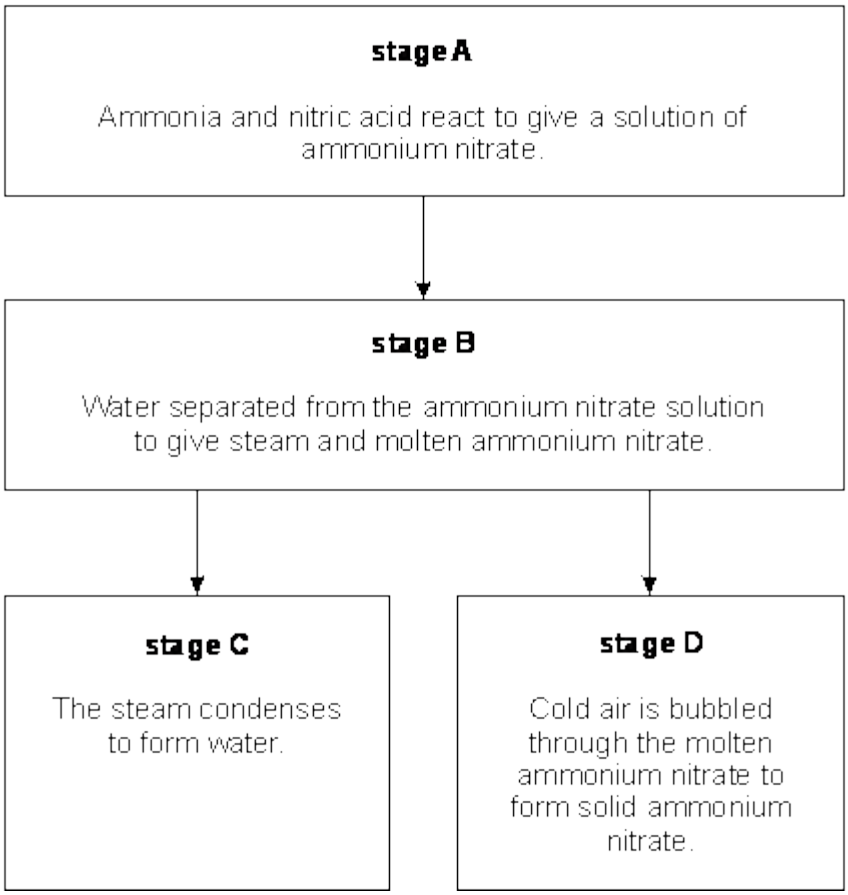
(c) In the table below, write the name of the compound represented by each formula.

formula	**name**
$CuSO_4$	
$MgCl_2$	

2 marks

Maximum 6 marks

4. Ammonium nitrate is used as a garden fertiliser. It is manufactured by the reaction between ammonia gas and nitric acid. The diagram below represents stages in the process for making ammonium nitrate.



(a) Ammonia is an alkaline gas. In stage A, an alkali reacts with an acid. What effect does an alkali have on an acid?

.....

1 mark

(b) The formula for ammonium nitrate is NH_4NO_3.

(i) How many different elements are there in ammonium nitrate?

.....

1 mark

(ii) How many atoms are represented in the formula for ammonium nitrate?

.....

1 mark

(c) Potassium nitrate is also a fertiliser. It can be made from the reaction between potassium hydroxide and an acid.
Complete the word equation for the reaction, naming the acid used.

potassium hydroxide + ... → potassium nitrate + ...

2 marks
Maximum 5 marks

5. The names and formulae of five compounds are listed in the table below.

name of compound	**formula of compound**
ammonia	NH_3
ammonium chloride	NH_4Cl
ammonium sulphate	$(NH_4)_2SO_4$
sodium hydroxide	NaOH
sodium sulphate	Na_2SO_4

(a) Ammonia and sulphuric acid react to give ammonium sulphate, $(NH_4)_2SO_4$.

(i) Balance the equation for this reaction.

$NH_3 + H_2SO_4 \rightarrow (NH_4)_2SO_4$

1 mark

(ii) Complete and balance the symbol equation for the reaction between sodium hydroxide and sulphuric acid.

$NaOH + H_2SO_4 \rightarrow$ ..... + ...

3 marks

(b) The formula for ammonia is NH_3.
One atom of nitrogen weighs fourteen times as much as one atom of hydrogen.
What is the total mass of hydrogen in 17 g of ammonia?

..... g

1 mark
Maximum 5 marks

6. Galena is an ore of lead. Deposits of galena often contain all of the minerals listed in the table below.

mineral	formula
galena	PbS
calcite	$CaCO_3$
fluorite	CaF_2
zinc blende	ZnS

(a) Give the chemical names of galena and fluorite.

G a l e n a … … … . … … … … … … … … … … … … … … … … … … … ..

f l u o r i t e … … … . … … … … … … … … … … … … … … … … … … …

2 marks

(b) Lead is obtained from galena in two stages.

(i) First the galena is roasted in air. Lead oxide (PbO) and sulphur dioxide are formed as shown in the equation below.
Write in the numbers to balance the equation.

… … … … P b S + … … $_2$ → ……PbO + …… SO_2

1 mark

(ii) The lead oxide is then heated with carbon in a furnace.
Write a balanced symbol equation for the reaction.

… …

1 mark

(iii) What is the function of the carbon in this reaction?

… …

… …

1 mark

(c) Lead can also be obtained from lead oxide by heating it in hydrogen.

The balanced symbol equation for this reaction is:

$$PbO + H_2 \rightarrow Pb + H_2O$$

(i) 112 g of lead oxide, treated in this way, reacted with 1 g of hydrogen to give 104 g of lead. What mass of water was formed in the reaction?

... ...

... ...

1 mark

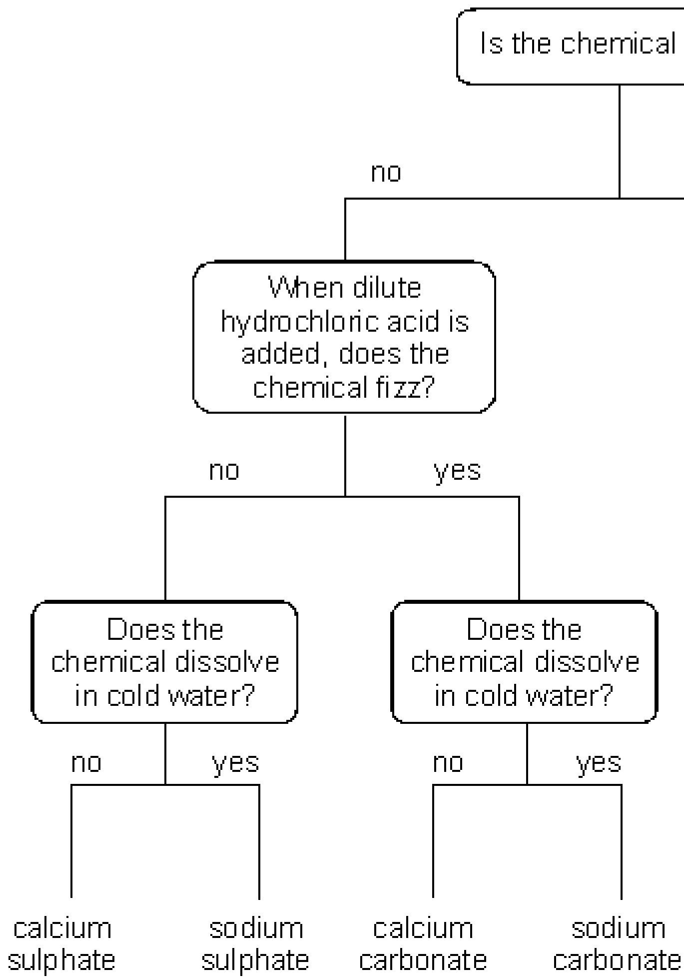
(ii) On heating strongly in air, lead gives lead oxide.
What is the maximum amount of lead oxide you could get from 26 g of lead?

... ...

... ...

1 mark
Maximum 7 marks

7. The diagram shows a key which can be used to identify different chemicals.



(a) Use the key to identify chemicals A, B and C.

(i) Chemical A is a white powder. It fizzes when dilute hydrochloric acid is added. It dissolves in cold water.

Chemical A is ....

1 mark

(ii) Chemical B is a green powder. It does **not** fizz when dilute hydrochloric acid is added

Chemical B is .....

1 mark

(iii) Chemical C is a white powder. It does **not** fizz when dilute hydrochloric acid is added. It is insoluble in cold water.

Chemical C is .....

1 mark

(b) Nickel carbonate is green. It is the nickel that makes nickel carbonate green, **not** the carbonate. Explain, using information from the key, how you know that this is true.

.....

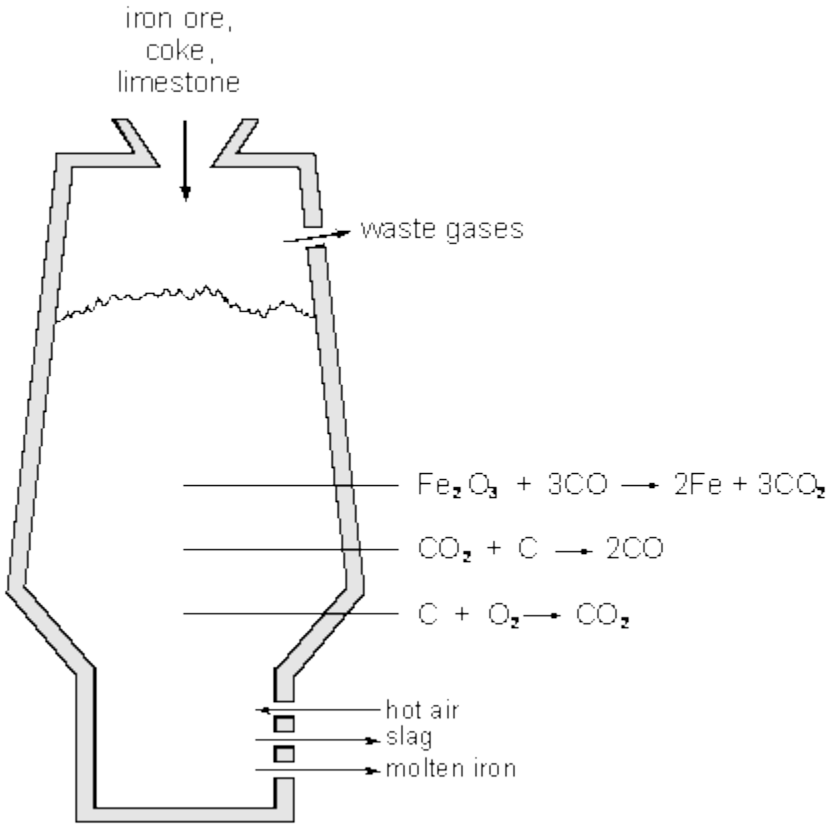
.....

.....

.....

2 marks
Maximum 5 marks

8. The diagram shows a blast furnace. The balanced equations for three of the reactions which occur in the blast furnace are shown. The lines indicate the approximate heights at which the reactions occur.



(a) In the reaction $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$:

(i) which substance is being reduced?

.....

1 mark

(ii) which substance is the reducing agent?

.....

1 mark

(b) Explain why the reaction $CO_2 + C \rightarrow 2CO$ can be described as both a reduction and an oxidation.

.....

.....

.....

.....

2 marks
Maximum 4 marks

9. Ammonium salts, such as ammonium sulfate, are used to help farmers grow crops.

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(a) Use the correct word from the box to complete the sentence.

fertilisers	**insecticides**	**pesticides**

Ammonium salts contain nitrogen and are used by farmers as .....to replace the nitrogen lost from the soil.

(1)

(b) Ammonia is made by reacting nitrogen with hydrogen.

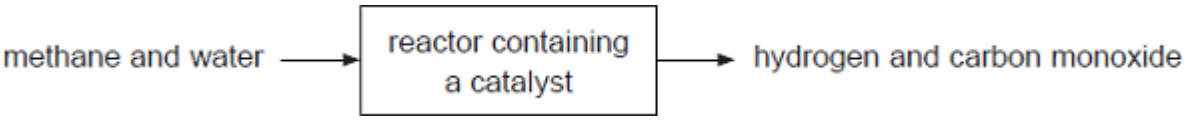
Which raw material provides nitrogen?

Draw a ring around your answer.

air **crude oil** **water**

(1)

(c) Methane and water react together to form hydrogen.



How does the catalyst help this reaction?

.....

(1)

(d) The reaction between nitrogen and hydrogen to make ammonia can be represented by this equation.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

What is the meaning of this symbol $\rightleftharpoons$?

Draw a ring around your answer.

endothermic reaction **precipitation reaction** **reversible reaction**

(1)

(e) A solution of ammonia in water is alkaline.

(i) Which **one** of these values could be the pH of a solution of ammonia?

Draw a ring around your answer.

4 **7** **10**

(1)

(ii) Ammonium sulfate can be made by reacting ammonia solution with sulfuric acid.

Use the correct answer from the box to complete the sentence.

ammonium sulfate	**hydrogen**	**sulfuric**	**water**

During the reaction the hydrogen ions (H^+) from the acid react with hydroxide ions (OH^-) from the alkali to make ..... .

(1)

(Total 6 marks)