Accredited

OCR

Oxford Cambridge and RSA

GCSE (9–1) Chemistry A (Gateway Science)

F

J248/02 Paper 2 (Foundation Tier)

Sample Question Paper

Date – Morning/Afternoon

Time allowed: 1 hour 45 minutes

You must have:
- the Data Sheet

You may use:
- a scientific or graphical calculator
- a ruler

First name	
Last name	
Centre number	
Candidate number	

INSTRUCTIONS
- Use black ink. You may use an HB pencil for graphs and diagrams.
- Complete the boxes above with your name, centre number and candidate number.
- Answer **all** the questions.
- Write your answer to each question in the space provided.
- Additional paper may be used if required but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the bar codes.

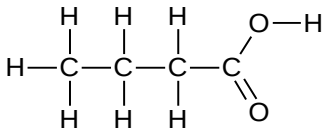
INFORMATION
- The total mark for this paper is **90**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended response will be assessed in questions marked with an asterisk (*).
- This document consists of **28** pages.

SECTION A

Answer **all** the questions.

You should spend a maximum of 30 minutes on this section.

1 Look at the displayed formula of an organic compound.



What is the name of this compound?

A butanoic acid

B butanol

C propanoic acid

D propanol

Your answer ☐

[1]

2 DNA is a condensation polymer made from monomers called nucleotides.

How many different nucleotides are used to make DNA molecules?

A 2

B 3

C 4

D 5

Your answer ☐

[1]

3 Ammonium phosphate is used as a fertiliser.

The formula for ammonium phosphate is:

$$(NH_4)_3PO_4$$

Which elements in ammonium phosphate are **essential elements** for plant growth?

A nitrogen and hydrogen

B nitrogen and phosphorus

C hydrogen and oxygen

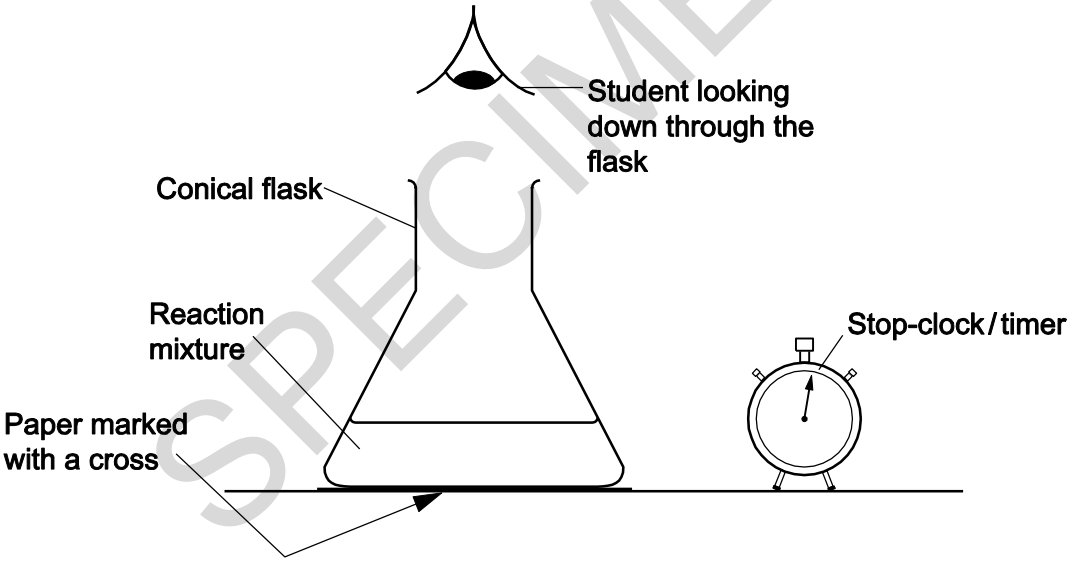
D phosphorus and oxygen

Your answer ☐

[1]

4 A student investigates the reaction between sodium thiosulfate and hydrochloric acid.

Look at the diagram below. It shows the apparatus he uses.



After a time he cannot see the cross because the liquid in the beaker goes cloudy. The student measures the time taken until the cross cannot be seen.

He does the experiment four times, each with a different concentration of sodium thiosulfate solution.

Which of the following must **not** be changed to do a fair test?

A concentration of sodium thiosulfate used

B stop-clock or timer

C total volume of the reaction mixture

D volume of sodium thiosulfate added

Your answer ☐

[1]

5 A student investigates the reaction between sodium carbonate and dilute nitric acid.

She measures the reaction time with four different concentrations of acid.

She does all the experiments using the

- same temperature
- same mass of sodium carbonate
- same volume of acid.

Look at her results.

Concentration	Reaction time in seconds
A	41
B	74
C	135
D	67

Which concentration of nitric acid gave the **fastest** reaction?

Your answer ☐

[1]

6 In some remote islands, drinking water is made from sea water.

What is the name of the process for making drinking water from sea water?

A chlorination

B distillation

C filtration

D sedimentation

Your answer ☐

[1]

7 A student adds sodium hydroxide solution to a small sample of copper(II) chloride solution.

A precipitate is made.

What is the colour of the precipitate?

A blue

B green

C orange

D white

Your answer ☐

[1]

8 A student bubbles ethene gas into bromine water.

What is observed?

A colour change from blue to colourless

B colour change from colourless to orange

C orange precipitate is made

D colour change from orange to colourless

Your answer ☐

[1]

9 A student reacts some metals with different salt solutions and records her results.

She places a tick (✓) in her results table if she sees a chemical change and a cross (x) if there is no reaction.

Some of the boxes are blanked out.

	Magnesium chloride	**Silver nitrate**	**Copper(II) sulfate**	**Iron(II) sulfate**
Magnesium		✓	✓	✓
Silver	x		x	x
Copper	x	✓		x
Iron	x	✓	✓	

What is the order of reactivity (**most** reactive to **least** reactive) of these four metals?

A magnesium, copper, iron, silver

B magnesium, iron, copper, silver

C silver, copper, iron, magnesium

D iron, silver, magnesium, copper

Your answer ☐

[1]

10 Which statement is correct for a Group 1 element?

A It dissolves in water to form a bleach.

B It is a non-metal.

C It is an inert gas.

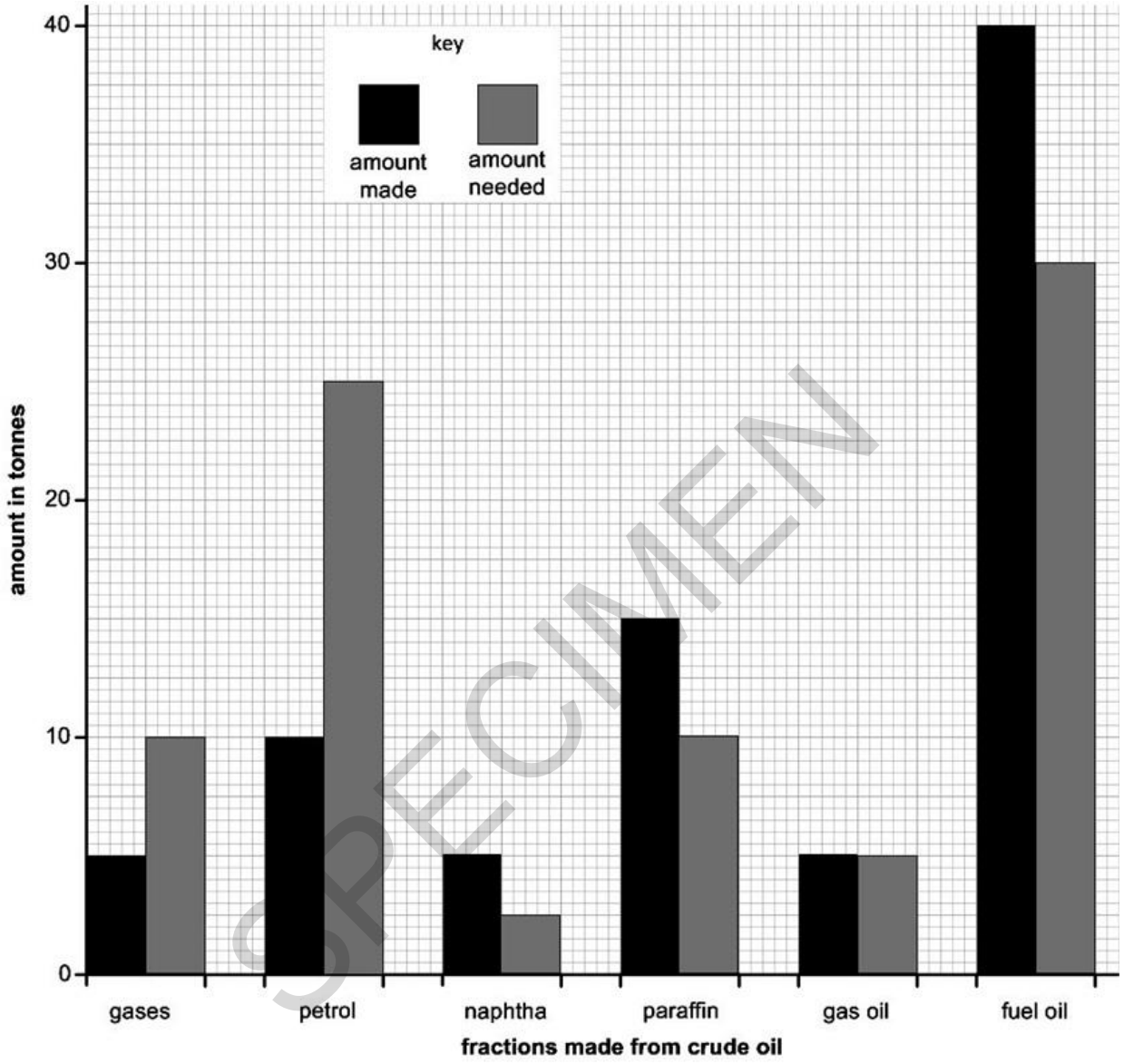
D It reacts with water to form hydrogen.

Your answer ☐

[1]

11 The bar chart shows the amount of some of the fractions made from 100 tonnes of crude oil by fractional distillation.

It also shows the amount of each fraction needed for everyday uses.



Cracking converts large molecules into smaller more useful molecules to make the supply match the demand.

Which fractions are most likely to be cracked to make the supply match the demand?

A gas oil and fuel oil

B gas oil and petrol

C naphtha, paraffin and fuel oil

D petrol and gases

Your answer ☐

[1]

12 Urea is a fertiliser.

The formula for urea is

$$(NH_2)_2CO$$

A student makes 1 mole of urea from 2 moles of ammonia.

What is the mass of urea that the student makes?

A 43.0 g

B 44.0 g

C 58.0 g

D 60.0 g

Your answer ☐

[1]

13 A student is testing sodium carbonate solution.

She adds barium chloride solution followed by excess dilute hydrochloric acid.

Which of these observations would **not** be seen?

A colourless solution at the end

B gas bubbles when the dilute acid is added

C white precipitate formed when the dilute acid is added

D white precipitate formed when the barium chloride solution is added

Your answer ☐

[1]

14 The **molecular formula** of cyclohexane is C_6H_{12}.

What is the **empirical formula** of cyclohexane?

A CH

B CH_2

C C_6H_{12}

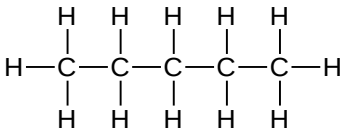
D $C_{12}H_{24}$

Your answer ☐

[1]

15 Which displayed formula includes the functional group of an alcohol?

A



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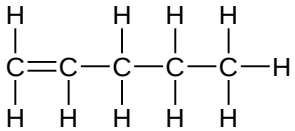

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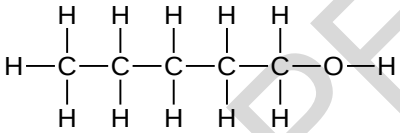

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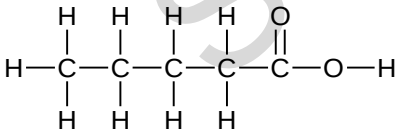

Your answer ☐

[1]

SECTION B

Answer **all** the questions.

16 Chemical tests are used to identify gases, anions and cations.

(a) Draw straight lines to match the **gas** to the correct **chemical test** used in analysis.

gas	chemical test
	relights a glowing splint
carbon dioxide	turns moist red litmus blue
chlorine	turns moist blue litmus red and then white
ammonia	turns acidified potassium manganate(VII) solution colourless
hydrogen	turns lime water milky
oxygen	burns with a squeaky pop
	turns moist pH paper green

[5]

(b) Fahmida uses the flame test to identify the cations in a solid.

Describe how Fahmida should do a flame test.

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……

…… **[3]**

(c) Fahmida does three chemical tests on an unknown solution.

Look at her results.

Chemical test	Result
pH probe	pH value is 3
dilute hydrochloric acid followed by barium chloride solution	white precipitate
dilute nitric acid followed by silver nitrate solution	white precipitate

Which ions are present in the solution?

Choose from:

calcium **hydrogen** **iron(II)** **chloride** **sulfate**

Explain your answer.

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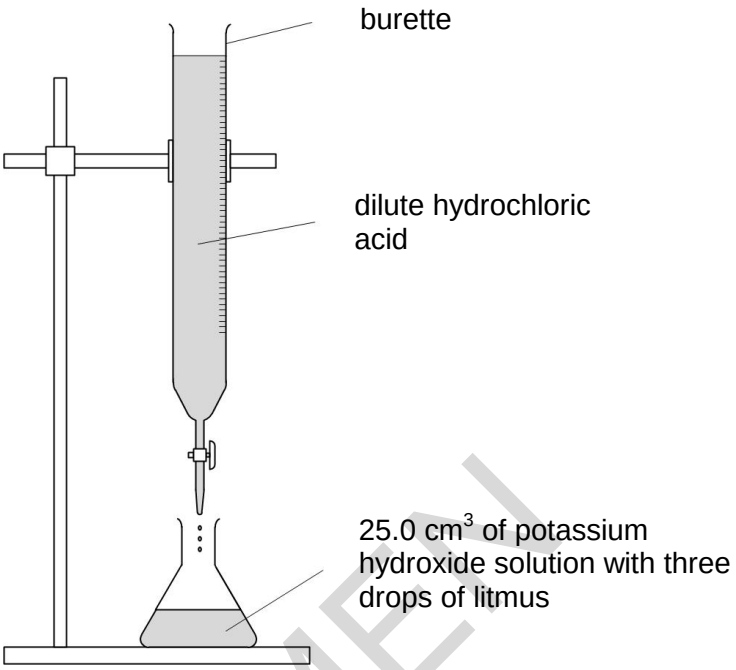
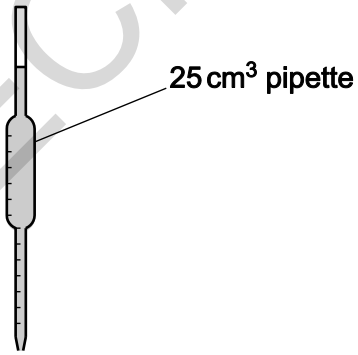
…… **[4]**

17 Sarah does three titrations with dilute hydrochloric acid and potassium hydroxide solution.

Look at the apparatus she uses.



(a) Sarah uses a pipette to measure out the 25.0 cm^3 of potassium hydroxide solution.



Describe and explain one safety precaution Sarah uses with the pipette.

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…… **[2]**

(b) In her first titration Sarah measures the initial volume of hydrochloric acid in the burette.

She slowly adds the acid until the potassium hydroxide is just neutralised.

She then measures the volume of the hydrochloric acid again.

Describe how Sarah can tell when the potassium hydroxide solution is just neutralised.

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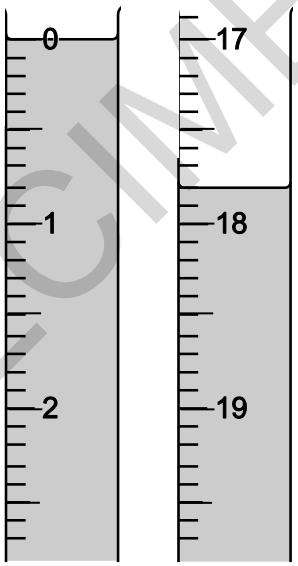
…… **[2]**

(c) Look at the diagrams. They show parts of the burette during the first titration.

first titration



Here is Sarah's results table.

Titration number	1	2	3
final reading in cm^3		37.5	32.1
initial reading in cm^3		20.4	15.0
titre (volume of acid added) in cm^3		17.1	17.1

(i) **Complete** the table by reading the burette readings from the diagrams. **[2]**

(ii) Sarah thinks the mean titre is 17.1 cm^3.

Is she correct?

Explain your answer.

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……

…….. **[1]**

(d) Sarah does another titration to make a fertiliser called potassium nitrate, KNO_3.

Look at the equation for the reaction she uses.

$$KOH + HNO_3 \rightarrow KNO_3 + H_2O$$

The relative formula masses, M_r, of each compound are shown in the table.

compound	formula	relative formula mass
potassium hydroxide	KOH	56.1
nitric acid	HNO_3	63.0
potassium nitrate	KNO_3	101.1
water	H_2O	18.0

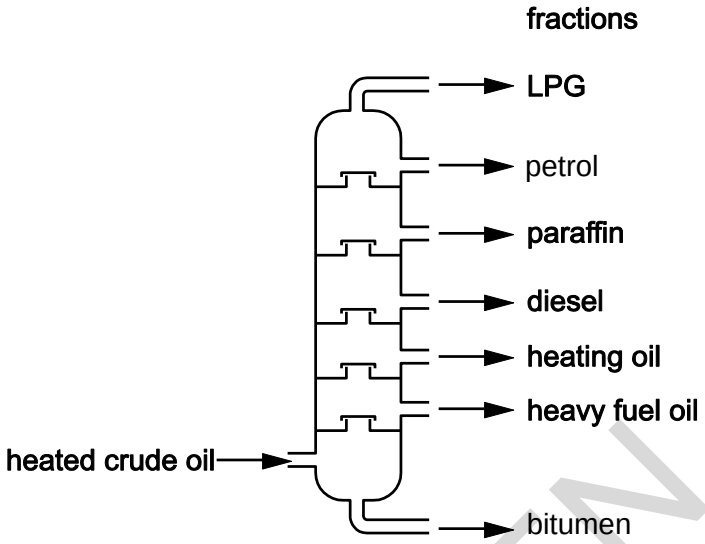
What is the atom economy for the reaction to make potassium nitrate?

Assume that water is a waste product.

Atom economy = ……% **[2]**

18 Crude oil is used as a source of fuels. It is separated into many fractions by fractional distillation.

The diagram below shows a fractionating column.



(a) Crude oil contains a mixture of hydrocarbons that boil at different temperatures.

Describe **how** crude oil can be separated using a fractionating column.

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…… **[4]**

(b) The alkane, $C_{15}H_{32}$, is cracked to make an alkene, C_6H_{12} and an alkane, C_3H_8.

Construct the **balanced symbol** equation for this reaction.

…… **[1]**

(c) The polymer is used to make clothes such as socks and jumpers.

Suggest **one** property of the polymer that makes it suitable for these uses.

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…… **[1]**

19 The reversible reaction between carbon dioxide and hydrogen makes methane and water.

carbon dioxide + hydrogen ⇌ methane + water

(a) In a sealed container this reversible reaction forms a **dynamic equilibrium**.

What is meant by the term dynamic equilibrium?

Refer to both concentration and rate of reaction in your answer.

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……...

……...

……... **[2]**

(b) Kayvan investigates this reaction.

He predicts that 11.0 g of carbon dioxide should make 4.0 g of methane.

In an experiment, he finds that 11.0 g of carbon dioxide makes 2.2 g of methane.

Calculate the percentage yield of methane.

……...

……...

……...

Percentage yield = ……% **[2]**

(c)* Kayvan investigates the effect of changing the pressure and changing the temperature on this reaction.

carbon dioxide + hydrogen ⇌ methane + water

The table shows the percentage yield of methane in the equilibrium mixture under different conditions.

		Pressure in atmospheres			
		100	**200**	**300**	**400**
Temperature in °C	**300**	35%	52%	65%	80%
	600	30%	46%	58%	74%
	900	23%	37%	47%	62%
	1200	14%	25%	36%	48%

Describe what happens to the percentage yield as the pressure and temperature change and explain the effect of increasing the pressure on the rate of reaction.

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.... **[6]**

20 Ammonium sulfate, $(NH_4)_2SO_4$, is a fertiliser.

Ammonium sulfate can be manufactured from ammonia and sulfuric acid.

(a) Sulfuric acid is manufactured in a series of steps.

Step 1:

Sulfur is burnt in oxygen to produce sulfur dioxide.

Step 2, The Contact Process:

Sulfur dioxide is reacted with oxygen to produce sulfur trioxide. This takes place in the presence of vanadium(V) oxide at a pressure of 2 atmospheres and at about 450˚C.

Step 3:

Sulfur trioxide is reacted with water to produce sulfuric acid.

Write balanced symbol equations for each stage of this process.

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……...

…… **[4]**

(b) Ammonium sulfate is a salt.

It is manufactured using the reaction between the alkali ammonia and sulfuric acid.

$$2NH_3 + H_2SO_4 \rightarrow (NH_4)_2SO_4$$

What type of reaction is this?

…… **[1]**

(c) A sample containing 17.0 g of ammonia completely reacts with sulfuric acid.

A mass of 66.0 g of ammonium sulfate is made.

Show that the maximum mass of ammonium sulfate that can be made from 51.0 g of ammonia is 198.0 g.

[1]

(d) A student has a solution of ammonium sulfate.

Describe how he can obtain a pure dry sample of ammonium sulfate.

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…… **[1]**

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PLEASE TURN OVER FOR THE NEXT QUESTION

21 Carbon dioxide is one of several greenhouse gases.

It is made by the combustion of fossil fuels such as coal, gas and oil.

Look at the table. It shows the amount of carbon dioxide produced in a large city between the years 2010 and 2016.

Source of carbon dioxide	Carbon dioxide produced (tonnes)		Percentage increase (%)
	in 2010	in 2016	
Homes	500 000	600 000	20
Factories and industry	500 000	750 000	50
Transport	1 000 000	1 000 000	0
Electricity generation	750 000	900 000	……

(a) Look at the row for electricity generation.

Calculate the percentage increase of carbon dioxide produced.

Percentage increase = …… % **[2]**

(b) Analyse the data in the table.

What is the ratio of carbon dioxide produced from **Homes** to **Electricity generation** for 2016?

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…… **[2]**

(c) The population of the city increased between 2010 and 2016.

The carbon dioxide produced from Transport has not changed between 2010 and 2016.

Why has the carbon dioxide production from Transport remained the same?

Give **two** conclusions.

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…… **[2]**

22 Iron rusts when it gets wet.

(a) The word equation for rusting is

iron + water + oxygen → rust (hydrated iron(III) oxide)

Balance the symbol equation for the formation of rust.

……Fe(s) + $6H_2O(l)$ +…… $O_2(g)$ → $2\ Fe_2O_3.3H_2O(s)$ **[2]**

(b) **(i)** Calculate the percentage by mass of iron in rust.

Give your answer to 2 decimal places.

Relative formula mass of rust = 213.6

……% **[2]**

(ii) An iron bar is left outside in the rain to rust.

It has a mass of 1.0 kg.

A student predicts that the mass of the bar will increase by no more than 0.8 kg if it completely turns to rust.

Do a calculation to work out the mass of rust produced, if the bar completely turns to rust, to see if the student is correct.

Give your answer to the nearest gram.

Mass of rust =…… g

Is the student's prediction correct and why?

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…….. **[3]**

23 Zinc and dilute sulfuric acid react to make hydrogen.

$$Zn(s) + H_2SO_4(aq) \rightarrow ZnSO_4(aq) + H_2(g)$$

Inga measures the rate of this reaction by measuring the **loss in mass** of the reaction mixture.

She finds that the change in mass is very small and difficult to measure.

(a) Draw a labelled diagram to show a **better way** of measuring the rate of this reaction.

[3]

(b) The reaction between zinc and dilute sulfuric acid is slow.

Inga decides to try and find a catalyst for this reaction.

She tests four possible substances.

Each time she adds 0.5 g of the substance to 1.0 g of zinc and 25 cm^3 of dilute sulfuric acid.

Look at her table of results.

Substance	Colour of substance at start	Colour of substance at end	Relative rate of reaction
no substance			1
calcium sulfate powder	white	white	1
copper powder	pink	pink	10
copper(II) sulfate powder	blue	pink	30
manganese(IV) oxide powder	black	black	1

(i) It is important to do the reaction with **only** zinc and dilute sulfuric acid.

Explain why.

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…… **[1]**

(ii) It is important to do all of the reactions with the same concentration of acid.

Explain why.

……

…… **[1]**

(iii) Which of the substances could be a catalyst for the reaction between zinc and dilute sulfuric acid?

……

Explain your answer.

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…… **[2]**

(iv) There is not enough evidence to confirm which substance is a catalyst.

Suggest an extra piece of experimental evidence that could be collected to confirm which substance is a catalyst.

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…… **[1]**

(v) Inga does the experiment with copper, zinc and dilute sulfuric acid again.

This time she uses a lump of copper rather than copper powder.

Predict, with reasons, the relative rate of reaction.

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……

…… **[2]**

24 The Group 7 elements are known as the halogens.

The halogens have similar chemical properties.

Their physical properties vary with increasing atomic number.

(a) Look at the table of information about the halogens.

Halogen	Atomic symbol	Atomic number	Molecular formula	Atomic radius in pm	Reaction of halogen with sodium iodide solution
fluorine	F	9	F_2	64	Makes iodine and sodium fluoride
chlorine	C*l*	17	Cl_2	99	Makes iodine and sodium chloride
bromine	Br	35	Br_2	114	……..... ……..... …….
iodine	I	53	I_2	133	No reaction
astatine	At	85	……..	……...	No reaction

(i) Predict the molecular formula and atomic radius of astatine.

Put your answers in the table. **[2]**

(ii) Predict the reaction of bromine with sodium iodide solution.

Put your answer in the table. **[1]**

(iii) Explain your answer to **(ii)** in terms of the reactivity of the halogens.

……

…….. **[1]**

(b) All halogens react with alkali metals to make a salt.

(i) All halogens have similar chemical reactions.

Explain why in terms of electronic structure.

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……... **[1]**

(ii) Sodium reacts with bromine to make sodium bromide, NaBr.

Construct the **balanced symbol** equation for this reaction.

……... **[2]**

(iii) What is the formula of the product of the reaction between astatine and potassium?

……... **[1]**

END OF QUESTION PAPER