OCR
Oxford Cambridge and RSA

Accredited

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

F

J248/02 Paper 2 (Foundation Tier)

Sample Question Paper

Date – Morning/Afternoon

Version 2

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.

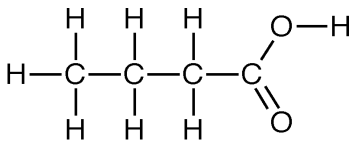
INFORMATION
- The total mark for this paper is **90**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended response will be assessed in questions marked with an asterisk (*).
- This document consists of **32** pages

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 Hydrogen and oxygen

B Nitrogen and hydrogen

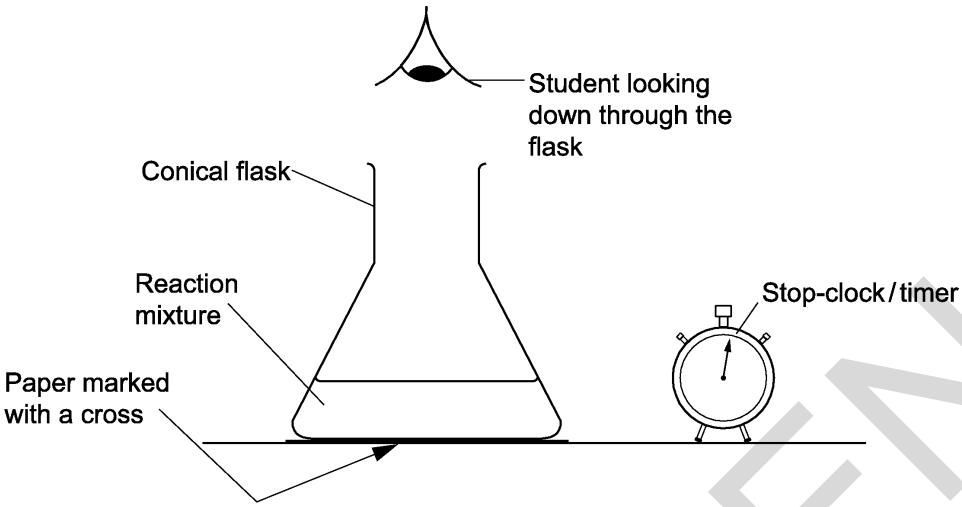
C Nitrogen and phosphorus

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 conical flask goes cloudy. The student measures the time taken until the cross **cannot** be seen.
- He does the experiment four times. For each experiment he uses 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

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 does all the experiments using the

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

She uses four different concentrations (**A**, **B**, **C** and **D**) of nitric acid.

For each concentration, she measures the time for the reaction to complete.

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

Concentration	Time for reaction to complete (in seconds)
A	41
B	74
C	135
D	67

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 Colour change from orange to colourless

D Orange precipitate is made

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 (×) if there is no reaction.

Some of the boxes are blanked out.

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

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

A Iron, silver, magnesium, copper

B Magnesium, copper, iron, silver

C Magnesium, iron, copper, silver

D Silver, copper, iron, magnesium

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 an inert gas.

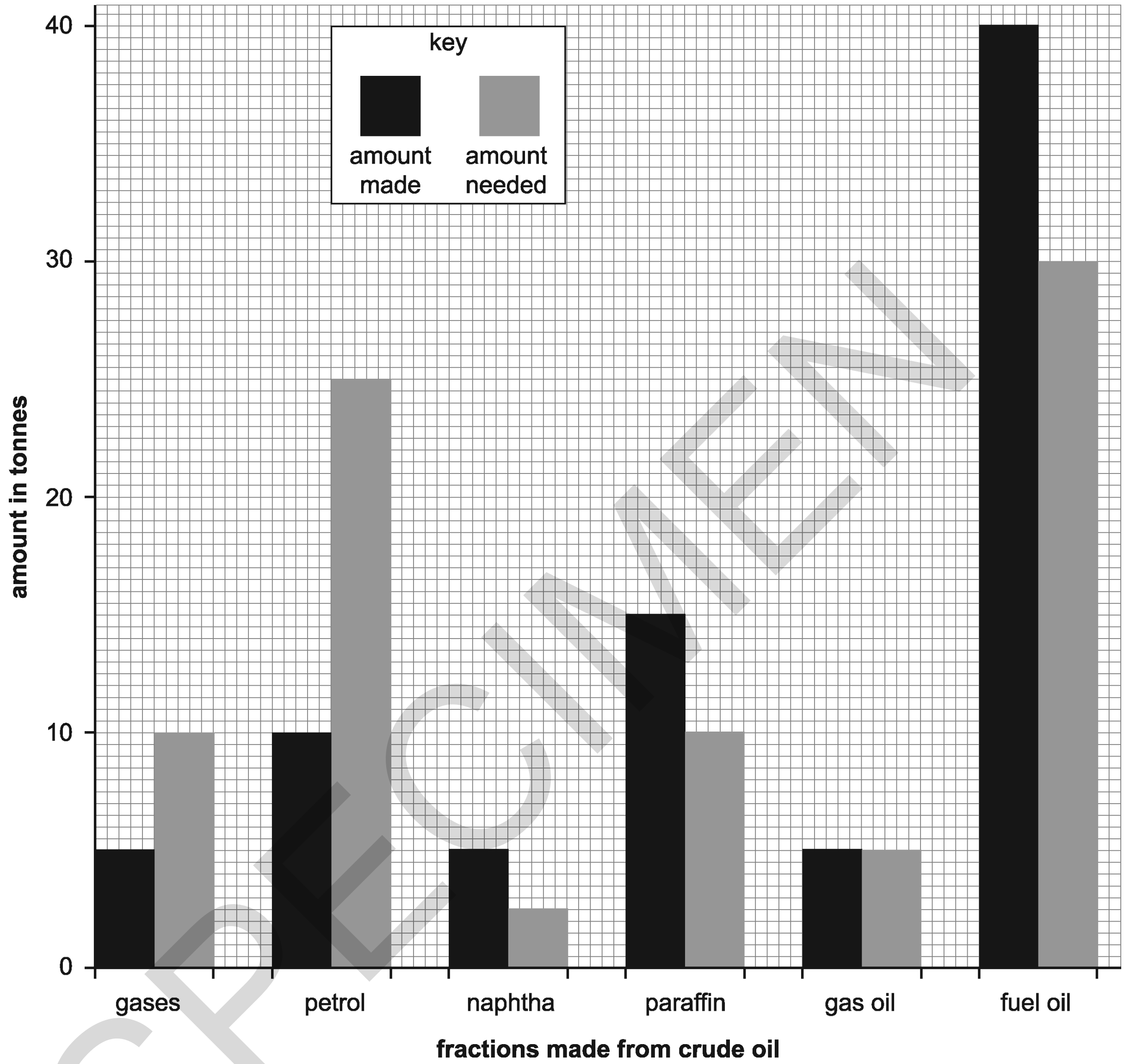
C It is a non-metal.

D It reacts with water to form hydrogen.

Your answer ☐ **[1]**

11 The bar chart shows the amount of some 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, $(NH_2)_2CO$, is a fertiliser.

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 barium chloride solution is added

D White precipitate formed when the dilute acid is added

Your answer ☐ **[1]**

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

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

A CH

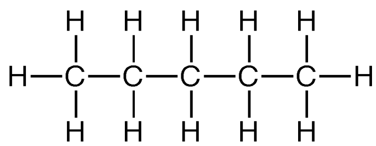
B CH_2

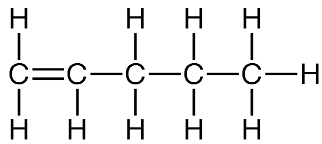
C C_6H_{12}

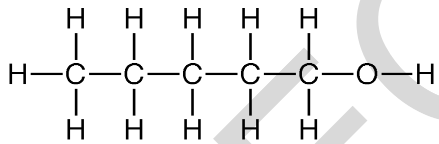
D $C_{12}H_{24}$

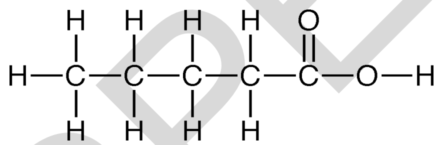
Your answer ☐ **[1]**

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

A 

B 

C 

D 

Your answer ☐ **[1]**

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TURN OVER FOR THE NEXT QUESTION

SECTION B

Answer **all** the questions.

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

(a) Draw lines to match the **gas** to the correct **chemical test**.

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) A student uses the flame test to identify the cations in a solid.

Describe how she should do a flame test.

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.... **[3]**

(c) The student 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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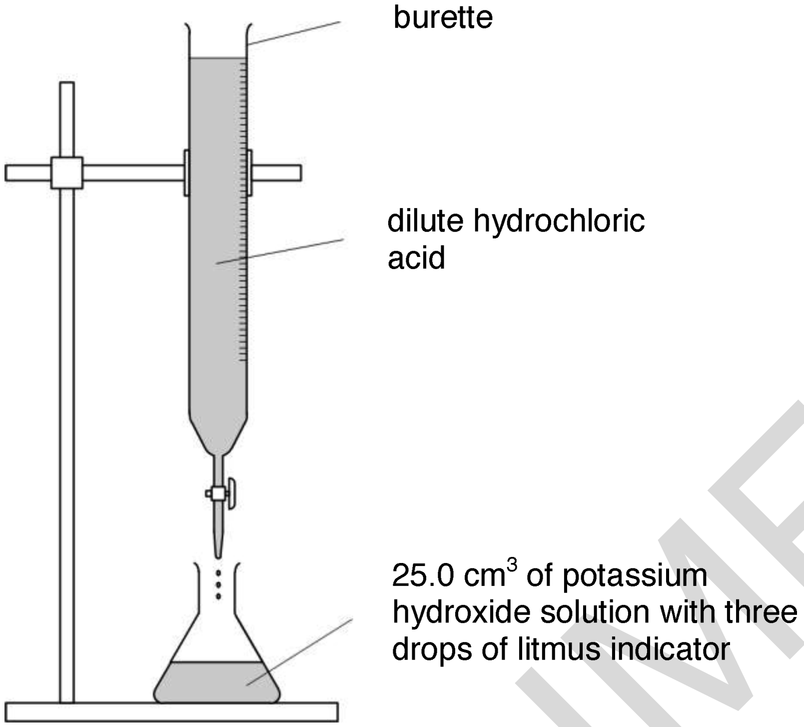
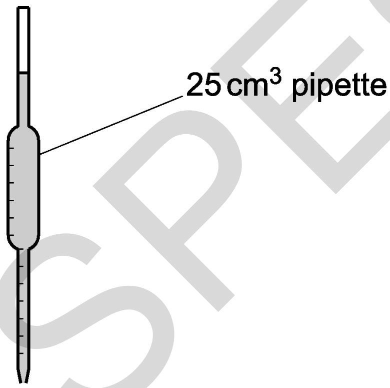
.... **[4]**

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

Look at the apparatus she uses.



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



Describe and explain **one** safety precaution that she should use with the pipette.

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.... **[2]**

(b) In her first titration the student 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 she can tell when the potassium hydroxide solution is just neutralised.

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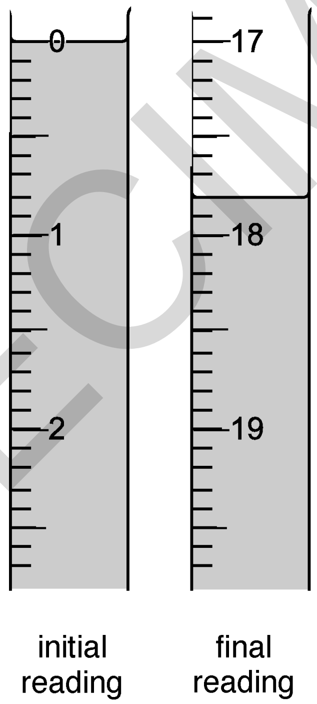
.... **[2]**

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

first titration



Here is the student'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 recording the burette readings from the diagrams. **[2]**

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

Is she correct?

Explain your answer.

....

....

.... **[1]**

(d) The student 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

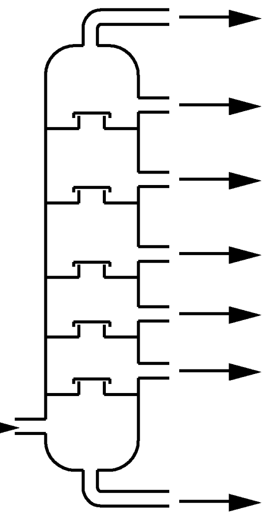
What is the atom economy for the reaction to make potassium nitrate?

Assume that water is a waste product.

Answer = ... % **[2]**

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

The diagram 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) Alkenes are used to make polymers. Polymers are used to make clothes such as socks and jumpers.

Suggest **one** property of a polymer that makes it suitable for making clothes.

....

.... **[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) A student investigates this reaction between carbon dioxide and hydrogen.

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.

Answer = ... % **[2]**

(c)* The student investigates the effect of changing pressure and changing 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 oC)	**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 a vanadium(V) oxide catalyst 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 step of this process.

Step 1: ....

Step 2: ....

Step 3: .... **[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.

....

.... **[1]**

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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.

The table 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.

Answer = ... % **[2]**

(b) Analyse the data in the table.

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

Answer = ... : .... **[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.

Suggest why the carbon dioxide production from transport has **not** changed.

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.

……$Fe(s)$ + $6H_2O(l)$ + ……$O_2(g)$ → $2Fe_2O_3{\bullet}3H_2O(s)$ **[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

Answer = ……………………………… % **[2]**

(ii) A 1.0 kg iron bar is left outside in the rain to rust.

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

Calculate the mass of rust produced, if the 1.0 kg iron bar completely turns to rust, to see if the student is correct.

Give your answer to the nearest gram.

Answer = ... g

Is the student's prediction correct and why?

....

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.... **[3]**

23 Zinc and dilute sulfuric acid react to make hydrogen.

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

A student 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.

The student 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 added	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 and no substance added.

Explain why.

....

.... **[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.

....

....

.... **[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.

....

.... **[1]**

(v) The student 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.

....

....

.... **[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	**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.

....

.... **[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

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…day June 20XX – Morning/Afternoon

GCSE (9–1) Chemistry A (Gateway Science)
J248/02 Paper 2 (Foundation Tier)

SAMPLE MARK SCHEME

Duration: 1 hour 45 minutes

MAXIMUM MARK 90

This document consists of 20 pages

MARKING INSTRUCTIONS

PREPARATION FOR MARKING

SCORIS

1. Make sure that you have accessed and completed the relevant training packages for on-screen marking: *scoris assessor Online Training*; *OCR Essential Guide to Marking*.

2. Make sure that you have read and understood the mark scheme and the question paper for this unit. These are posted on the RM Cambridge Assessment Support Portal http://www.rm.com/support/ca

3. Log-in to scoris and mark the **required number** of practice responses (“scripts”) and the **required number** of standardisation responses.

   YOU MUST MARK 10 PRACTICE AND 10 STANDARDISATION RESPONSES BEFORE YOU CAN BE APPROVED TO MARK LIVE SCRIPTS.

MARKING

1. Mark strictly to the mark scheme.

2. Marks awarded must relate directly to the marking criteria.

3. The schedule of dates is very important. It is essential that you meet the scoris 50% and 100% (traditional 50% Batch 1 and 100% Batch 2) deadlines. If you experience problems, you must contact your Team Leader (Supervisor) without delay.

4. If you are in any doubt about applying the mark scheme, consult your Team Leader by telephone, email or via the scoris messaging system.

5. Work crossed out:

   a. where a candidate crosses out an answer and provides an alternative response, the crossed out response is not marked and gains no marks

   b. if a candidate crosses out an answer to a whole question and makes no second attempt, and if the inclusion of the answer does not cause a rubric infringement, the assessor should attempt to mark the crossed out answer and award marks appropriately.

6. Always check the pages (and additional objects if present) at the end of the response in case any answers have been continued there. If the candidate has continued an answer there then add a tick to confirm that the work has been seen.

7. There is a NR (No Response) option. Award NR (No Response)

   - if there is nothing written at all in the answer space

   - OR if there is a comment which does not in any way relate to the question (e.g. ‘can’t do’, ‘don’t know’)

   - OR if there is a mark (e.g. a dash, a question mark) which isn’t an attempt at the question.

   Note: Award 0 marks – for an attempt that earns no credit (including copying out the question).

8. The scoris **comments box** is used by your Team Leader to explain the marking of the practice responses. Please refer to these comments when checking your practice responses. **Do not use the comments box for any other reason.**

   If you have any questions or comments for your Team Leader, use the phone, the scoris messaging system, or email.

9. Assistant Examiners will send a brief report on the performance of candidates to their Team Leader (Supervisor) via email by the end of the marking period. The report should contain notes on particular strengths displayed as well as common errors or weaknesses. Constructive criticism of the question paper/mark scheme is also appreciated.

10. For answers marked by levels of response:

    Read through the whole answer from start to finish, using the Level descriptors to help you decide whether it is a strong or weak answer. The indicative scientific content in the Guidance column indicates the expected parameters for candidates’ answers, but be prepared to recognise and credit unexpected approaches where they show relevance.
    Using a ‘best-fit’ approach based on the skills and science content evidenced within the answer, first decide which set of level descriptors, Level 1, Level 2 or Level 3, best describes the overall quality of the answer. Once the level is located, award the higher or lower mark:

    The higher mark should be awarded where the level descriptor has been evidenced and all aspects of the communication statement (in italics) have been met.
    The lower mark should be awarded where the level descriptor has been evidenced but aspects of the communication statement (in italics) are missing.

    In summary:

    The skills and science content determines the level.
    The communication statement determines the mark within a level.

11. **Annotations**

Annotation	Meaning
DO NOT ALLOW	Answers which are not worthy of credit
IGNORE	Statements which are irrelevant
ALLOW	Answers that can be accepted
( )	Words which are not essential to gain credit
__	Underlined words must be present in answer to score a mark
ECF	Error carried forward
AW	Alternative wording
ORA	Or reverse argument

12. **Subject-specific Marking Instructions**

INTRODUCTION

Your first task as an Examiner is to become thoroughly familiar with the material on which the examination depends. This material includes:

- the specification, especially the assessment objectives
- the question paper
- the mark scheme.

You should ensure that you have copies of these materials.

You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet **Instructions for Examiners**. If you are examining for the first time, please read carefully **Appendix 5 Introduction to Script Marking: Notes for New Examiners**.

Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

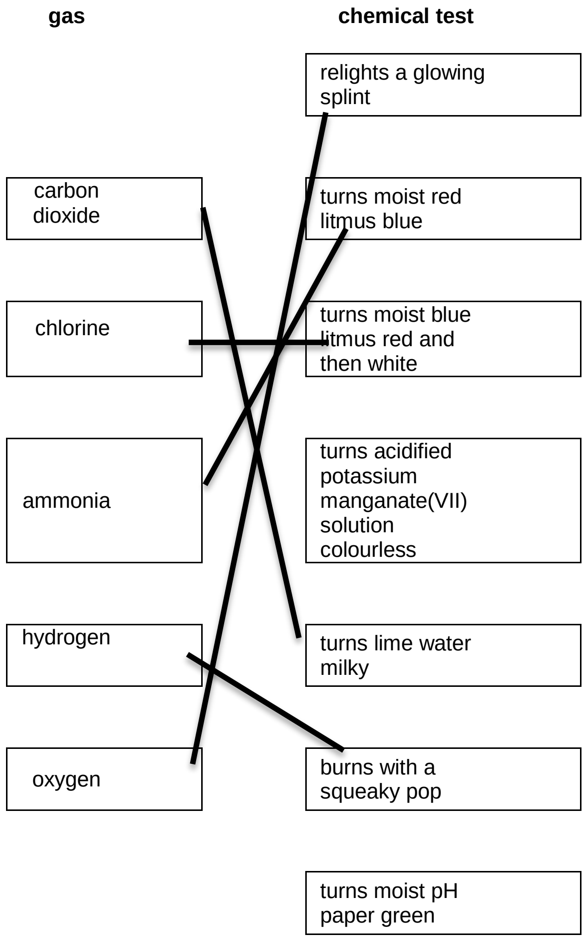
The breakdown of Assessment Objectives for GCSE (9–1) in Chemistry A:

	Assessment Objective
AO1	**Demonstrate knowledge and understanding of scientific ideas and scientific techniques and procedures.**
AO1.1	Demonstrate knowledge and understanding of scientific ideas.
AO1.2	Demonstrate knowledge and understanding of scientific techniques and procedures.
AO2	**Apply knowledge and understanding of scientific ideas and scientific enquiry, techniques and procedures.**
AO2.1	Apply knowledge and understanding of scientific ideas.
AO2.2	Apply knowledge and understanding of scientific enquiry, techniques and procedures.
AO3	**Analyse information and ideas to interpret and evaluate, make judgements and draw conclusions and develop and improve experimental procedures.**
AO3.1	Analyse information and ideas to interpret and evaluate.
AO3.1a	Analyse information and ideas to interpret.
AO3.1b	Analyse information and ideas to evaluate.
AO3.2	Analyse information and ideas to make judgements and draw conclusions.
AO3.2a	Analyse information and ideas to make judgements.
AO3.2b	Analyse information and ideas to draw conclusions.
AO3.3	Analyse information and ideas to develop and improve experimental procedures.
AO3.3a	Analyse information and ideas to develop experimental procedures.
AO3.3b	Analyse information and ideas to improve experimental procedures.

SECTION A

Question	Answer	Marks	AO element	Guidance
1	A	1	1.1	
2	C	1	1.1	
3	C	1	2.1	
4	C	1	2.2	
5	A	1	2.2	
6	B	1	1.1	
7	A	1	1.2	
8	C	1	1.2	
9	C	1	2.2	
10	D	1	1.1	
11	C	1	2.1	
12	D	1	2.1	
13	D	1	1.2	
14	B	1	2.1	
15	C	1	2.1	

SECTION B

Question			Answer	Marks	AO element	Guidance
16	(a)			5	1.2	**Each link** = 1 mark

Question			Answer	Marks	AO element	Guidance
	(b)		Use a flame test wire (1) Moisten wire and dip into sample (1) Introduce sample into blue flame of Bunsen burner (1)	3	1.2	**ALLOW** use a wooden splint **ALLOW** spray bottle **ALLOW** moisten wooden splint and dip into sample **ALLOW** have ions dissolved in the spray bottle
	(c)		Hydrogen, chloride and sulfate are present (1) Hydrogen ions because pH is 3 (1) Sulfate because white precipitate with barium chloride (1) Chloride because white precipitate with silver nitrate (1)	4	3.1a 3.2b 3.2b 3.2b	**ALLOW** H^+, Cl^- and SO_4^{2-} **ALLOW** (1) for the three correct ions **ALLOW** (1) for each correct explanation (must be linked to correct ion)

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>AO element</th><th>Guidance</th></tr>
<tr><td>17</td><td>(a)</td><td></td><td>Use a pipette filler (1)

Potassium hydroxide is caustic / potassium hydroxide can burn skin (1)</td><td>2</td><td>1.2</td><td></td></tr>
<tr><td></td><td>(b)</td><td></td><td>When one drop makes the litmus change colour (1)

Correct colour change blue to red (1)</td><td>2</td><td>1.2</td><td>ALLOW use a pH probe = 1 mark

ALLOW gives a pH value of 7 when neutral = 1 mark</td></tr>
<tr><td></td><td>(c)</td><td>(i)</td><td><table><tr><th>Titration number</th><th>1</th><th>2</th><th>3</th></tr><tr><td>final reading in cm^3</td><td>17.8</td><td>37.5</td><td>32.1</td></tr><tr><td>initial reading in cm^3</td><td>0.0</td><td>20.4</td><td>15.0</td></tr><tr><td>titre (volume of acid added) in cm^3</td><td>17.8</td><td>17.1</td><td>17.1</td></tr></table></td><td>2</td><td>2.2</td><td>Correct burette readings = 1 mark

Correct titre = 1 mark

DO NOT ALLOW 0</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>Yes

Titration 1 is a rough estimate / titration 1 is an outlier / titrations 2 and 3 are identical (1)</td><td>1</td><td>3.2a</td><td></td></tr>
<tr><td></td><td>(d)</td><td></td><td>Atom economy = (M_r of desired products / sum of M_r of all products) x 100

= (101.1 ÷ 119.1) x 100 (1)

= 84.9 (%) (1)</td><td>2</td><td>2.2</td><td></td></tr>
</table>

Question			Answer	Marks	AO element	Guidance
18	(a)		Tall column with condensers coming off at different heights (1) Column heated at the bottom so hot at the bottom and cool at the top (1) Substances with high boiling points condense at the bottom (1) Substances with low boiling points condense at the top (1)	4	1.2	
	(b)		$C_{15}H_{32} \rightarrow 2C_6H_{12} + C_3H_8$ (1)	1	2.1	**ALLOW** any correct multiple
	(c)		Can be made into fibres / waterproof / insoluble in water / flexible / soft (1)	1	2.1	

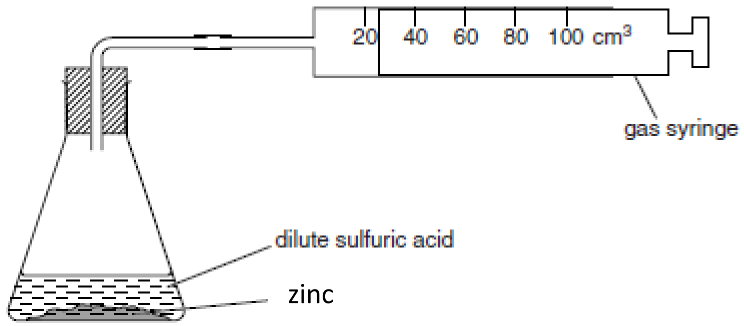
Question			Answer	Marks	AO element	Guidance
19	(a)		Rate of forward reaction equals the rate of the backward reaction (1) Concentration of reactants and products do not change (1)	2	1.1	**DO NOT ALLOW** concentration of reactant and products are the same **ALLOW** concentration of reactants and products stay the same
	(b)		Percentage yield = (actual yield ÷ predicted yield) × 100 or (2.2 ÷ 4.0) × 100 (1) 55 (1)	2	2.1	**ALLOW** full marks for answer with no working out

Question			Answer	Marks	AO element	Guidance
	(c)*		*Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.* **Level 3 (5–6 marks)** **Describes the effect of changing the temperature and pressure on the percentage yield from the table and includes clear explanations on the effect of increasing the pressure on the rate of reaction** *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** **Describes the effect of changing the temperature and pressure on the percentage yield from the table and either describes the effect of increasing the pressure on the rate of reaction or explains the effect increasing the pressure on the rate of reaction** *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1–2 marks)** **Describes the effect of changing the temperature and pressure on the percentage yield from the table or describes the effect of increasing the pressure on the rate of reaction** *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.* **0 marks** *No response or no response worthy of credit.*	6	4 x 1.1 2 x 3.1a	**AO1.1: Knowledge of pressure on rate of reaction** • Increasing the pressure increases the rate of reaction. • Increasing the pressure means particles are closer together. • Increasing the pressure means more crowded particles / more particles in the same space. • Increasing the pressure means more collisions between particles. • More collisions the quicker the reaction. • More collisions more percentage yield. **AO3.1a: Analyse information in the table to interpret percentage yield** • As temperature increases the percentage yield decreases. • As pressure increases the percentage yield increases. • The highest yield is when the temperature is low and the pressure is high.

Question			Answer	Marks	AO element	Guidance
20	**(a)**		$S + O_2 \rightarrow SO_2$ (1) $2SO_2 + O_2 \leftrightharpoons$ (1) $2SO_3$ (1) $SO_3 + H_2O \rightarrow H_2SO_4$ (1)	**4**	**1.2**	One mark for each correct balanced equation One mark for reversible reaction sign
	(b)		Neutralisation (1)	**1**	**1.1**	
	(c)		17 (g) of ammonia makes 66 (g) of ammonium sulfate So 51 g makes 198 g of ammonium sulfate (1)	**1**	**2.1**	
	(d)		Slow evaporation of solution / heat solution over a steam bath (1)	**1**	**1.2**	

Question			Answer	Marks	AO element	Guidance
21	(a)		(150 000 ÷ 750 000) × 100 (1) 20 (1)	**2**	**2.1**	
	(b)		600 000:900 000 (1) 2:3 (1)	**2**	**3.1a**	
	(c)		**Any two from:** Number of vehicles has not increased (1) More use of public transport / cycling / walking / car sharing (1) New cars more efficient with less carbon dioxide being produced (1) Tax lower on low emission vehicles therefore more smaller engine vehicles being used (1)	**2**	**3.1a**	

Question			Answer	Marks	AO element	Guidance
22	(a)		….**4**…Fe(s) + $6H_2O(l)$ +…**3**… $O_2(g)$	**2**	**2.1**	
	(b)	(i)	((2 x 55.8) / 213.6) x 100 (1) = 52.25% (1)	**2**	**2.1**	
		(ii)	52.25% of rust is iron For a 1.0 kg Fe bar, total mass of rust produced = (1.0 (kg) / 52.25) x 100 (1) = 1.914 kg = 1914(g) (1) Therefore increase is 914 g which is greater than 800 g so student is incorrect (1)	**3**	 **2.1** **2.1** **3.2a**	

Question			Answer	Marks	AO element	Guidance
23	**(a)**		Suitable container for the reactants e.g. flask, boiling tube or test tube (1) Use of a gas syringe / upturned burette with water in trough of water / upturned measuring cylinder with water in trough of water (1) The method actually works (1)	**3**	**3.3b**	
	(b)	**(i)**	To allow a comparison between with and without the added substance (1)	**1**	**2.2**	
		(ii)	Idea that the rate of reaction will change if concentration is changed (1)	**1**	**2.2**	It is a fair test is not sufficient **ALLOW** if concentration is increased the rate of reaction is increased **ALLOW** to ensure there are the same number of acid particles present / same number of acid particles per unit volume
		(iii)	Copper Because the reaction is faster (1) There is no change in appearance (1)	**2**	**3.2b**	**No** marks for copper on its own If substance other than copper given then 0 marks for the question
		(iv)	Measure mass of catalyst before and after (1)	**1**	**3.3b**	
		(v)	(Relative rate) between above 1 and below 10 because of smaller surface area / less exposed particles / less collisions (2)	**2**	**2.2**	**No** marks for the prediction on its own **No** marks for whole question if prediction incorrect

Question			Answer	Marks	AO element	Guidance
24	**(a)**	**(i)**	Molecular formula: At_2 (1) Atomic radius: 148 – 168 (1)	**2**	**2.1**	**DO NOT ALLOW** AT_2 / At2 **ALLOW** any range of numbers provided it is completely within the range given for the answer
		(ii)	Makes iod<u>ine</u> and sodium brom<u>ide</u> (1)	**1**	**2.1**	
		(iii)	Brom<u>ine</u> is more reactive than iod<u>ine</u> (1)	**1**	**2.1**	**ALLOW** ORA
	(b)	**(i)**	Same number of electrons in outer shell / all have 7 electrons in outer shell (1)	**1**	**1.1**	**ALLOW** outer electrons or valence electrons rather than electrons in the outer shell **ALLOW** valence shell rather than outer shell **DO NOT ALLOW** the wrong number of electrons in the outer shell
		(ii)	$2Na + Br_2 \rightarrow 2NaBr$ Correct formulae of reactants and products (1) Balancing – depend on correct formulae (1)	**2**	 **2.1** **2.2**	**ALLOW** any correct multiple of the equation including fractions **ALLOW** = or ⇌ instead of → **DO NOT ALLOW** and or & instead of + **ALLOW** one mark for correct balanced equation with minor errors of case and subscript e.g. 2NA + Br2 → 2NaBr
		(iii)	KAt (1)	**1**	**2.1**	

Summary of updates

Date	Version	Change
May 2018	2	We’ve reviewed the look and feel of our papers through text, tone, language, images and formatting. For more information please see our assessment principles in our “Exploring our question papers” brochures on our website