OCR
Oxford Cambridge and RSA

Accredited

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

F

J248/01 Paper 1 (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 **28** pages

SECTION A

Answer **all** the questions.

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

1 Which technique is the best for separating pure water from a solution of sodium chloride in water?

A Chromatography

B Crystallisation

C Distillation

D Filtration

Your answer ☐ **[1]**

2 Which statement shows that lead is a metal?

A It is a dull grey colour.

B It is in Group 4 of the periodic table.

C It is in Period 6 of the periodic table.

D It is malleable and can be easily shaped.

Your answer ☐ **[1]**

3 When 12 g of carbon (C) burns in oxygen (O_2), 44 g of carbon dioxide (CO_2) is formed.

What mass of C would burn to form 11 g of CO_2?

A 3 g

B 4 g

C 11 g

D 12 g

Your answer ☐ **[1]**

4 What is the relative formula mass of sodium carbonate, Na_2CO_3?

A 83.0

B 90.0

C 106.0

D 130.0

Your answer ☐ **[1]**

5 The size of a nanoparticle is similar to the size of a molecule.

What is the approximate size of a nanoparticle?

A 0.01 nm

B 50 nm

C 1000 nm

D 10,000 nm

Your answer ☐ **[1]**

6 Two isotopes of neon are

$^{22}_{10}Ne$ and $^{20}_{10}Ne$

The two isotopes of neon have different:

A Charges

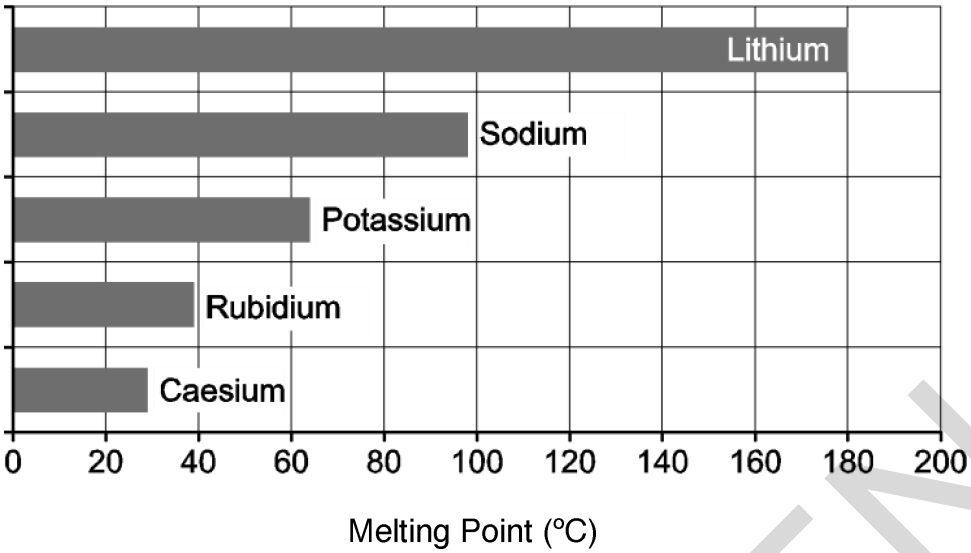
B Numbers of electrons

C Numbers of neutrons

D Numbers of protons

Your answer ☐ **[1]**

7 The bar chart shows the melting points of Group 1 elements.



What are the melting points of rubidium and caesium?

	Melting point of rubidium (°C)	Melting point of caesium (°C)
A	39	29
B	40	25
C	29	41
D	41	25

Your answer ☐ **[1]**

8 A student separates the colours of black ink using paper chromatography.

- He puts a spot of black ink onto a piece of filter paper.
- He dips the filter paper into ethanol in a beaker.

What phase describes **ethanol** in this experiment?

A Gas phase

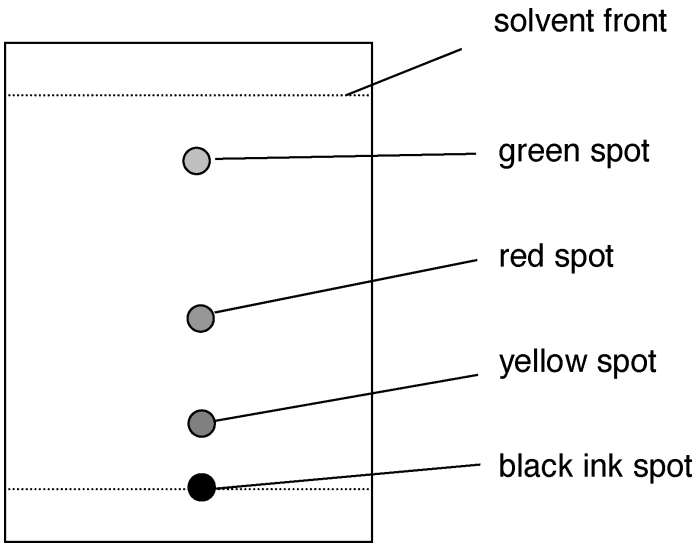
B Mobile phase

C Solid phase

D Stationary phase

Your answer ☐ **[1]**

9 Look at the chromatogram.



What is the R_f value of the **green** spot? Use a ruler to help you.

A 0.17

B 0.42

C 0.83

D 1.00

Your answer ☐ **[1]**

10 What is the best description of the particles in a liquid?

	Distance between particles	Movement of particles
A	Close together	in continuous random motion
B	Close together	vibrating about a fixed point
C	Far apart	in continuous random motion
D	Far apart	vibrating about a fixed point

Your answer ☐ **[1]**

11 Look at the table of fractions from the fractional distillation of crude oil.

Fraction	Boiling range (°C)
LPG	less than 25
petrol	85 – 105
diesel	150 – 290
fuel oil	290 – 380
bitumen	greater than 400

A hydrocarbon has a boiling point which is 3.5 times the boiling point of petrol.

Which fraction contains the hydrocarbon?

A Bitumen

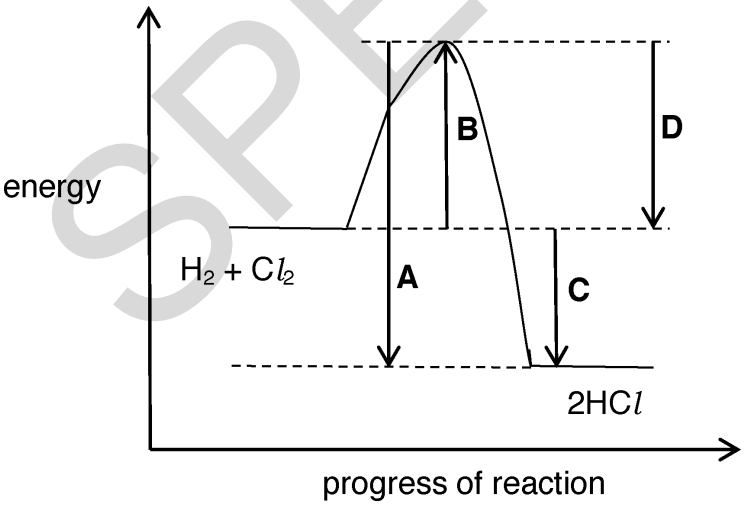
B Diesel

C Fuel oil

D LPG

Your answer ☐ **[1]**

12 Look at the energy changes in the reaction profile for the reaction between hydrogen and chlorine.



Which energy change shows the enthalpy change of reaction?

Your answer ☐ **[1]**

13 The **molecular** formula of decene is $C_{10}H_{20}$.

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

A CH_2

B C_2H_4

C C_5H_{10}

D $C_{20}H_{40}$

Your answer ☐ **[1]**

14 A student measures the pH on an acid and an alkali.

He adds magnesium metal to the acid and to the alkali.

What results should he expect?

	Acid		**Alkali**	
	pH	**Reaction with magnesium**	**pH**	**Reaction with magnesium**
A	Below 7	No reaction	Above 7	Magnesium fizzes
B	Below 7	Magnesium fizzes	Above 7	No reaction
C	Above 7	Magnesium fizzes	Above 7	No reaction
D	Above 7	No reaction	Below 7	Magnesium fizzes

Your answer ☐ **[1]**

15 A student tests the conductivity of an ionic compound.

Which row in the table shows the correct results?

	Solid ionic compound	**Ionic compound dissolved in water**	**Molten ionic compound**
A	Conducts	Conducts	Does not conduct
B	Conducts	Conducts	Conducts
C	Does not conduct	Does not conduct	Conducts
D	Does not conduct	Conducts	Conducts

Your answer ☐ **[1]**

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TURN OVER FOR THE NEXT QUESTION

SECTION B

Answer **all** the questions.

16 A student investigates some exothermic and endothermic reactions.

(a) He measures the temperature changes during some chemical reactions.

Look at his table of results.

Reaction	Temperature at start (°C)	Temperature at end (°C)	Temperature change (°C)
1	15	25	+10
2	15	15	0
3	18	15	-3
4	15	20	+5

What can you conclude about the **type** of energy change in each reaction?

Explain your answer.

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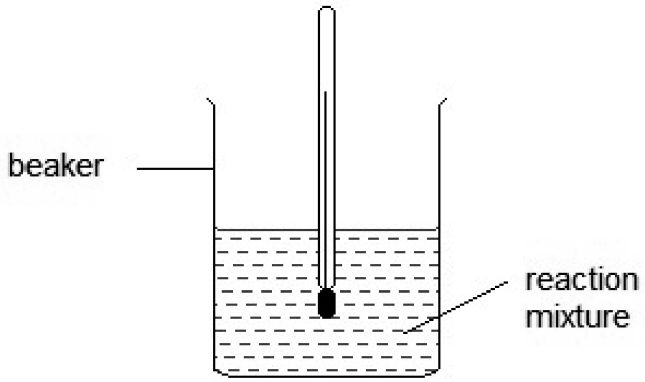
..... **[4]**

(b) A student does an experiment with an acid and an alkali.



1. He adds the acid to a beaker and measures its temperature.
2. He then adds the alkali to the beaker and stirs the mixture.
3. At the end of the reaction, he removes the thermometer from the beaker and measures the temperature.

How should he improve his method? Explain your answer.

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

(c) A student adds water to calcium oxide. A vigorous exothermic reaction takes place forming calcium hydroxide.

Calcium hydroxide has the formula $Ca(OH)_2$.

Show that the relative formula mass (M_r) of calcium hydroxide is 74.1.

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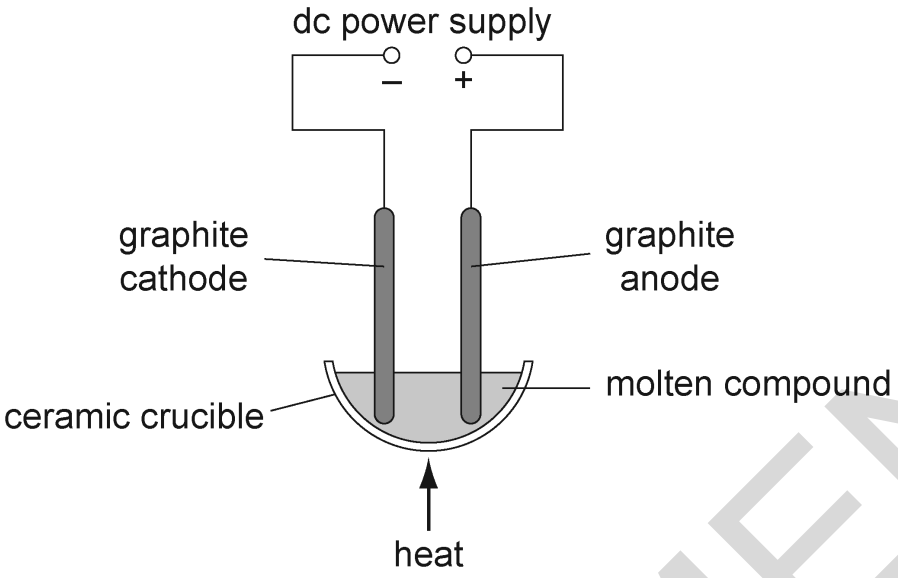
..... **[2]**

17 **(a)** Look at the diagram.

It shows the apparatus used for the electrolysis of some molten compounds.



The table shows the products at each electrode during the electrolysis of two molten compounds.

Complete the table.

Molten compound	**Formula**	**Product at negative electrode (cathode)**	**Product at positive electrode (anode)**
sodium chloride	$NaCl$	……	chlorine
lead bromide	$PbBr_2$	lead	……

[2]

(b) Copper sulfate solution can be electrolysed using non-inert copper electrodes.

Describe what happens at the negative copper electrode **and** the positive copper electrode.

Negative electrode: .....

Positive electrode: ..... **[2]**

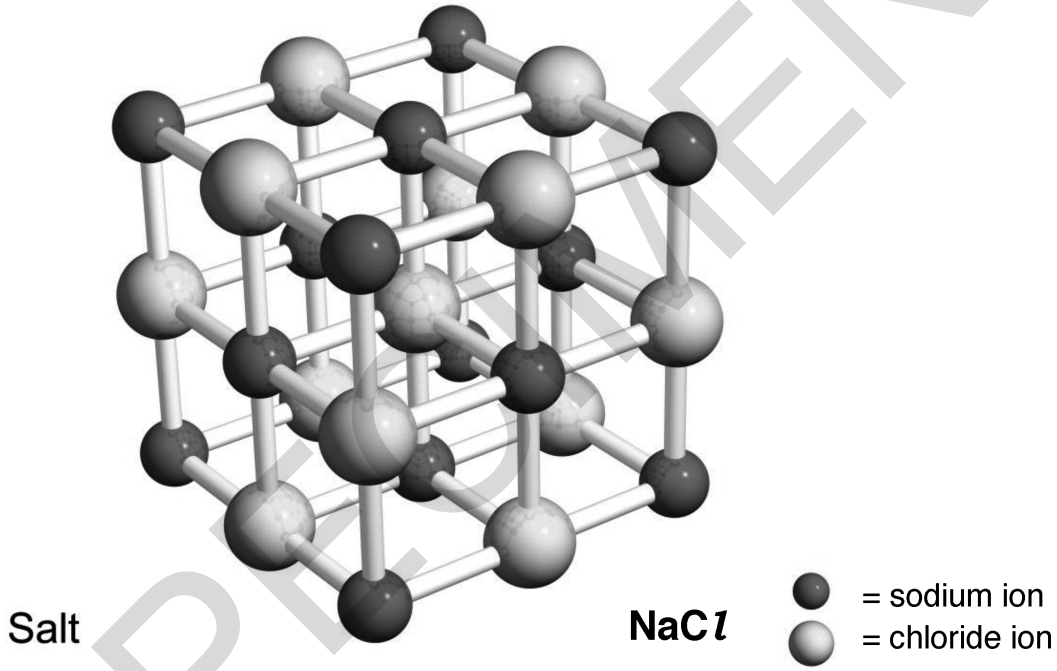
(c) A student is electrolysing a solution of sodium chloride, NaC*l*, in water, H_2O.

Complete the list of ions present in sodium chloride solution.

Positive ions (cations)	Negative ions (anions)
Na^+	……
……	OH^-

[2]

(d) Here is a diagram of a sodium chloride crystal.



- The C*l*–Na–C*l* length in a crystal of sodium chloride is 0.564 nm.

What is the volume of this cube in nm^3?

Give your answer to **3** significant figures.

Answer = …… nm^3 **[3]**

18* A student is separating a mixture of three solid substances, **A**, **B** and **C**.

Look at the table. It gives information about these substances.

Substance	Colour	Melting point (°C)	Is it magnetic?	Is it soluble in water?
A	grey	1535	yes	no
B	white	801	no	yes
C	yellow	1427	no	no

Suggest how the student can separate the mixture to get pure, dry samples of substances **A**, **B** and **C**.

Explain why your methods work.

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..... **[6]**

19 Magnesium burns in oxygen to make magnesium oxide.

The reaction involves both oxidation and reduction.

(a) Complete the equation by adding the state symbols for magnesium and oxygen at room temperature.

$2Mg(....) + O_2(....) \rightarrow 2MgO(s)$

magnesium + oxygen → magnesium oxide **[2]**

(b) Which element is oxidised and which element is reduced?

oxidised: …….

reduced: ……. **[1]**

(c) Magnesium oxide reacts with water to make an alkaline solution.

Describe how you would measure the pH of the magnesium hydroxide solution.

A pH meter is **not** available.

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..... **[3]**

20 Two students, **A** and **B**, want to make some solid zinc sulfate.

They make some predictions.

Student **A** says

> You can react sulfuric acid with zinc metal or zinc carbonate to make zinc sulfate. Both reactions make hydrogen.

Student **B** says

> You can react hydrochloric acid with zinc metal or zinc carbonate to make zinc sulfate. The reaction with zinc metal makes hydrogen and the reaction with zinc carbonate makes carbon dioxide.

(a) Comment on how correct **both** predictions are.

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..... **[4]**

(b) **(i)** Zinc oxide, ZnO, is reacted with nitric acid, HNO_3.

The reaction makes zinc nitrate, $Zn(NO_3)_2$, and water, H_2O.

Write a **balanced symbol** equation for this reaction.

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

(ii) A student suggests this method for preparing zinc nitrate.

1. Measure 50 cm^3 of dilute nitric acid into a beaker.
2. Add one spatula measure of zinc oxide.
3. Heat the mixture until crystals of zinc nitrate are made.

Her method will **not** make a pure dry sample of zinc nitrate.

What improvements should she make to the method to make sure that:

- the reaction is complete
- the zinc nitrate can be separated from the nitric acid and the zinc oxide?

Explain your answer.

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..... **[4]**

21 Look at the data about some hydrocarbons.

Hydrocarbon	Number of carbon atoms in molecule	Molecular formula	Boiling point (°C)
ethane	2	C_2H_6	–88
propane	3	C_3H_8	–42
pentane	5	C_5H_{12}	36
hexane	6	C_6H_{14}	69

(a) Butane contains 4 carbon atoms.

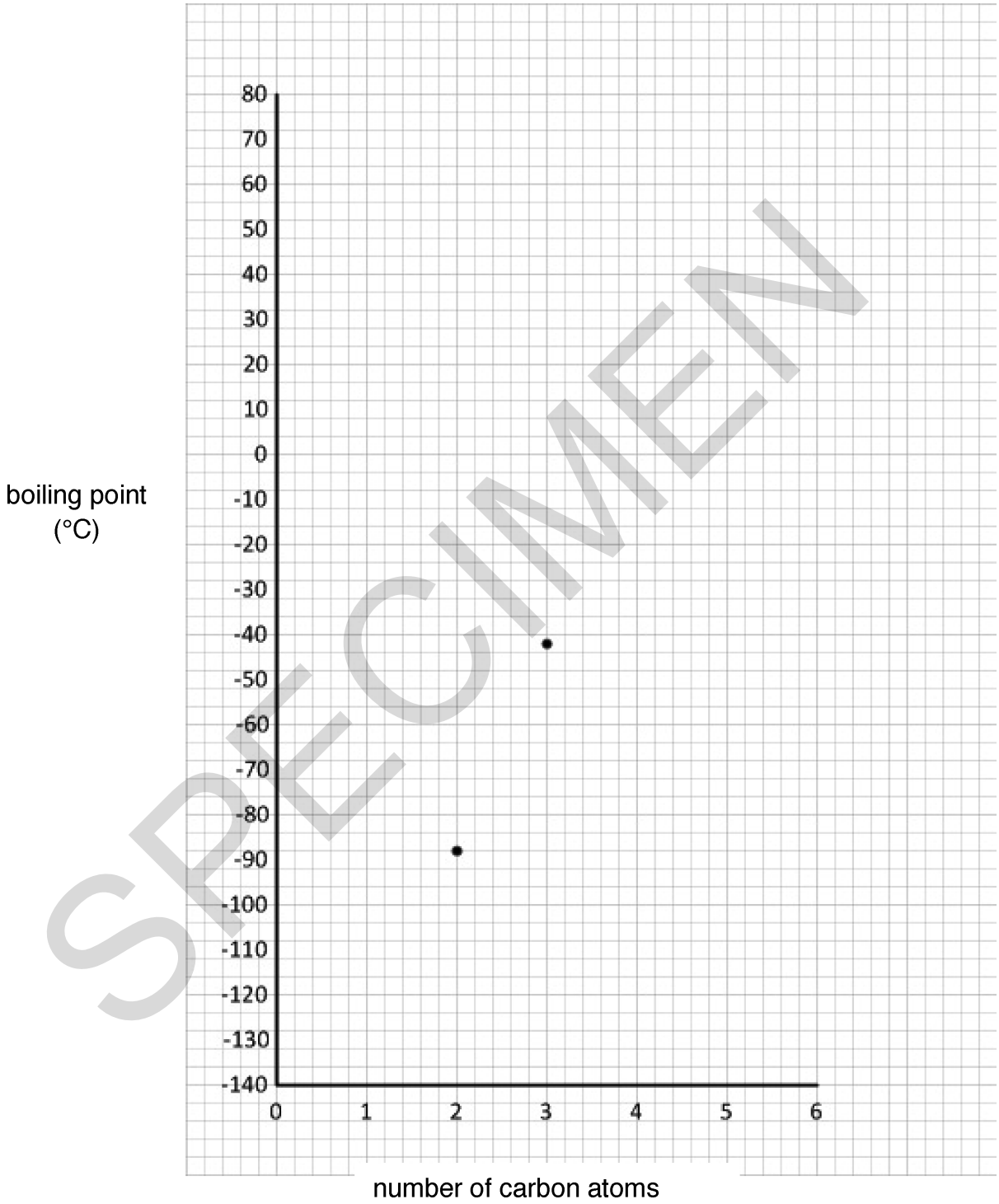
Use the table to suggest the molecular formula of butane.

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

(b) The boiling points of ethane and propane have been plotted on the graph.

(i) Plot the boiling points for pentane and hexane on the graph.

Draw the line of best fit. **[2]**



(ii) Use your graph to estimate the boiling point of butane.

Answer: ……. °C **[1]**

(iii) Describe the relationship between the number of carbon atoms in a molecule and its boiling point.

Use ideas about forces between molecules to explain your answer.

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

(c) Propane burns in oxygen, O_2.

Carbon dioxide and water are made.

Write a **balanced symbol** equation for this reaction.

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

(d) Propane gives out 50 000 J/g when it reacts with oxygen.

- A propane burner is used to boil water to make a cup of tea.
- 63 000 J of energy are needed to boil the water.
- There is only 3 g of propane in the burner.

Do a calculation to find out if there is enough propane in the burner to boil the water.

[3]

22 **(a)** Nanoparticles are used as catalysts.

Describe a property of nanoparticles that make them useful as catalysts.

.....

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

(b) A student is synthesising a new titanium dioxide (TiO_2) nanoparticle for use as a catalyst.

One TiO_2 nanoparticle has a mass of 5.0×10^{-3} mg.

Calculate how many TiO_2 nanoparticles are in 80.0 mg of TiO_2.

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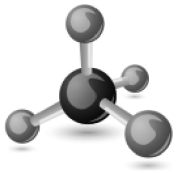
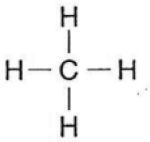
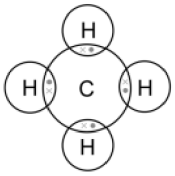
..... **[2]**

23 Methane has the formula, CH_4.

Look at the representations of methane.







ball and stick model **displayed formula** **dot and cross diagram**

Describe the limitations of a **displayed** formula.

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

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TURN OVER FOR THE NEXT QUESTION

24 Look at **Table 24.1**.

It shows information about some atoms and ions.

Particle	Atomic number	Mass number	Number of protons	Number of neutrons	Number of electrons	Electronic structure
A	11	23	11	.....	11	2.8.1
B	9	19	9	10	9	.....
C	.....	37	17	.....	17	2.8.7
D	13	27	.....	.....	10	2.8

Table 24.1

(a) **Complete** the missing information in **Table 24.1**. **[4]**

(b) Particle **A** is a **metal atom**, particle **D** is an **ion**.

Explain why.

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

(c) Element **C** has the electronic structure 2.8.7.

What does this electronic structure tell you about the position of element **C** in the periodic table?

Explain your answer.

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..... **[4]**

(d) Complete the table below to give information about protons, neutrons and electrons.

	Charge	**Mass in atomic mass units**
proton	.....	1
neutron	.....	.....
electron	negative	.....

[2]

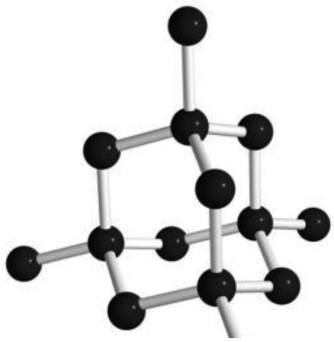
(e) Rutherford was a scientist who helped to develop the atomic model.

State how Rutherford's work contributed to the development of the atomic model.

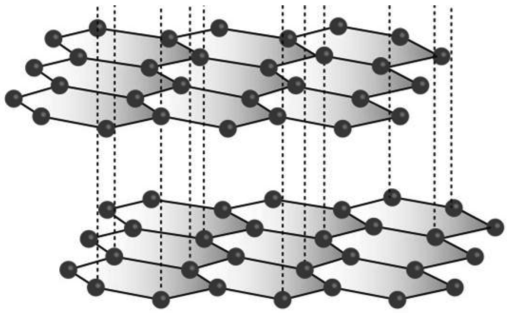
.....

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

25 **(a)** The diagrams show the structures of two forms of carbon.



diamond



graphite

- Graphite is a good conductor of electricity.
- Diamond does **not** conduct electricity.

Use ideas about structure and bonding in diamond and graphite to explain these observations.

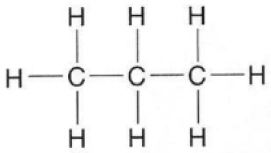
.....

.....

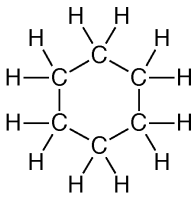
..... **[3]**

(b) Carbon can form many thousands of different compounds.

Two examples are shown below.



propane



cyclohexane

Why can carbon form many thousands of different compounds?

.....

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

(c) Ethanol contains carbon.

Look at some information about ethanol.

- Melting point = –114 °C
- Boiling point = 78 °C

Predict the state of ethanol at 25 °C. How can you tell?

.....

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

END OF QUESTION PAPER

Oxford Cambridge and RSA

…day June 20XX – Morning/Afternoon

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

J248/01 Paper 1 (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	C	1	1.2	
2	D	1	1.2	
3	A	1	2.1	
4	C	1	1.1	
5	B	1	1.1	
6	C	1	1.1	
7	A	1	2.1	
8	B	1	2.2	
9	C	1	2.2	
10	A	1	1.1	
11	C	1	2.1	
12	C	1	1.1	
13	A	1	2.1	
14	B	1	1.2	
15	D	1	1.2	

SECTION B

Question			Answer	Marks	AO element	Guidance
16	(a)		**A** is exothermic as the temperature increases (1) **B** is neither exothermic nor endothermic as the temperature stays the same (1) **C** is endothermic as the temperature drops (1) **D** is exothermic as the temperature increases (1)	4	1.2 3 x 3.2b	**ALLOW** no energy change
	(b)		Idea that thermometer should remain in reaction mixture for temperature at end (1) otherwise temperature at end will be inaccurate (1)	2	3.3b	**ALLOW** do not stir with thermometer (1) as it is fragile (1) **ALLOW** lag the beaker (1) to reduce energy loss (1)
	(c)		(1 x 40.1) + [(16.0 + 1.0) x 2] Correct use of number of atoms (1) Correct use of A_r (1)	2	2.1	

<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>
<table>
<tr><th>Molten electrolyte</th><th>Formula</th><th>Product at negative electrode (cathode)</th><th>Product at positive electrode (anode)</th></tr>
<tr><td>sodium chloride</td><td>$NaCl$</td><td>sodium (1)</td><td>chlorine</td></tr>
<tr><td>lead bromide</td><td>$PbBr_2$</td><td>lead</td><td>bromine (1)</td></tr>
</table>
</td><td>2</td><td>2.2</td><td>DO NOT ALLOW bromide</td></tr>
<tr><td></td><td>(b)</td><td></td><td>negative electrode / cathode – copper deposited (1)
positive electrode / anode – anode dissolves / copper ions formed (1)</td><td>2</td><td>1.2</td><td></td></tr>
<tr><td></td><td>(c)</td><td></td><td>
<table>
<tr><th>Positive ions (cations)</th><th>Negative ions (anions)</th></tr>
<tr><td>Na^+</td><td>Cl^- (1)</td></tr>
<tr><td>H^+ (1)</td><td>OH^-</td></tr>
</table>
</td><td>2</td><td>2.2</td><td></td></tr>
<tr><td></td><td>(d)</td><td></td><td>Volume = 0.564^3 (1)

= 0.179406144 (1)

to 3 significant figures

= 0.179 (1)</td><td>3</td><td>1.2</td><td>ALLOW 3 marks for 0.179 without any working out</td></tr>
</table>

Question			Answer	Marks	AO element	Guidance
18*			*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)** **Suggestion would enable pure dry samples of all three components to be obtained in the correct sequence with clear explanations of why the methods work.** *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)** **Suggestion would enable pure dry samples of two of the components of the mixture to be obtained with an attempt at an explanation.** *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)** **Suggestion would enable a pure sample of one of the components to be obtained.** *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 3.3a 2 x 2.2	**AO3.3a: Analyse information in the table to develop experimental procedures** • Wash solid **C** with water and allow to dry. • Evaporate solution of **B** to obtain solid crystals. • Using a magnet will separate **A** from other two. • Add water to mixture of **B** and **C**. • Filter mixture of **B** and **C**. • Rinse and dry solid **C**. • Evaporate solution of **B**. **AO2.2: Apply knowledge of purification techniques** • **A** is magnetic or **B** and **C** are not magnetic. • **A** can be removed from the mixture as it will stick to the magnet. • **B** will dissolve but **C** will not. • Solid **C** will be left after filtering.

Question			Answer	Marks	AO element	Guidance
19	(a)		$2Mg(s)$ (1) + $O_2(g)$ (1) $\longrightarrow$ $2MgO(s)$	2	1.1	
	(b)		During this reaction, the oxidising agent is **oxygen** and the reducing agent is **magnesium** (1)	1	1.2	
	(c)		add universal indicator solution / pH paper (1) identify colour produced (1) match to colour chart to determine pH (1)	3	1.2	

Question			Answer	Marks	AO element	Guidance
20	(a)		**Correct - Any two from:** sulfuric acid reacts with zinc and/or zinc carbonate to make zinc sulfate (1) zinc reacts with acid to make hydrogen (1) zinc carbonate reacts with acid to make carbon dioxide (1) **Incorrect - Any two from:** Both reactions do not make hydrogen (1) zinc and/or zinc carbonate will not react with hydrochloric acid to make zinc sulfate (1) zinc carbonate does not make hydrogen when it reacts with acid (1)	**4**	**2 x 2.1** **2 x 3.1a**	
	(b)	**(i)**	$ZnO + 2HNO_3 \rightarrow Zn(NO_3)_2 + H_2O$ correct formulae in correct position (1) balancing (1)	**2**	**2.1** **2.2**	balancing mark is conditional on correct formulae **ALLOW** any correct multiple e.g. $2ZnO + 4HNO_3 \rightarrow 2Zn(NO_3)_2 + 2H_2O$ (2) **ALLOW** = or ⇆ or ⇌ for arrow **DO NOT ALLOW** 'and' or & for + **ALLOW** one mark for correct balanced equation with minor errors in case, subscript and superscript e.g. $ZnO + 2HNO^3 \rightarrow Zn(NO_3)_2 + H_2$
		(ii)	**any four from:** idea that an excess of zinc oxide must be added (1) so reaction is complete / all nitric acid is reacted (1) filter off excess zinc oxide (1) evaporate off some of the water (1) allow to crystallise (1)	**4**	**3.3b**	

Question			Answer	Marks	AO element	Guidance
21	(a)		C_4H_{10} / $H_{10}C_4$ (1)	1	2.1	**DO NOT ALLOW** C^4H^{10} / $H^{10}C^4$ / C4H10 / H10C4
	(b)	(i)	both points correctly plotted (1) reasonable line of best fit (1)	2	2.1	
		(ii)	-4 to -10°C dependent on line of best fit (1)	1	2.1	
		(iii)	as the number of carbon atoms increases the boiling point increases (1) idea that larger molecules have greater intermolecular forces (1)	2	1.1	
	(c)		$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$ (2) correct formulae (1) balancing (1)	2	2.1	balancing mark is conditional on correct formulae **ALLOW** any correct multiple e.g. $2C_3H_8 + 10O_2 \rightarrow 6CO_2 + 8H_2O$ (2) **ALLOW** = or ⇆ or ⇌ for arrow **DO NOT ALLOW** 'and' or & for + **ALLOW** one mark for correct balanced equation with minor errors in case, subscript and superscript e.g. $C^3H^8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$ (2)
	(d)		Mass of fuel needed to boil water (g) = energy needed to boil water (J) / energy per gram = 63000 / 50000 (1) = 1.2 g (1) Since 3 g in burner, this is enough propane / **AW** (1)	3	 2.2 2.2 3.1b	

Question			Answer	Marks	AO element	Guidance
22	(a)		large surface area to volume ratio (2)	2	1.1	**ALLOW** large surface area (1)
	(b)		Number of particles = 80.0 mg ÷ (5.0 x 10^{-3} mg) (1) = 16 000 particles (1)	2	1.1	
23			idea that does not show arrangement in space / is 2-dimensional only (1) bond angles are incorrect (1)	2	1.1	

<table>
<tr><th colspan="2">Question</th><th>Answer</th><th>Marks</th><th>AO element</th><th>Guidance</th></tr>
<tr><td>24</td><td>(a)</td><td>
<table>
<tr><th>Particle</th><th>Atomic number</th><th>Mass number</th><th>Number of protons</th><th>Number of neutrons</th><th>Number of electrons</th><th>Electronic structure</th></tr>
<tr><td>A</td><td>11</td><td>23</td><td>11</td><td>12</td><td>11</td><td>2.8.1</td></tr>
<tr><td>B</td><td>9</td><td>19</td><td>9</td><td>10</td><td>9</td><td>2.7</td></tr>
<tr><td>C</td><td>17</td><td>37</td><td>17</td><td>20</td><td>17</td><td>2.8.7</td></tr>
<tr><td>D</td><td>13</td><td>27</td><td>13</td><td>14</td><td>10</td><td>2.8</td></tr>
</table>
</td><td>4</td><td>2 x 2.1
2 x 3.1b</td><td>one mark scored for each correct line</td></tr>
<tr><td></td><td>(b)</td><td>particle A – one electron in outer shell or energy level (1)
particle D – has more protons than electrons (1)</td><td>2</td><td>2.1</td><td></td></tr>
<tr><td></td><td>(c)</td><td>group 7 (1) as 7 electrons in outer shell (1)
period 3 (1) as 3 shells occupied (1)</td><td>4</td><td>2.1</td><td></td></tr>
<tr><td></td><td>(d)</td><td>
<table>
<tr><th></th><th>Charge</th><th>Mass in atomic mass units</th></tr>
<tr><td>proton</td><td>positive /+</td><td>1</td></tr>
<tr><td>neutron</td><td>neutral / no charge</td><td>1</td></tr>
<tr><td>electron</td><td>negative</td><td>0.0005</td></tr>
</table>
</td><td>2</td><td>1.1</td><td>one mark scored for each correct column (2)

ALLOW
1/1760
or 1/1836
or 1/2000</td></tr>
<tr><td></td><td>(e)</td><td>idea of the nuclear atom (1)</td><td>1</td><td>1.2</td><td></td></tr>
</table>

Question			Answer	Marks	AO element	Guidance
25	(a)		**graphite** – has a layered structure (1) electrons can move / electrons between layers or delocalised (1) **diamond** – no free electrons or ions (1)	3	1.1	
	(b)		it can bond to itself (and make chains and rings) (1)	1	1.1	
	(c)		liquid (1) liquid above -114°C and does not boil until 78°C (1)	2	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

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