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GCSE (9–1)

Examiners' report

GATEWAY SCIENCE CHEMISTRY A

J248

For first teaching in 2016

J248/01 Summer 2022 series

Version 1

ocr.org.uk/science

Contents

Introduction

Our examiners' reports are produced to offer constructive feedback on candidates' performance in the examinations. They provide useful guidance for future candidates.

The reports will include a general commentary on candidates' performance, identify technical aspects examined in the questions and highlight good performance and where performance could be improved. A selection of candidate answers are also provided. The reports will also explain aspects which caused difficulty and why the difficulties arose, whether through a lack of knowledge, poor examination technique, or any other identifiable and explainable reason.

Where overall performance on a question/question part was considered good, with no particular areas to highlight, these questions have not been included in the report.

A full copy of the question paper and the mark scheme can be downloaded from OCR.

Advance Information for Summer 2022 assessments

To support student revision, advance information was published about the focus of exams for Summer 2022 assessments. Advance information was available for most GCSE, AS and A Level subjects, Core Maths, FSMQ, and Cambridge Nationals Information Technologies. You can find more information on our website.

Paper 1 series overview

J248/01 is the first of two foundation tier papers for Gateway Science Chemistry A. This unit assesses topics C1, C2, C3 and C7 and is worth 50% of the total GCSE. To do well on this paper, candidates need to demonstrate knowledge and understanding of scientific ideas, techniques and procedures across all four topics. They need to be able to apply their knowledge and understanding to unfamiliar contexts as well as displaying the ability to analyse information. Candidates also need to be familiar with a range of experimental procedures.

J248/01 has an equal emphasis on knowledge and understanding of the assessment outcomes from the specification and application of this knowledge.

Candidates were generally well prepared for this examination, only the more challenging questions were omitted. Questions on atomic structure were answered well. Questions on bonding and structure were more challenging with the most successful responses explaining concepts. More successful responses applied knowledge and understanding to unfamiliar contexts.

Calculations were generally performed well. It is advisable for candidates to structure their working out so that where a final answer is incorrect it may be possible for working and error carried forward marks to be given; this also helps the candidate to process their thoughts clearly and logically.

More successful responses described experimental procedures in detail.

After completing an answer, it is advisable for candidates to read the question again to make sure they have answered all of what is being asked, this will help make sure that numerical answers are given to an appropriate number of significant figures and that written responses cover all aspects of the question.

Writing an answer in pencil and then overwriting in ink should be discouraged as it makes answers difficult to decipher.

Candidates who did well on this paper generally did the following:	Candidates who did less well on this paper generally did the following:
• produced a clear, concise and well-structured answer for the Level of Response Question: 20 (a) • applied the theory of atomic structure: Question 16 (a), 16 (b) (i) and 16 (b) (ii) • performed calculations relating to: experimental data manipulation: Question 17 (b) (iii), mean value: Question 17 (c) (ii), ratio: Question 18 (b) (iv), R_f value Question 19 (c), number of atoms in a compound: Question 21 (d), percentage yield: Question 22 (b) (i) • applied knowledge of melting and boiling points to data: Question 18 (a) (iii) • derive a relationship from data: Question 18 (b) (v) • identified the product of a reaction: Questions 17 (a) and 17 (b) • described distillation or fractional distillation in detail: Question 22 (a) (iii).	• tended to repeat the question stem as their answer to a question • showed imprecise use of scientific terminology • found it difficult to describe an experimental procedure: Question 22 (a) (iii), sequence an experimental procedure: Question 17 (c) (i), describe observations of a reaction: Question 17 (b) (ii) • did not show working steps in calculations • found bonding and the properties of bonding types difficult: Questions 16 (c), 16 (d), 18 (a) (i) and 18 (a) (ii) • found the properties of nanomaterials difficult: Question 19 (a) (ii).

Section A overview

Few candidates omitted any of the multiple choice questions.

Questions on states of matter (2), choosing apparatus (6), physical change (7) and calculating relative formula mass (11) were particularly well answered.

Questions on the electron shells (4), formula of a compound (8), electrolysis (9 and 15) the Periodic Table (12) and particle size (13) proved to be the most difficult for candidates.

Question 1

1 Which state symbol is used for liquids?

A (aq)

B (g)

C (l)

D (s)

Your answer ☐ **[1]**

A was a popular incorrect response.

Question 3

3 Which substance has **four** covalent bonds to each carbon atom?

A Carbon nanotubes

B Diamond

C Graphene

D Graphite

Your answer ☐ **[1]**

A and D were the most popular responses.

Question 4

4 Which is correct about any two elements with the **same** number of electron shells?

A They are both metals.

B They are both non-metals.

C They are both in the same group on the Periodic Table.

D They are both in the same period on the Periodic Table.

Your answer ☐ **[1]**

More successful candidates appreciated the difference between a group and a period. C was a popular incorrect response.

Question 5

5 The table shows the results when four solutions are tested with universal indicator and a pH probe.

Solution	Colour when universal indicator is added	Reading on pH probe
A	blue	12
B	green	7
C	purple	14
D	red	2

Which solution is an acid?

Your answer ☐ **[1]**

Acidic properties were generally well known, response A also proved popular.

Question 8

8 The symbol for a calcium ion is Ca^{2+}. The symbol for an iodate ion is IO_3^-.

What is the formula for calcium iodate?

A $CaIO_3$

B $CaIO_{32}$

C $Ca(IO_3)_2$

D Ca_2IO_3

Your answer ☐ **[1]**

More successful responses balanced the charges to determine a formula. Many candidates used the charges as the balancing numbers and so D was the most popular response.

OCR support

Teachers may find our Writing Formulae resources useful in the classroom to improve this skill with candidates. There is also an activity and answer available.

Question 9

9 During the electrolysis of molten sodium chloride, sodium and chlorine are formed.

What happens at the **positive** electrode (anode)?

A The chloride ion, Cl^-, gains an electron.

B The chloride ion, Cl^-, loses an electron.

C The sodium ion, Na^+, gains an electron.

D The sodium ion, Na^+, loses an electron.

Your answer ☐ **[1]**

Many candidates appreciated that the anode would attract Cl^- with most choosing 'gains an electron'. D was also a popular incorrect response.

OCR support

The Electrolysis Topic exploration pack could be used to develop understanding for this topic by providing extra teacher guidance and a range of activities to use in the classroom.

Question 10

10 What did Rutherford suggest about the model of the atom?

A Atoms contain a nucleus.

B Atoms contain electrons.

C The atom is a solid sphere like a billiard ball.

D The nucleus is made up of protons and neutrons.

Your answer ☐ **[1]**

More successful candidates appreciated the role of Rutherford, D was the most popular incorrect response.

Question 12

12 Mendeleev swapped the positions of the elements tellurium and iodine when he was creating his Periodic Table. This meant that the atomic masses were not in order.

Why were the atomic masses not in order?

A He developed his table without knowing about atomic structure.

B He measured the atomic masses incorrectly.

C He left gaps for undiscovered elements.

D He put the elements in order of increasing reactivity.

Your answer ☐ **[1]**

Most candidates remembered that gaps were left and chose option C, the context of tellurium and iodine leads to response A.

Question 13

13 Which particles are smaller than 1×10^{-9} m?

A Nanoparticles, molecules and atoms

B Nanoparticles, neutrons and electrons

C Neutrons, atoms and electrons

D Neutrons, polymers and protons

Your answer ☐ **[1]**

More successful responses chose atoms and subatomic particles, response A was very popular and a smaller number chose response B.

Question 14

14 The element mercury is a liquid at 25 °C.

Which row about mercury is correct?

	Melting Point (°C)	**Boiling Point (°C)**
A	above 25	above 25
B	below 25	below 25
C	below 25	above 25
D	above 25	below 25

Your answer ☐ **[1]**

Most confident candidates placed 25°C between the melting point and boiling point of mercury, A was the most popular incorrect response.

Question 15

15 Which products are formed in the electrolysis of aqueous copper sulfate, $CuSO_4$ using inert electrodes?

A Copper and oxygen

B Copper and sulfur dioxide

C Hydrogen and oxygen

D Hydrogen and sulfur dioxide

Your answer ☐ **[1]**

More successful responses chose elements and the most successful chose response A. B was the most popular incorrect response.

Section B overview

Questions on atomic structure: Question 16 (a), choosing apparatus Question 20 (b) (i), calculations Questions 17 (b) (iii), 17 (c) (ii), 18 (b) (iv) and 21 (d), ball and stick model: Question 21 (a), identifying water as a product: Question 17 (a) were particularly well answered.

Questions on ion formation: 16 (i), ion symbol: Question 16 (d), metallic structure: Questions 18 (b) (i) and 18 (b) (ii), nanoparticles: Question 19 (a) (ii), states of matter theory: Question 21 (c), determining purity: Question 22 (a) (i) and balancing a symbol equation: Question 22 (b) (ii) proved to be the most difficult for candidates.

A significant number of candidates omitted the more difficult questions, particularly the overlap Questions 21 and 22.

There was no evidence that candidates did not have enough time to complete the paper.

Question 16 (a)

16 (a) Complete the sentences about the structure of an atom. Use words from the list.

electrons	**negative**	**neutral**	**neutrons**	**positive**	**protons**

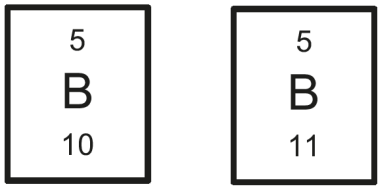
An atom has a nucleus with a ..... charge. The nucleus is made up of

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

Atomic structure was generally well known. A significant number of candidates gave the nucleus a neutral charge containing protons and electrons.

Question 16 (b) (i)

(b) (i) Look at the information about two **isotopes** of boron.



Which statements about the isotopes of boron are correct?

Tick (✓) **two** boxes.

Boron has 11 protons. ☐

The atomic number of boron is 5. ☐

The electrons are heavier than the protons. ☐

The isotopes of boron have different numbers of neutrons. ☐

The isotopes of boron have different numbers of protons. ☐

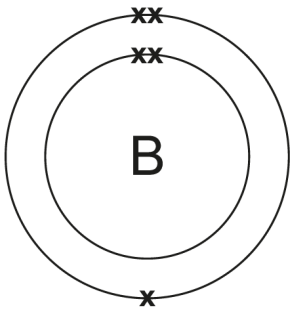
The mass number of boron is the same for both isotopes. ☐

[2]

Many candidates confused atomic number and mass number and so ticked mass number the same for both isotopes and boron has 11 protons. A smaller number chose different numbers of protons.

Question 16 (b) (ii)

(ii) The diagram shows a boron atom.



Explain why boron is in Group 3 of the Periodic Table.

.....

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

More successful responses interpreted the diagram to give three electrons on the outer shell. Common incorrect responses said that boron contained five electrons and has two shells.

Question 16 (c)

(c) Chlorine is in Group 7 of the Periodic Table. Chlorine is a non-metal.

Why do non-metals form negative ions?

.....

.....

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

Type your commentary here

Misconception

Many candidates described the negative charge arising from a loss of electrons.
Very few included the attainment of a filled outer shell.

Question 16 (d)

(d) Chlorine reacts with aluminium to form aluminium chloride.

- The formula for aluminium chloride is $AlCl_3$.
- The symbol for a chloride ion is Cl^-.

What is the **symbol** for an aluminium ion?

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

More successful responses used the formula to determine the charge on the aluminium ion. Common incorrect responses included: Al, Al_3, Al^+ and Al^{2+}.

Question 17 (a)

17 (a) Complete the **word** equation for neutralisation.

acid + alkali → salt + ...

[1]

Water was well known. Incorrect responses included: base, hydrogen and carbon dioxide.

Question 17 (b) (i)

(b) A student reacts magnesium carbonate with dilute hydrochloric acid.
Carbon dioxide gas and a salt are made.

(i) What is the name of the salt made?

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

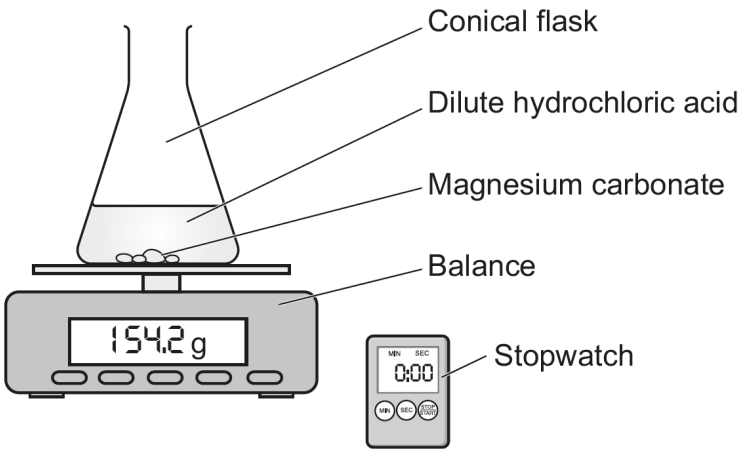
More successful responses identified the salt from the reagents. Popular responses included: magnesium hydroxide, magnesium carbonate, magnesium oxide, the most popular being the common salt sodium chloride.

OCR support

To support teachers, we have our Making salts presentation and associated activities that can be used in the classroom to improve candidate knowledge and offer more chances to practice in context.

Question 17 (b) (ii)

(ii) The diagram shows the apparatus the student uses.



How can the student tell when the reaction is complete?

.....

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

The most confident candidates evaluated the information and gave a correct observation. Popular incorrect responses included bubbling, mass decreases, solid dissolves and stopwatch stops.

Question 17 (b) (iii)

(iii) The student records the mass on the balance every 2 minutes for 12 minutes.

The student's results are shown in the table.

Time (minutes)	Mass (g)
0	154.2
2	150.5
4	148.2
6	146.5
8	145.3
10	144.0
12	142.9

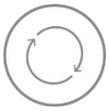
The mass before the reaction starts is 154.2 g.

How much carbon dioxide gas is made after 8 minutes?

Mass of carbon dioxide = ... g **[2]**

Many candidates chose the correct values from the table and found the difference between them. A significant number either chose the value at 8 minutes, 145.3 or found the amount of carbon dioxide made over the whole 12 minutes. Showing working in multistep calculations is advised as working marks can often be given even when the final answer is incorrect.

Assessment for learning



Practical Activity Group

In PAG 8, candidates are expected to use appropriate apparatus to make and record a range of measurements accurately, including mass, and measure the rate of a reaction when a gas is produced. Teachers should make sure candidates are exposed to a variety of practical methods that will help them to be successful in their exams.

Question 17 (c) (i)

(c) (i) The student wants to prepare a **pure**, **dry** sample of the soluble salt.
This is made by reacting magnesium carbonate and dilute hydrochloric acid.

Select the **three** correct steps that the student uses to prepare the pure, dry salt.

Put them in the order the student completes each step by labelling them 1, 2 and 3.

Crystallise the filtrate in an evaporating basin. ☐

Distil the filtrate using fractional distillation. ☐

Filter the solution, leaving the magnesium carbonate in the filter paper. ☐

Filter the solution, leaving the salt in the filter paper. ☐

React hydrochloric acid with excess magnesium carbonate. ☐

React magnesium carbonate with excess hydrochloric acid. ☐

[3]

The most successful candidates numbered the correct boxes. All combinations of numbers in boxes were seen with a significant number putting ticks in boxes rather than numbers.

Question 17 (c) (ii)

(ii) The student does the experiment 4 times.

They measure the mass of salt produced. Their results are shown in the table.

Experiment number	Mass of salt (g)
1	20.95
2	22.36
3	21.78
4	23.40

Calculate the mean mass of salt produced.

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

Mean mass of salt produced = ... g **[3]**

Calculation of the mean was achieved by almost all candidates with More successful responses quoting their answer to 3 significant figures. Showing working in calculations worth more than one mark is advised as working and error carried forward marks can often be given even when the final answer is incorrect.

Question 18 (a) (i)

18 The table shows data about four different substances.

Substance	Melting point (°C)	Boiling point (°C)	Soluble in water?	Conducts electricity as a solid?	Conducts electricity when molten or dissolved?
A	550	1300	yes	no	yes
B	–183	–162	no	no	no
C	420	907	no	yes	yes
D	1670	>1670	no	no	no

A scientist uses the information to find out what type of bonding is present in each substance.

(a) (i) The scientist thinks substance **A** is an **ionic** compound.

Explain why the scientist is correct.

.....

.....

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

High boiling point/melting point was well known. Many discussed electrical conductivity with more successful candidates including solid, molten and dissolved in their answer.

Question 18 (a) (ii)

(ii) Which of the substances is a **simple covalent** compound?

Explain your answer.

Substance .....

Reason 1 .....

Reason 2 .....

[3]

The more successful candidates knew the properties of the simple covalent compound B. Most candidates chose substance C.

Question 18 (a) (iii)

(iii) What is the state of substance **B** at room temperature?

Put a (ring) around the correct answer.

Solid **Liquid** **Gas**

[1]

The most successful candidates determined the state of substance B, solid was the most popular incorrect response.

Question 18 (b) (i)

(b) The scientist investigates some metals and metal alloys.

(i) Describe the structure and bonding in a metal.

You can include a labelled diagram in your answer.

.....

.....

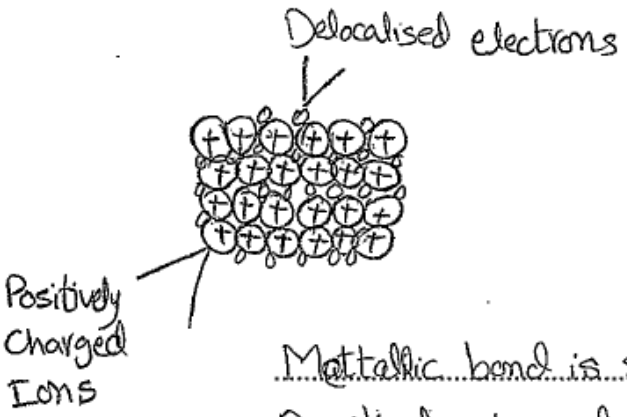
.....

.....

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

The most successful responses gave a labelled diagram and described the bonding. Diagrams were often missing or unlabelled and often diamond. Many discussed ionic or covalent bonding. A large number omitted the question.

Exemplar 1



Mattallic bond is strong electrostatic attraction between positively charged ions to a "Sea" of delocalised electrons.

Metals have gaint mettalic lattice.

Diagram has close packed regular positive ions and labelled, ions interspersed with delocalised electrons and labelled; text has strong attraction between positive ions and delocalised electrons. This response gained all 3 marks.

Question 18 (b) (ii)

(ii) Explain why metals are malleable.

.....

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

The most successful responses discussed layers. Many discussed weak bonding, delocalised electrons or forces between atoms and a large number omitted the question

Question 18 (b) (iii)

(iii) Explain why metals can conduct electricity.

.....

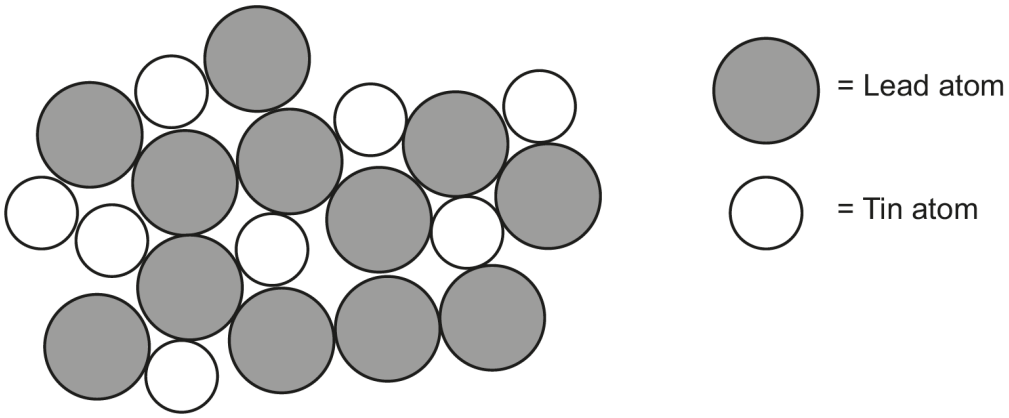
.....

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

More successful responses discussed electrons and the most successful described the electrons as moving. Popular responses included bonding, close packing of atoms allowing conduction and moving ions.

Question 18 (b) (iv)

(iv) The scientist has a diagram of one type of metal alloy as shown.



What is the smallest ratio of lead to tin in the alloy?

Ratio of lead to tin = ... **[2]**

This was answered well, a small number of candidates gave 12:8, simplified to 6:4 or reversed the ratio.

Question 18 (b) (v)

(v) The table shows data about other alloys made from tin, copper and silver.

	Alloy 1	**Alloy 2**	**Alloy 3**
Tin content (%)	95.5	99.0	96.5
Copper content (%)	0.7	0.7	0.5
Silver content (%)	3.8	0.3	3.0
Melting point (°C)	217	227	220

What is the relationship between the silver content and the melting point?

.....

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

More successful candidates derived the link between silver content and melting point. Popular incorrect responses included high melting point, low melting point and the melting point increasing as silver content increases.

Question 19 (a) (i)

19 A student investigates dyes.

(a) Some dyes are nanoparticles.

(i) What is the size of a nanoparticle?

Tick (✓) **one** box.

Less than 1 nm ☐

Between 1 and 100 nm ☐

Between 100 and 1000 nm ☐

Greater than 1000 nm ☐

[1]

More successful candidates gained the mark. Many candidates chose less than 1 nm.

Question 19 (a) (ii)

(ii) Some people think using nanoparticulate materials is dangerous. Other people want to keep using them.

State **one advantage** and **one disadvantage** of using nanoparticulate materials.

Advantage .....

.....

Disadvantage .....

.....

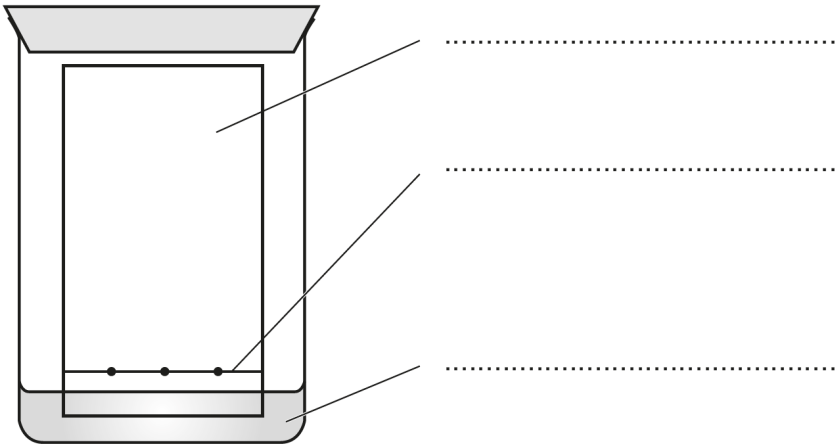
[2]

The most successful candidates identified either an advantage or a disadvantage of nanomaterials. Incorrect responses for advantages included small, strong, a medicine, can fit through the skin; and for disadvantages small, can't be seen, can be lost easily, toxic, hard to work with and dangerous.

Question 19 (b)

(b) The student uses paper chromatography to separate the dyes.

The diagram shows the apparatus at the start of the experiment.



Label the apparatus. Use phrases from the list.

Ink spot
Mobile phase
Pencil line
Solvent front
Stationary phase

[3]

Pencil line was the most well known. Stationary phase was often labelled as solvent front, mobile phase was often labelled as stationary phase or water.

Question 19 (c) (i)

(c) At the end of the experiment one of the dyes has moved 55 mm.

The solvent has moved 65 mm.

(i) Calculate the R_f value of this dye.

Give your answer to **2** significant figures.

R_f value of dye = ... **[2]**

More successful responses calculated the value correctly and quoted it to two significant figures; 0.8 was the common part correct response. A large number inverted the division and gave their final answer to three significant figures hence 1.18 was a common incorrect response.

Question 19 (c) (ii)

(ii) Another dye, **X**, has an R_f value of 0.22.

The student knows that the food colouring tartrazine has an R_f value of 0.11.

The student thinks dye **X** is tartrazine.

Explain why the student is incorrect.

.....

.....

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

More successful responses interpreted the values as being different and the most successful appreciated that if they were the same substance the values need to be the same. Many repeated the question stem with no interpretation and a large number omitted the question.

Question 20* (a)

20* The table shows the results of two chemical reactions, **A** and **B**.

	Temperature at the start of the reaction (°C)	**Temperature at the end of the reaction (°C)**	**Energy change (kJ / mol)**
Reaction **A**	25.5	32.1	– 157
Reaction **B**	23.4	18.3	+ 241

(a) Use the information in the table to state if each of the reactions, **A** and **B**, are exothermic or endothermic.

Explain your answers.

.....

.....

.....

.....

.....

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

Most candidates attempted this Level of Response Question and the majority scored some marks. Many candidates ascribed the increase in temperature to an increase in energy and an endothermic reaction and the decrease in temperature to energy loss and an exothermic reaction, restricting their answer to Level 1. Candidates who used the sign of the energy change to identify the type of change correctly often gave detailed responses including all of the information from the table gaining full or almost full marks.

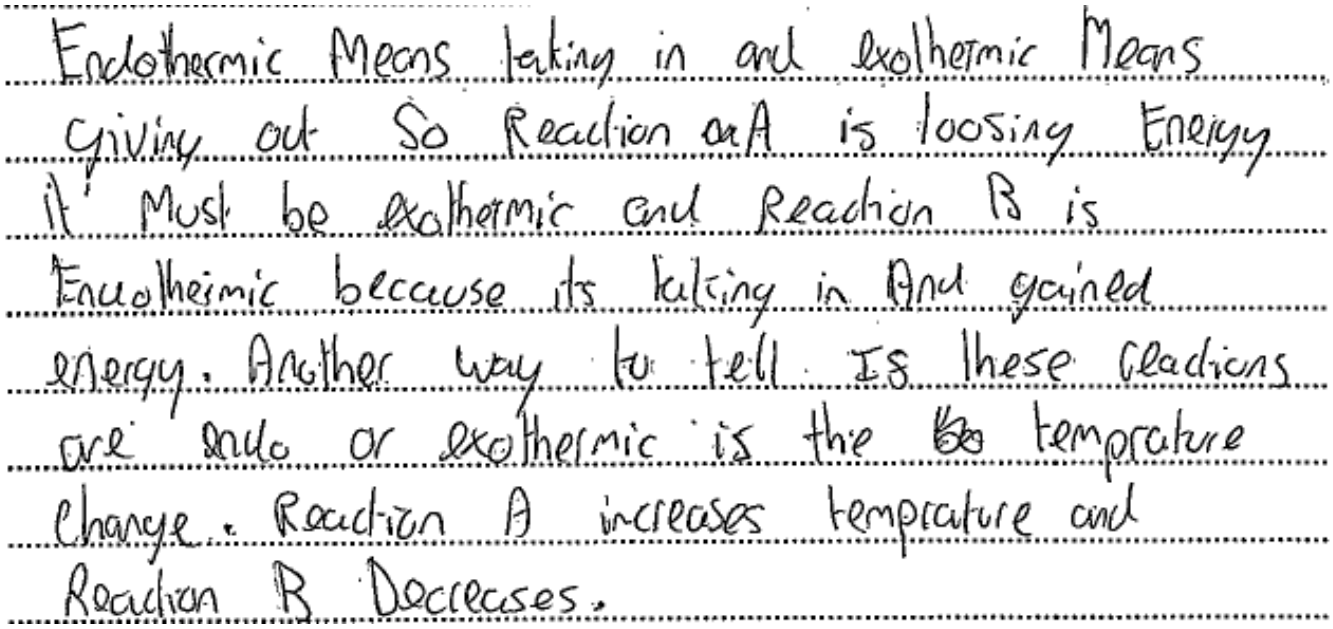
Exemplar 2

Reaction A is ~~and~~ an Endothermic reaction because the temperature increases at the end of the reaction so it's keeping the heat in aswell as it's Energy change decreases by -157 So it is Endothermic.

Reaction B is an exothermic Reaction because the temperature decreases at the end of the Reaction so it's releasing Some heat aswell as it's Energy change increases by +241.

A is endothermic and B is exothermic is incorrect. The temperature increase and decrease and energy decrease and increase have been correctly assigned to A and B. This is Level 1, 2 marks.

Exemplar 3


Endothermic Means taking in and exothermic Means giving out So Reaction or A is loosing Energy it Must be exothermic and Reaction B is Endotheimic because its taking in And gained energy. Anther way to tell Is these reactions are endo or exothermic is the temprature change. Reaction A increases temprature and Reaction B Decreases.

Reaction A and B have been correctly ascribed as exothermic and endothermic. The temperature and energy changes have been correctly described and ascribed. This is Level 3, 6 marks.

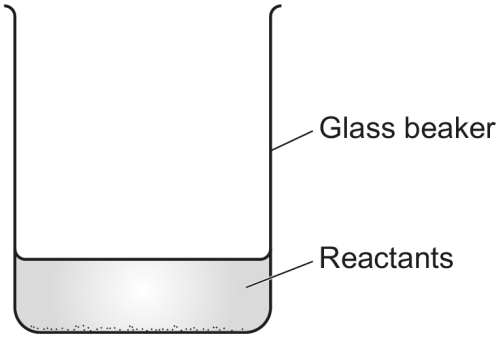
Key point call out – Level of Response

Often candidates interpret the level of response questions as requiring a very long answer, and this can be demotivating for some or encourage others to write far more than is necessary. This exemplar shows that succinct answers can gain full marks and every line available on the page does not need to be filled to be successful.

Question 20* (b) (i)

(b) A teacher wants to calculate the temperature change of another reaction.

The diagram shows the apparatus they use.



(i) The teacher measures the temperature of the reaction at the start and end of the reaction.

What apparatus do they use to measure the temperature?

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

Thermometer was very well known. Ruler and beaker were also seen.

Question 20* (b) (ii)

(ii) The temperature of the reaction does not change. The teacher thinks too much heat is escaping from the apparatus.

Suggest **two** ways they can improve the apparatus to stop the heat escaping.

1 .....

.....

2 .....

.....

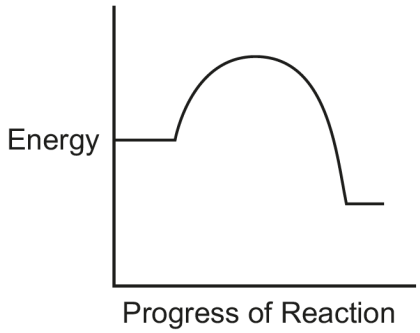
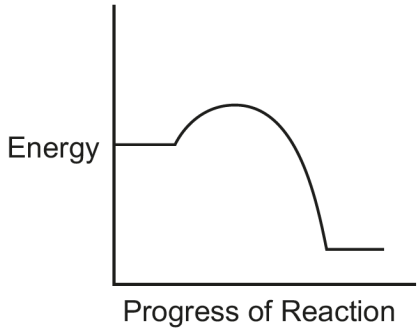
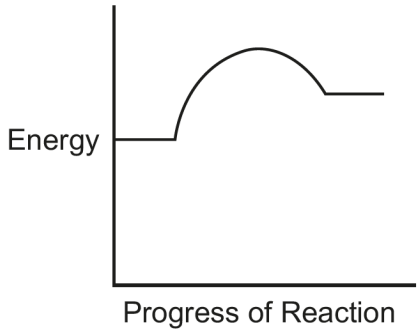
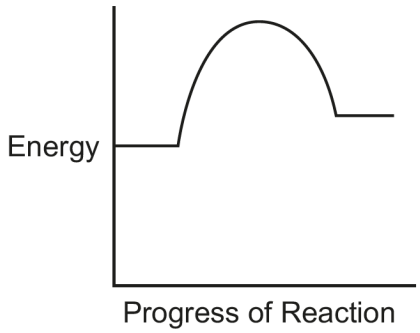
[2]

Many candidates suggested a lid, more successful considered insulation. Heating with a Bunsen burner was a common incorrect response.

Question 20* (c)

(c) The diagrams show the reaction profiles for four different reactions.

Draw **three** lines to connect the **reaction profile** with its correct **description**.

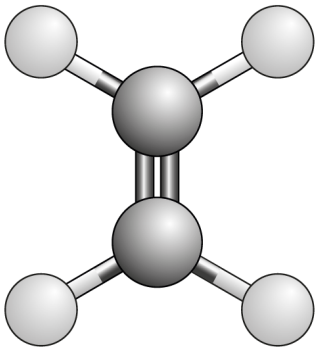
Reaction profile	Description
	Exothermic reaction with low activation energy
	Endothermic reaction with low activation energy
	Exothermic reaction with high activation energy
	

[3]

All combinations of lines were seen, with responses for reaction 2 most commonly correct.

Question 21 (a)

21 The diagram shows a ball and stick model for ethene, C_2H_4.



(a) Which statements about this ball and stick model of ethene are correct?

Tick (✓) **two** boxes.

The model shows how many electrons the carbon atoms have. ☐

The model shows how many electrons the hydrogen atoms have. ☐

The model shows how much space each atom fills. ☐

The model shows that the carbon atoms are bigger than the hydrogen atoms. ☐

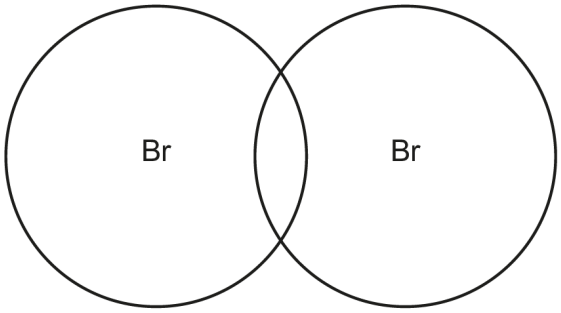
The model shows the difference between double bonds and single bonds. ☐

[2]

The ball and stick model was well known, the most common incorrect response was box 1,

Question 21 (b)

(b) Molecules can be drawn using dot and cross diagrams.



Complete the dot and cross diagram for bromine, Br_2.

Show the electrons in the outer shells only.

[2]

More successful responses drew a single bond between the atoms and gave each atom 6 non-bonding electrons. Incorrect responses had a double or triple bond. Non-bonding electrons were often omitted or 4 or 7 drawn on each atom.

Assessment for learning

It is important to remember that each atom in a covalent bond needs to achieve a filled outer shell of electrons, and that each atom has all of its outer electrons present in the final structure of the molecule.

Question 21 (c)

(c) At room temperature, ethene is a gas and bromine is a liquid.

Use the particle model to describe **two** differences between the movement or arrangement of the particles in ethene and the particles in bromine.

1 .....

.....

2 .....

.....

[2]

The most successful responses described differences by either use of comparative terms, e.g. faster or by discussing movement of particles or arrangement of particles in both substances. It was common for candidates to discuss one of the substances or to describe properties which were not movement or arrangement. A large number omitted the question.

Question 21 (d)

(d) Ethene reacts with bromine to make a product.

The relative formula mass of the product is 187.8.

There are **2** carbon atoms and **4** hydrogen atoms in the product.

Calculate how many bromine atoms are in the product.

Number of bromine atoms = ... **[3]**

More successful responses performed all three steps correctly to gain three marks. A significant number stopped at 159.8, gaining two marks. 31.3 was a common incorrect response from 187.8 divided by 6. In a multi step calculation it is advisable for candidates to show their working steps so that if the final answer is incorrect working or error carried forward marks can be gained.

Question 22 (a) (i)

22 A student has a sample of a **liquid**.

(a) (i) State a method the student uses to find out if the sample is **pure**.

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

Most successful responses described chromatography or boiling point determination. Distillation, filtration and crystallisation were common incorrect responses. A significant number omitted the question.

Question 22 (a) (ii)

(ii) The student finds out that the sample is **impure**.

The sample contains hexane, C_6H_{14}, and cyclohexane, C_6H_{12}.

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

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

The most successful candidates simplified the formula to its lowest possible numbers keeping the ratio of atoms the same. Many candidates omitted the question.

Question 22 (a) (iii)

(iii) The boiling point of hexane is lower than the boiling point of cyclohexane.

Describe a method the student could use to obtain a sample of **pure** hexane from the mixture of cyclohexane and hexane.

You can include a labelled diagram in your answer.

.....

.....

.....

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

More successful responses named the process as either distillation or fractional distillation, included use of a condenser and appreciated that hexane would boil and be collected first. Filtering was a common response and many omitted the question.

Question 22 (b) (i)

(b) (i) The student obtains 12.0 g of hexane from 15.2 g of the mixture of hexane and cyclohexane.

Calculate the percentage of hexane obtained.

Give your answer to **2** significant figures.

Percentage of hexane = ... % **[2]**

More successful responses calculated the percentage and gave their final answer to two significant figures. Inverting the division, subtracting values and incorrect rounding were common in answers.

Question 22 (b) (ii)

(ii) Hexane reacts with oxygen in a combustion reaction.

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

$$\mathbf{2}\ C_6H_{14} + ...O_2 \rightarrow .....CO_2 + ...H_2O$$

[1]

The most successful responses balanced the equation using 19, 12 and 14. Many omitted the question, used 2 and 3 or added C and H into the gaps.

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