OCR
Oxford Cambridge and RSA

Accredited

**GCSE (9–1) Chemistry B
(Twenty First Century Science)**
J258/04 Depth in chemistry (Higher Tier)
Sample Question Paper

H

Date – Morning/Afternoon
Time allowed: 1 hour 45 minutes

Version 2.3

You must have:
• a ruler (cm/mm)
• the Data Sheet

You may use:
• a scientific or graphical calculator

First name	
Last name	

Centre number						Candidate number				

INSTRUCTIONS
• Use black ink. HB pencil may be used for graphs and diagrams only.
• 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 responses will be assessed in questions marked with an asterisk (*).
• This document consists of **20** pages.

Turn over

Answer **all** the questions.

1 Mendeleev organised the elements into the first Periodic Table.

The diagram shows some elements from Groups 2 and 3 in Mendeleev's Periodic Table.

Group 2
Be
Mg
Cd
Zn

Group 3
B
Al
(gap)
(gap)

(a) Mendeleev left gaps in his table.

Two gaps are shown in Group 3.

Explain why these gaps were so important.

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....

.... **[2]**
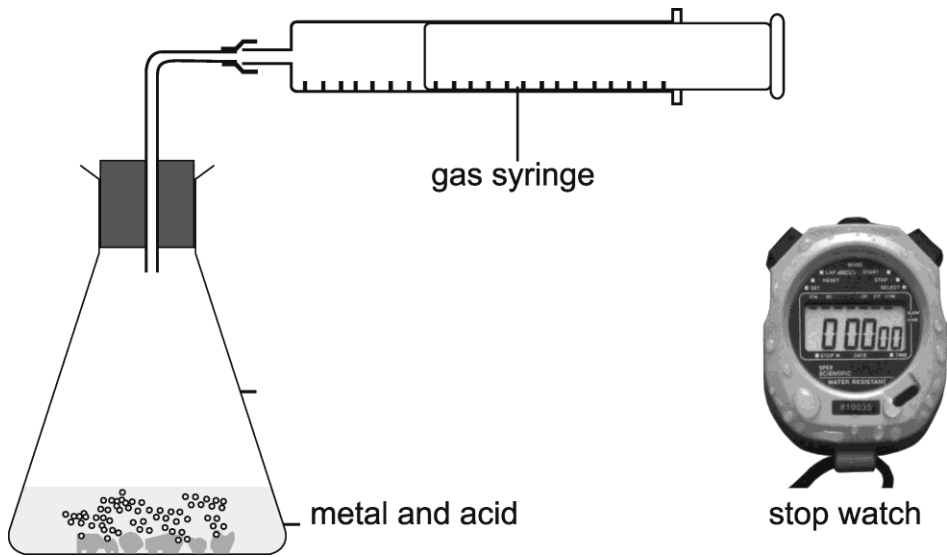
(b) Two of the elements in Mendeleev's Group 2 are **not** in Group 2 of the modern Periodic Table.

Identify the elements and state where they are found in the modern Periodic Table.

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....

.... **[2]**

2 Kai investigates the rate of reaction between a metal and an acid.

He uses this apparatus.

(a) Kai investigates how changing the concentration of the acid affects the volume of gas collected in 10 s.

What factors should Kai control to make sure that his results are repeatable?

Justify your answer.

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.... **[5]**

(b) Kai repeats his experiment three times for four different concentrations of acid.

The table shows his results.

Concentration of acid (mol/dm³)	Volume of gas collected after 10 seconds (cm³)			Mean volume of gas (cm³)
	Repeat 1	Repeat 2	Repeat 3	
0.50	3	2	4	3
1.00	4	5	4	4
1.50	5	6	6	
2.00	6	7	6	

Kai makes this comment on his results.

> If I show the mean volumes for the last two concentrations to one significant figure, they are the same .
>
> I need to show the mean volumes to at least two significant figures to see a difference.

(i) Use calculations to show that Kai is right.

....

....

[3]

(ii)* Evaluate Kai's results and explain how he could change his method to improve the quality of his results.

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.... **[6]**

3   **Extreme Weather Events**

Extreme weather events make big news all over the world. Floods and storms have killed and injured many people around the world and caused massive damage to populated cities in recent years. People are looking to try to explain these events and to predict what will happen in the future.

Scientists have collected data about changes to our climate and our weather and about global carbon emissions. They use data such as this to identify correlations about factors that may affect our climate and to predict likely changes in the future.

Trend in extreme weather events 1970-2005
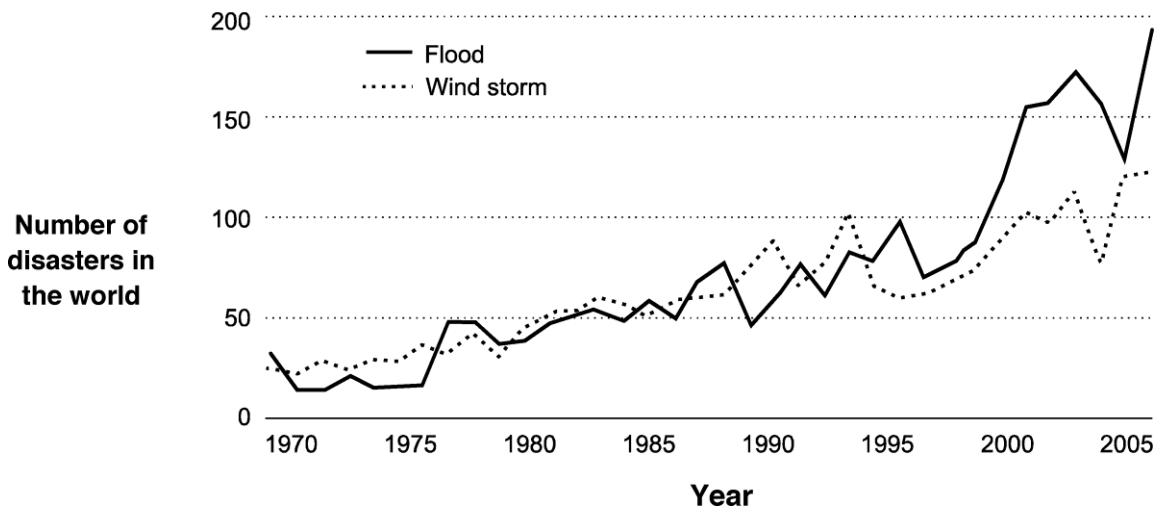
Average Global Temperature, 1880-2013

Global Fossil Carbon Emissions
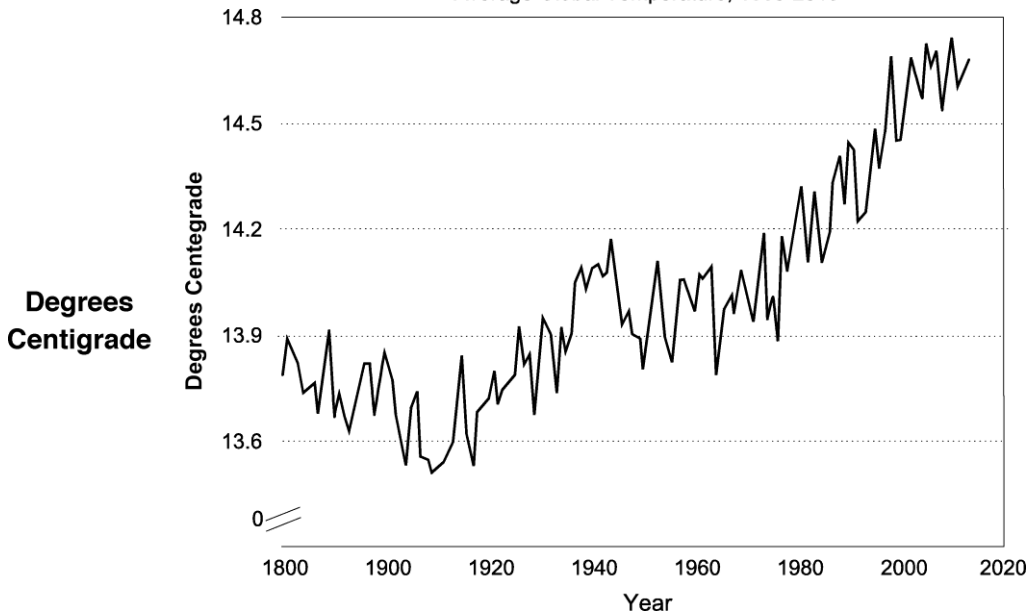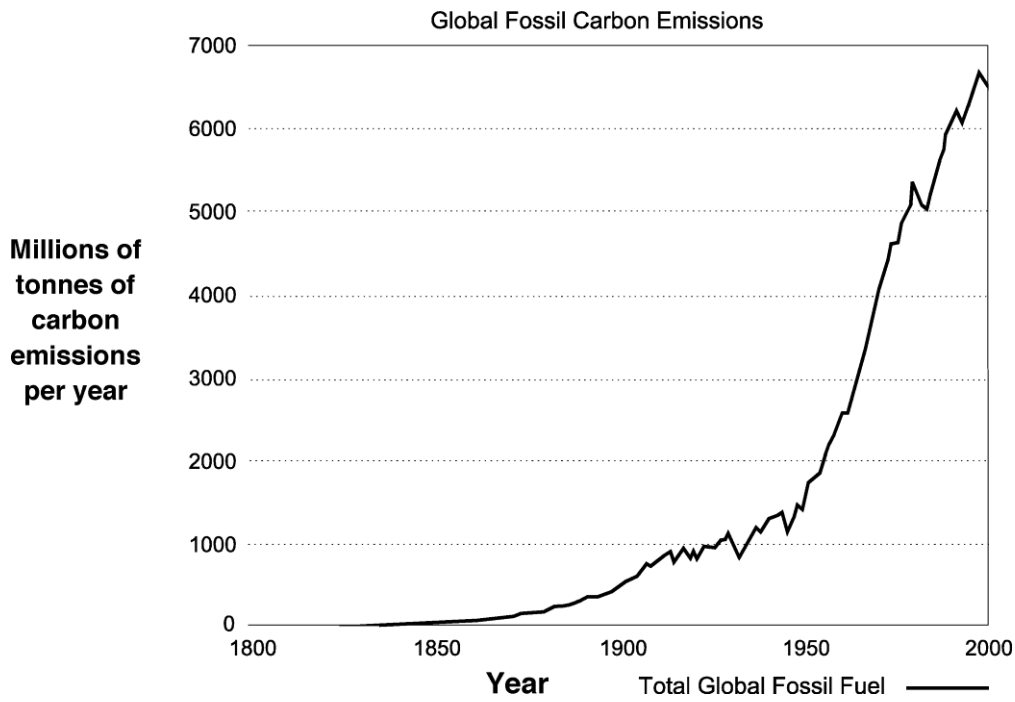
Computer simulations have been developed to predict how our weather and climate may change in the future. These simulations give very accurate predictions about temperature, but they rely on using known values of global carbon emissions. However, scientists say that it is very difficult to make reliable long term predictions for the future.

(a) Scientists have identified correlations about factors which may affect our climate.

Describe the correlations that the graphs show.

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.... **[3]**

(b) Explain why it is difficult to make reliable predictions about changes to global temperatures in the future.

....

....

.... **[2]**

(c) Ben looks at the graphs and makes this comment:

'**There is a much greater percentage increase in the number of floods than in the global temperatures.**

The future risks from floods will get bigger and bigger. In the future, people will be at much greater risks from floods than the risks from rising temperatures.'

(i) Ben says there is a much greater percentage increase in the number of floods than in the global temperature.

Explain why Ben thinks this.

Use values from the graphs to support your answer.

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....

.... **[3]**

(ii) Ben thinks that in the future, people will be at much greater risks from floods than the risks from rising temperatures.

Explain why Ben may not be right.

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.... **[3]**

(d) Read the information about a new way to reduce the problems caused by fossil fuels.

> Scientists in Poland have developed a new method of making old CDs into a material that can absorb carbon dioxide. Carbon dioxide can be 'captured' from the air and stored in the material. Now that consumers download music and store it electronically, more and more CDs will be thrown away and can be recycled to make this new material.
>
> Toxic gases from industrial processes can also be stored in the material.
>
> Scientists hope to be able to make the same material from other waste plastics. However, further development of these ideas will have a high cost. To raise the necessary funding, scientists will need to show that this new idea will have a significant impact on the problems caused by fossil fuels.

Do you think benefits of this process are likely to outweigh the costs in the long term?

Explain your reasoning.

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.... **[4]**

4 Lithium is an element in Group 1 of the Periodic Table.

Lithium reacts with fluorine gas to form lithium fluoride.

Lithium fluoride is an ionic compound.

(a) Write a balanced symbol equation for this reaction.

Include state symbols in your answer.

.... **[3]**

(b) Lithium atoms react with fluorine atoms to form lithium ions and fluoride ions.

Draw dot and cross diagrams to show the arrangement of electrons and charge for a lithium ion and a fluoride ion.

[3]

(c) The table shows some information about fluorine and lithium fluoride.

Substance	Structure	Melting point (in °C)	Boiling point (in °C)
fluorine	simple covalent	−220	−188
lithium fluoride	giant ionic	845	1680

Explain why the melting point and boiling point of fluorine and lithium fluoride are different.

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.... **[3]**

 Turn over

5 Sundip is a geologist. She takes samples of minerals from a range of rocks.

She tests their melting points and electrical conductivity so that she can work out the bonding and structure of each mineral.

The table shows her results.

Mineral	Melting point (in °C)	Electrical conductivity		
		when solid	when molten	when dissolved in water
A	1083	good	good	insoluble
B	1600	does not conduct	does not conduct	insoluble
C	801	does not conduct	good	good
D	373	conduct	good	does not conduct

(a) Sundip thinks minerals **C** and **D** are both ionic compounds with a giant structure.

Explain why Sundip thinks this.

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....

.... **[2]**

(b) Compare minerals **A** and **B**.

What type of structure and bonding do minerals **A** and **B** have?

Explain your answer.

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.... **[4]**

6 The table shows information about some alkanes.

Alkane	Number of carbon atoms	Molecular formula
methane	1	CH_4
ethane	2	C_2H_6
pentane	5	C_5H_{12}
heptane	7	C_7H_{16}

(a) What is the name of the alkane in the table which has the empirical formula CH_3?

Explain your reasoning.

Name: ....

Reason: ....

....

.... **[2]**

(b) The diagram shows a ball and stick model of a hydrocarbon.
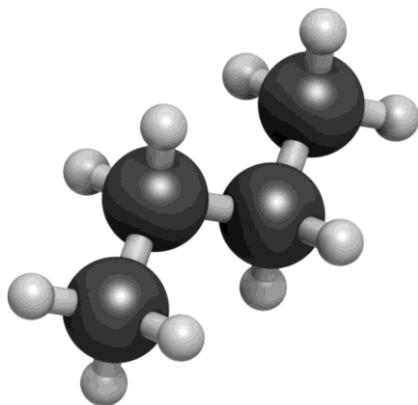
Give the molecular formula and the name of this hydrocarbon.

Molecular formula: ....

Name: ....**[2]**

(c) An alkane in petrol contains 8 carbon atoms.

Draw a fully displayed formula for this alkane.

[2]

7   Li works for a company that makes skateboards.
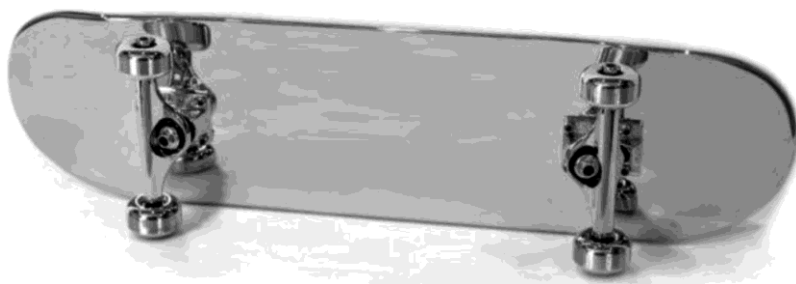
Customers complain that their skateboards lose performance when they get wet.

Skateboards have bearings in **each** wheel to help the wheels rotate smoothly and freely.

Skateboard wheel bearing

The bearings in the wheels contain smaller steel ball bearings.

These rust if they get wet.

The word equation for rusting is:

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

(a) Balance the symbol equation for the formation of rust.

..........$Fe(s)$ + ...$H_2O(l)$ + ...$O_2(g)$ →   ....$Fe_2O_3.3H_2O(s)$ **[2]**
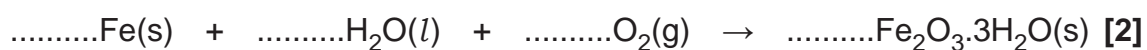
(b) (i) Li tests the skateboard after it has been in wet conditions.

Each ball bearing has a mass of 5 g.

- There are seven ball bearings in each bearing.

- The steel is an alloy of iron and carbon. It contains 0.5% carbon.

- Half of the iron in each ball bearing rusts away.

Calculate the mass of rust (hydrated iron(III) oxide) produced per bearing.

Give your answer to the nearest gram.

Mass of rust = ... g **[5]**

(ii) The mass of the skateboard when new is 3 kg.

Calculate the percentage increase in the mass of the skateboard caused by the rust.

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

Percentage mass increase = ... % **[3]**

(c) Li notices that this skateboard does **not** perform as well as when new.

Suggest, with an explanation, a reason for this and how the problem could be solved.

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.... **[2]**

8 Eve works in a laboratory where food dyes are tested.

Some dyes are banned because they are known to be harmful.

Eve is going to test a jelly that will be exported to the USA.

The table shows R_f values of some food dyes. The first four dyes are banned in the USA.

Food dye	R_f value in 1.755 g/dm^3 sodium chloride solution
Yellow 5	0.71
Blue 2	0.22
Yellow 6	0.52
Red 3	0.10
Red 40	0.25
Blue 1	0.88

(a) Eve prepares a chromatogram of the jelly.

(i) Calculate what concentration of sodium chloride in mol/dm^3 she needs to use.

Concentration of sodium chloride = ... mol/dm^3 **[2]**

(ii) Describe how Eve should set up her chromatography experiment of the jelly.

You may use a diagram in your answer.

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.... **[4]**

(b) * Eve's finished chromatogram is shown below.

Explain the conclusions Eve can make about the jelly.

Include what she could do to increase the confidence in her conclusions.

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.... **[6]**

9 Hydrogen is used on an industrial scale to make fertilisers.

One reaction pathway for making hydrogen is from methane gas reacting with steam.

This is a two stage process.

Stage 1: $CH_4 + H_2O \rightleftharpoons CO + 3H_2$

Stage 2: $CO + H_2O \rightleftharpoons CO_2 + H_2$
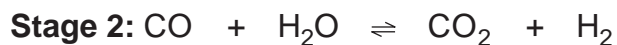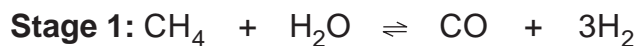
(a) The overall equation for the reaction is:

$CH_4 + 2H_2O \rightleftharpoons 4H_2 + CO_2$
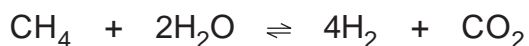
Jack and Nina discuss the process.

> This is an efficient process for making hydrogen. The volume of hydrogen made is four times the volume of the waste

Jack

> I don't agree with you. The atom economy for the reaction is well below 20%.

Nina

(i) What is the waste product of this process?

.... **[1]**

(ii) Use a calculation to show that the volume of hydrogen made is four times the volume of the waste product.

•   One mole of gas has a volume of 24 dm³ at room temperature and pressure.

[2]

(iii) Use the overall equation for the reaction to calculate the atom economy.

Atom economy = ... %   **[3]**

(iv) Explain why the atom economy for the process is low even though the volume of hydrogen made is high.

....

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.... **[2]**

(b) Nina also says that she thinks that this method of making hydrogen is not sustainable in the long term.

Explain why Nina may think this.

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....

.... **[4]**

END OF QUESTION PAPER

OCR
Oxford Cambridge and RSA

…day June 20XX – Morning/Afternoon

GCSE (9–1) Chemistry B (Twenty First Century Science)
J258/04   Depth in chemistry (Higher Tier)

SAMPLE MARK SCHEME

Duration: 1 hour 45 minutes

MAXIMUM MARK   90

This document consists of 23 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.

Level of response questions on this paper are **2(b)(ii)** and **8(b)***.

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 B:

	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.

Question			Answer	Marks	AO element	Guidance
1	(a)		gaps are for undiscovered elements ✓ he predicted properties / new elements matched his predictions / new elements had the properties he predicted ✓	2	1.1	
	(b)		d and Zn / cadmium and zinc ✓ transition metals ✓	2	2.1	Both elements needed for one mark
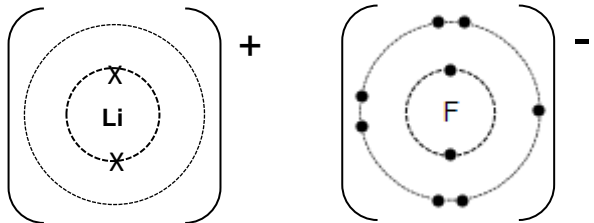
Question			Answer	Marks	AO element	Guidance
2	(a)		volume of acid✓ temperature of acid ✓ mass of magnesium✓ surface area of magnesium ✓ correct link between increase in rate of reaction and factor (e.g. if surface area is greater, rate increase) ✓	5	1.2	
	(b)	(i)	(1.50) 5+6+6 /3=5.7(to two sig figs) ✓ (2.00) 6+7+6 /3 =6.3 (to two sig figs) ✓ Both values round to 6 (to one sig fig) ✓	3	2.2	**ALLOW** 5.67 etc if correctly rounded (last number must be 7)
		(ii)*	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)** *Correctly evaluates the quality of the data as being poor with valid reasons.* ***And*** *Makes several correct suggestions for the development of the method with correct explanation of how the data will be improved.* *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)** *Correctly evaluates the quality of the data as being poor with valid reasons.* ***And*** *Makes several correct suggestions for the development of the method or makes one suggestion with a correct*	6	2 x 3.1b 2 x 3.3a 2 x 3.3b	**Indicative scientific points may include** **AO3.1b evaluation of the quality of Joe's results.** For example • no spread of data • results too close together • volumes measured very small **AO3.3a suggestions for the development of Joe's method** For example • increase time before volume measured • increase volume of acid • increase surface area of magnesium • more magnesium **AO3.3b explanation of how the data will be improved** For example

Question	Answer	Marks	AO element	Guidance
	explanation of how the data will be improved. *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)** *Correctly evaluates the quality of the data as being poor with a valid reason.* ***And*** *Makes one suggestion for the development of the method with no explanation.* *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.			• volume of gas will be greater • more precise measurement of volume • larger spread of data • less overlap of ranges

Question			Answer	Marks	AO element	Guidance
3	(a)		floods, storms, global temperatures or carbon emissions show an increase ✓ idea of similar or <u>same pattern</u> in increase in storms and carbon emissions ✓ identifies similarity in <u>rate</u> of changes / since 1950 far greater increase in carbon emission and global temperature ✓	3	2.1	
	(b)		future global carbon emissions are not definite / not known ✓ idea that predictions are uncertain from extrapolated data / cannot be certain about factors in the future / cannot be certain about a named factor e.g. atmospheric composition / effect of increased water vapour or other ✓	2	2.1 2.2	
	(c)	(i)	gives an approximation of increase in floods /quotes numbers from graph of floods / less than 50 to almost 200 / about 400% ✓ during same period (since 1970) only about 1°C temperature increase / about 3.5% ✓ (conclusion) Idea that floods <u>percentage</u> increase is in multiples / much greater than 100% and that <u>percentage</u> increase in temperature is small ✓	3	3.1a 3.1a 3.2a	

Question			Answer	Marks	AO element	Guidance
		(ii)	risk from floods is increasing more/faster than global temperature ✓	3	**3.1a**	
			(don't agree because) overall risk of harm from floods is still small ✓		**3.2b**	
			(don't agree because) idea that risk of increased temperature is far greater/ names issue such as crop failure/weather pattern changes ✓		**3.2b**	
	(d)		explains positive benefits: **Any <u>two</u> points from**	4		**must be clearly linked to idea of benefit or cost**.
			uses waste CDs ✓			copied statements from question alone do not score.
			carbon dioxide from burning fossil fuels can be stored ✓		**3.1b**	for two benefits award one mark
			also can be used to absorb toxic gases ✓			for two drawbacks award one mark
			in the future other plastic waste may be used ✓			
			saves space in landfills ✓			
			idea of recycling / saves using crude oil to make material ✓			
			explains costs /drawbacks**: Any <u>two</u> points from**			
			cost of development is high ✓		**3.1b**	
			may be other developments which would have a bigger effect ✓			
			not enough CDs/ idea that this is a small scale process / will run out ✓			
			judges overall outcome:			
			makes a decision (yes/no) and justifies it in terms of relative size of benefit and cost ✓		**3.2a**	
					3.2a	

Question			Answer	Marks	AO element	Guidance
			acknowledges uncertainty at judging future benefits and costs / cannot be sure of future outcomes ✓			

Question			Answer	Marks	AO element	Guidance
4	(a)		$2Li(s)$ + $F_2(g)$ → $2.LiF(s)$ state symbols ✓ chemical symbols ✓ balancing ✓	3	 1.1 1.1 1.2	**ALLOW** $Li(s) + \frac{1}{2}F_2(g) \rightarrow LiF(s)$
	(b)		lithium: 2 electrons ✓ fluoride ion: 10 electrons in the arrangement 2, 8 ✓ both charges correct Li^+ and F^- ✓ 	3	1.2	
	(c)		simple covalent substances have lower MP and BP than ionic compounds ✓ idea that forces between molecules of simple covalent substances are weak ✓	3	2.1	**IGNORE** reference to size

Question			Answer	Marks	AO element	Guidance
			idea that attraction between ions in ionic compounds are strong ✓			

Question			Answer	Marks	AO element	Guidance
5	**(a)**		do not conduct when solid but do when molten so ionic✓	2	1.1	
			have a high melting point so giant structure✓		2.1	
	(b)		both have giant structures as both have high melting points✓	4	1.1	
			A conducts electricity when solid or molten, **B** does not conduct electricity✓		2.1	
			therefore			
			A is a metal with a giant structure✓		3.2b	
			B is a covalent compound with a giant structure✓		3.2b	

Question			Answer	Marks	AO element	Guidance
6	(a)		ethane ✓ ratio C:H is 2:6 therefore empirical ratio of C:H is 1:3 ✓	2	2.2	
	(b)		C_4H_{10} ✓ butane ✓	2	1.1 1.2	
	(c)		shows a formula with 8 carbon and 18 H atoms ✓ fully correctly displayed with 4 bonds around each C atom ✓	2	2.1	

Question			Answer	Marks	AO element	Guidance
7	(a)		**4Fe(s) + 6 H$_2$O(l) +3O$_2$(g) ⟶ 2Fe$_2$O$_3$.3H$_2$O(s)**✓✓	2	1.1	One mark for 2 or 3 right Two marks for all 4 right **ALLOW** **2Fe(s) + 3H2O +1 ½ O2(g) ⟶ (1)Fe2O3.3H2O(s)**□
	(b)	(i)	**FIRST CHECK THE ANSWER ON THE ANSWER LINE If answer = 33 (g) award 5 marks.** 7x5 = 35 = mass of steel in ball bearings 35x 0.995 = 34.825g of Fe 34.825 ÷ 2 = 17.4125 amount of iron turned to rust ✓ RAM Fe = 55.8 RMM rust = 213.6 ✓ therefore number of moles of Fe = 17.4125 ÷ 55.8 ✓ ratio of Fe:Rust is 2:1 therefore number of grams of rust = $\frac{17.4125 \times 213.6}{55.8 \times 2}$ ✓ = 33.327 = 33 (g) ✓	5	2.2 1.2 2.2 2.2 1.2	

Question			Answer	Marks	AO element	Guidance
		(ii)	**FIRST CHECK THE ANSWER ON THE ANSWER LINE** **If answer = 2.1 (%) award 3 marks** mass of rust = 4 x 33 = 132 g mass of iron converted to rust = 4 x 17.4125 = 69.65 increase in mass = 132 – 69.65 = 62.35g ✓ % increase = $\frac{62.35}{3000}$ x 100 = 2.078333… ✓ = 2.1(%) to 2 sig figs ✓	3	2.2	**ALLOW ECF** from **(b)(i)**
	(c)		rust is loose so stops the bearings turning the wheels / jams the bearings ✓ one solution from: coat/galvanise/grease ball bearings to form barrier to keep the water and oxygen from the steel ✓ use another material with the same desirable properties but that does not rust/suggestion of an alternative material such as ceramic ✓	2	2.1 1.1	

Question			Answer	Marks	AO element	Guidance
8	(a)	(i)	**FIRST CHECK THE ANSWER ON THE ANSWER LINE** **If answer = 0.03 (mol/dm^2) award 2 marks** RFM of NaCl = 23.0 + 35.5 = 58.5 ✓ therefore $\dfrac{1.755}{58.5}$ = 0.03 (mol/dm^2) ✓	2	2.2	
		(ii)	draw start line with pencil ✓ put a dot of dye on start line ✓ add sodium chloride/solvent to beaker / put paper into solvent ✓ make sure solvent is below level of dot ✓	4	1.2	all points may be scored from a clearly labelled diagram

Question	Answer	Marks	AO element	Guidance
(b)*	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)** *Shows correct understanding of output of the chromatogram and calculates correctly the Rf of each spot, including linking the Rf values to the table of food dyes, leading to identification of issues.* ***And*** *makes correct conclusions about the jelly* ***And*** *Suggests improvements to increase confidence in the result.* *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)** *Shows correct understanding of output of the chromatogram and calculates correctly the Rf of some of the spots, including linking the Rf values to the table of food dyes.* ***And*** *makes some conclusions about the jelly or suggests improvements.* *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.*	**6**	**2 x 1.2** **2 x 2.2** **3.2b** **3.3b**	**Indicative scientific points may include** **AO3.2b: making conclusions about the dye dyes by comparing results with table of Rf values** For example • not clear result • one spot possibly a safe dye • possibly two banned dyes • cannot be exported to USA **AO2.2: directly linking spots Rf values** For example • calculates the Rf of dyes: 0.22/ 0.25/ 0.88 • noticed two spots that have very close Rf values and have merged into one spot • comments on difficulty of calculating the Rf of the all spots • compares spots with table **AO1.2: understanding of the output from a chromatogram** For example • jelly contains 3 dyes • shows how to calculate RF value **AO3.3b: making improvement to increase confidence** For example • use a different solvent • suggest a different method

Question			Answer	Marks	AO element	Guidance
			Level 1 (1–2 marks) *Shows correct understanding of output of the chromatogram and calculates correctly the Rf of some of the spots.* *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.			

Question			Answer	Marks	AO element	Guidance
9	(a)	(i)	carbon dioxide ✓	1	1.1	
		(ii)	H_2: 4 x 24 = 96 dm^3 ✓ CO_2: 1 x 24 = 24 dm^3 ✓	2	2.2	**ALLOW** clear indication of 4 <u>moles</u>:1 <u>mole</u> ratio in calculation for (1) mark
		(iii)	**FIRST CHECK THE ANSWER ON THE ANSWER LINE** **If answer = 15.38 award 3 marks** 8 / 52 x 100 = 15.4 / 15.38 % uses 8 in calculation ✓ uses 52 in calculation ✓ substitutes and computes correctly ✓	3	2.2	**ALLOW** any number of (correct) sig figs correct answer scores (3)
		(iv)	hydrogen has a low (relative atomic) mass ✓ all gases have the same (molar) volume / mass of carbon dioxide is much greater than hydrogen ✓	2	2.1	
	(c)		methane is a fossil fuel / in finite supply ✓ waste product is carbon dioxide ✓ carbon dioxide causes climate change ✓ idea that process cannot continue without causing harm to the environment / cannot continue because raw materials will not be available ✓	4	2.1 2.1 2.1 3.2b	

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.
October 2019	2.1	Question 4 (a) – There has been a change to the Mark Scheme. Addition to guidance column: **ALLOW** $Li(s) + \frac{1}{2}F_2(g) \rightarrow LiF(s)$ Question 7 (a) – There has been a change to the Mark Scheme. Addition to guidance column: **ALLOW $2Fe(s) + 3H_2O + 1\frac{1}{2}O_2(g) \longrightarrow (1)Fe_2O_3.3H_2O(s)$** ✓
October 2021	2.2	Updated copyright acknowledgements.
September 2024	2.3	Updated the font of oxidation numbers.