OCR
Oxford Cambridge and RSA

Foundation

GCSE

Combined Science B Twenty First Century Science

J260/06: Chemistry (Higher Tier)

General Certificate of Secondary Education

Mark Scheme for June 2023

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

MARKING INSTRUCTIONS

PREPARATION FOR MARKING

RM ASSESSOR

1. Make sure that you have accessed and completed the relevant training packages for on-screen marking: *RM 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 available in RM Assessor.

3. Log-in to RM Assessor and mark the **required number** of practice responses ("scripts") and the **required number** of standardisation responses.

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 RM Assessor 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 RM Assessor 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 RM Assessor **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 RM Assessor 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.

The level of response question on this paper is **4c**

11. Annotations available in RM Assessor

Annotation	Meaning
	Correct response
	Incorrect response
	Omission mark
	Benefit of doubt given
	Contradiction
	Rounding error
	Error in number of significant figures
	Error carried forward
	Level 1
	Level 2
	Level 3
	Benefit of doubt not given
	Noted but no credit given
	Ignore

12. Abbreviations, annotations and conventions used in the detailed Mark Scheme (to include abbreviations and subject-specific conventions).

Annotation	Meaning
/	alternative and acceptable answers for the same marking point
✓	Separates marking points
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

13. **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 Combined Science 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)	(i)	Carbon monoxide - Incomplete combustion of fossil fuels Particulates - Incomplete combustion of fossil fuels Nitrogen oxides - oxidation of nitrogen at high temperature Sulfur dioxide - combustion of sulfur impurities in fossil fuel ✓✓	2	1.1	Two or three correct = 1 mark Four correct = 2 marks
		(ii)	(Sulfur dioxide forms) acid rain ✓ (Acid rain) damages buildings/damages wildlife/plants corrodes materials ✓	2	1.1	**ALLOW** idea of combining with water to form (sulfuric) acid. **ALLOW** specific effects on humans e.g. breathing difficulties/irritates eyes/irritates skin/destroys buildings etc **IGNORE** air pollution/ harms ecosystems/ unqualified corrosive/ unqualified toxic
		(iii)	**Any one from:** Catalytic converters ✓ Low sulfur petrol ✓ Gas scrubbers ✓	1	1.1	**IGNORE** wrong gases removed by catalytic converter e.g. carbon dioxide **ALLOW** example of using less petrol in cars e.g use of biofuels/hybrid engines/electric cars/walking/cycling/public transport/low emission zones/energy efficient engines etc as alternative marking point

	(b)		(Description of Trends (Fig 1.1 and Fig 1.2) Carbon dioxide concentration and carbon dioxide emissions increase/both graphs increase (with time) ✓ Change in carbon dioxide concentration and carbon dioxide emissions starts at about the same time/ rate of change in carbon dioxide concentration and carbon emissions becomes faster at about the same time ✓	**4**	**3.1a x 2**	**ALLOW** use of specific dates from graph e.g. both start to change in 1870 Increase in carbon dioxide concentration and carbon dioxide emissions starts at about the same time/ rate of increase in carbon dioxide concentration and carbon dioxide emissions becomes faster at about the same time scores **2** marks
			(Explanation with link to Fig 1.3.) Idea that increased carbon dioxide emissions from fossil fuels (fig 1.2)/increased levels of (atmospheric) CO_2 (fig 1.1) has increased global average temperature (fig 1.3) ✓ Idea that increased CO_2 emissions are due to human activities such as start of use of fossil fuels/increase use of cars/ food production/ metal (eg steel) production/ power generation, ✓		**3.2b x 2**	**ALLOW** any acceptable suggestion that could arise due to increase in human activity

Question			Answer	Marks	AO element	Guidance
2	(a)		**(Healthy food)** dyes are tested for safety / natural / won't harm you ✓ **(Scientist)** only 1 substance in pure substance ✓	**2**	**2.1**	**DO NOT ALLOW** only one type of atom/element **ALLOW** not pure because it is a mixture of (elements/compounds/substances)/more than one ingredient
	(b)		A **AND** D ✓	**1**	**2.1**	
	(c)	**(i)**	A –> solvent front B –> stationary phase C –> mobile phase ✓✓	**2**	**1.2**	3 correct = 2 marks 2 or 1 correct = 1 mark
		(ii)	Their different distribution between phases ✓	**1**	**1.2**	
	(d)	**(i)**	Dye 1 = 2.4(cm) ✓ Solvent = 5.0(cm) ✓	**2**	**1.2**	**ALLOW** tolerance of +/- 0.1 for dye only
		(ii)	**First check the answer on answer line.** **If answer = 0.48 award 2 marks** (2.4 ÷ 5.0) ✓ = 0.48 ✓	**2**	**2.2**	**ALLOW** 2 marks if answer on answer line is correct for responses in (d)(i).

Question			Answer	Marks	AO element	Guidance
3	(a)	(i)	$Mg(OH)_2$ – alkali/base HNO_3 - acid $Mg(NO_3)_2$ – salt ✓✓	2	1.1	3 correct = 2 marks 2 or 1 correct = 1 mark
		(ii)	(Nitric acid -) H^+ (Magnesium hydroxide -) OH^- (Product –) H_2O ✓✓	2	1.1	3 correct = 2 marks 2 or 1 correct = 1 mark
	(b)	(i)	Zinc chloride ✓ Hydrogen ✓	2	2.1	
		(ii)	Zinc/lead loses electrons when they react ✓ (Zinc loses electrons) more easily than lead/higher in reactivity series ✓	2	2.1	**DO NOT ALLOW** zinc/lead gains electrons. **IGNORE** zinc more reactive than lead alone Zinc loses electrons more easily than lead is 2 marks.

Question			Answer	Marks	AO element	Guidance
4	(a)		They are used as fuel/for transport ✓ They are used (by the petrochemical industry) to make many materials/used as feedstock. ✓	2	1.1	**ALLOW** road surfacing/ lubricating oils **IGNORE** named fuels. **ALLOW** used to make polymers/plastics
	(b)	(i)	shorter ✓ so can use for fuels ✓ **OR** Alkenes/contain double bonds ✓ More reactive/ can be turned into many other chemicals ✓	2	1.1	
		(ii)	C_8H_{18} ✓	1	2.2	

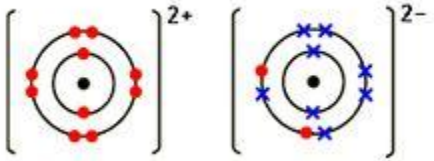
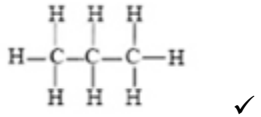
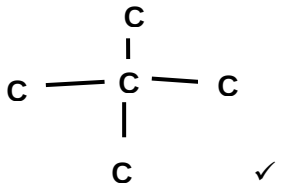
	(c)*		Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question. **Level 3 (5–6 marks)** Detailed description of how separation occurs. **AND** Detailed explanation of why separation occurs. *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** Detailed description of how separation occurs. **OR** Detailed explanation of why separation occurs. **OR** Clear description of how separation occurs **AND** clear explanation of why separation occurs. *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)** Limited description of how separation occurs. **OR** Limited explanation of why separation occurs. *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**	**1.2**	**Describes how separation occurs:** • Crude oil heated • vapourised • passed into fractionating column/tower • vapours pass up column • cool and condense • different sized molecules condense at different levels. • molecules with different boiling points condense at different levels • molecules with higher boiling point condense lower down/ORA • bigger molecules condense lower down/ORA **Explains why separation occurs:** • tower cooler at the top • bigger molecules have stronger intermolecular forces • stronger forces are harder to overcome/more energy needed to overcome forces of attraction • stronger forces so higher boiling point • bigger molecules have higher boiling points • Bigger molecules condense more easily Look for points made on the diagram

Question			Answer	Marks	AO element	Guidance
5	(a)		Rutherford – small, heavy, positive nucleus with electrons orbiting in space around it - most of mass and positive charge must be in a small volume. Bohr - positive nucleus with electrons in shells in space around it – electrons must be in fixed orbits. Thomson – solid positive sphere with small negative particles embedded in it – atoms must contain smaller particles. ✓✓	2	1.1	2 or 3 scientists correct = 2 marks 1 scientist correct = 1 mark **ALLOW** if no marks scored, 1 mark for correctly linking all 3 scientists with how they changed the model **or** for correctly linking how the model changed with why it was changed.
	(b)		**First check the answer on answer line.** **If answer = 2 x 10^{-15} (m) award 2 marks** 1 x 10^{-10} ÷ 50000 ✓ = 2 x 10^{-15} (m) ✓	2	2.2	
	(c)	(i)	Full outer shell (of electrons) ✓	1	1.1	
		(ii)	**Any two from:** Low melting point ✓ Low boiling point ✓ Gas at room temperature (and pressure) ✓	2	1.1	**ALLOW** Non-conductor of heat/non-conductor of electricity/colourless
	(d)	(i)	Na H_2O H_2 ✓	1	1.2	All need to be correct for the mark. **IGNORE** any incorrect balancing added.
		(ii)	**Any two from:** Burns very violently ✓ Melts very quickly ✓ Disappears instantly/more quickly/more rapidly/very quickly ✓ Explodes ✓	2	1.2	

Question			Answer	Marks	AO element	Guidance
6	(a)	(i)	To make sure all the acid is used up / only copper sulfate in solution ✓	1	2.2	**IGNORE** No more solid reacts. **ALLOW** To make sure reaction is complete.
		(ii)	**Any two from:** Stir ✓ Heat (the acid) ✓ More concentrated acid ✓ Powdered solid ✓	2	3.3b	**IGNORE** catalyst/increase concentration unqualified.
	(b)		Filter (off the excess solid) ✓ Heat/boil to evaporate some of the solution / until crystallisation point ✓ Leave to cool / crystallise ✓ Wash (with little distilled water) and dry (between filter papers) ✓	4	1.2	Heat alone is not enough. **DO NOT ALLOW** evaporate to dryness/heat until ALL water evaporated.
	(c)	(i)	**First check the answer on answer line.** **If answer = 0.01 award 3 marks** 20÷1000(=0.02) ✓ 0.5 x 0.02 ✓ 0.01 ✓	3	 **1.2** **2.2 x 2**	
		(ii)	0.01 ✓	1	2.2	**ALLOW** ecf from (c)(i)
		(iii)	**First check the answer on answer line.** **If answer = 2.5 (g) award 3 marks** 249.6 x 0.01 ✓ = 2.496 ✓ = 2.5 (g) ✓	3	 **2.2 x 2** **1.2**	**ALLOW** ecf from (c)(ii) **ALLOW** 249.6 x (c)(ii) **ALLOW** 1dp given alone from incorrect calculation

Question			Answer	Marks	AO element	Guidance
7	(a)	(i)	(Hydrogen) gains oxygen ✓	1	2.1	**ALLOW** hydrogen has reacted with oxygen.
		(ii)	Catalyst ✓ Lowers activation energy / weakens bonds ✓ More collisions lead to reaction/more successful collisions ✓	3	2.1	I**GNORE** more collisions unqualified
		(iii)	**First check the answer on answer line.** **If answer = -486 (kJ) award 3 marks** 436 x2 + 498 (= 1370kJ) ✓ 464 x 4 (= 1856 kJ) ✓ 1370-1856 = -486 kJ ✓	3	2.2	**ALLOW** (+)486 for 2 marks
	(b)	(i)	Add ammonium nitrate to water ✓ Measure temperature (of liquid) before and after / measure temperature change ✓ Temperature should go down (as it says in box that it is an endothermic reaction) ✓	3	3.3a	**DO NOT ALLOW** temperature change of surroundings.
		(ii)	NH_4NO_3 (s) on LHS and NH_4^+ (aq) + NO_3^- (aq) on RHS ✓ Reactant on left and product on right at higher energy ✓ Arrow/line between reactant and peak labelled activation energy ✓	3	2.2	I**GNORE** state symbols.

Question			Answer	Marks	AO element	Guidance
8	(a)		**Any four from:** Copper has the best thermal conductivity so spreads heat evenly ✓ It has higher scratch resistance (than everything else except for glass) so durable ✓ Glass has a low thermal conductivity so wouldn't be suitable ✓ Density high so aluminium would have been better because will be difficult to lift for some people ✓ Polymer, although lowest density, has too low of a melting point to go onto a hob ✓ Copper is best compromise when considering all the factors ✓	4	3.1b	**IGNORE** properties without reason they are important. **ALLOW** low scratch resistance so not durable. **ALLOW** high density so will be (too) heavy. . **ALLOW** company has made a good choice with some justification/choice of other material with justification **ALLOW** high melting point so won't change shape.
	(b)		**Any one from:** Cost (per kg) of material/raw material ✓ Recyclability of material ✓ Availability of raw material ✓ Energy/water usage to manufacture goods ✓ Market competitiveness/appeal to consumers ✓	1	3.2a	**ALLOW** how easily it breaks. **IGNORE** strength.
	(c)	(i)	Energy used ✓ Water used ✓	2	1.1	
		(ii)	**Any one from:** Transport ✓ Use of product ✓ Disposal ✓	1	1.1	

Question			Answer	Marks	AO element	Guidance
9	(a)	(i)	(Dot and cross) does not show arrangement in space/size/scale of ions ✓ (3-d diagram) does not show electron arrangement/size/scale of ions ✓	2	1.1	**ALLOW** does not show shape/is not 3 dimensional. **ALLOW** particles for ions. **DO NOT ALLOW** atoms.
		(ii)	(electrons) are transferred from sodium to chlorine ✓ (Electrostatic forces) between oppositely charged ions ✓	2	2.1	
		(iii)	 Correct electrons ✓ Correct charges ✓	2	2.2	**ALLOW** all dots, all crosses or any combination of dots and crosses. **ALLOW** outer shells only shown. **ALLOW** one mark for correct electrons and charge on one ion.
	(b)		$FeBr_3$ ✓ $Fe_2(SO_4)_3$ ✓	2	2.2	
	(c)	(i)	 ✓	1	2.2	
		(ii)	Does not show arrangement in space/(relative) size of atoms ✓	1	2.1	**ALLOW** does not show shape/is not arranged in 3 dimensions.
		(iii)	CH_3 ✓	1	2.2	
	(d)		 ✓	1	2.2	**ALLOW** more carbons if clearly 2-D

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