Higher

GCSE

Combined Science B Twenty First Century Science

J260/08: Combined science (Higher Tier)

General Certificate of Secondary Education

Mark Scheme for June 2024

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of candidates of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, Cambridge Nationals, Cambridge Technicals, Functional Skills, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

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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. **Crossed Out Responses**
   Where a candidate has crossed out a response and provided a clear alternative then the crossed out response is not marked. Where no alternative response has been provided, examiners may give candidates the benefit of the doubt and mark the crossed out response where legible.

Rubric Error Responses – Optional Questions

Where candidates have a choice of question across a whole paper or a whole section and have provided more answers than required, then all responses are marked and the highest mark allowable within the rubric is given. Enter a mark for each question answered into RM assessor, which will select the highest mark from those awarded. *(The underlying assumption is that the candidate has penalised themselves by attempting more questions than necessary in the time allowed.)*

Multiple Choice Question Responses

When a multiple choice question has only a single, correct response and a candidate provides two responses (even if one of these responses is correct), then no mark should be awarded (as it is not possible to determine which was the first response selected by the candidate).
When a question requires candidates to select more than one option/multiple options, then local marking arrangements need to ensure consistency of approach.

Contradictory Responses

When a candidate provides contradictory responses, then no mark should be awarded, even if one of the answers is correct.

Short Answer Questions (requiring only a list by way of a response, usually worth only one mark per response)

Where candidates are required to provide a set number of short answer responses then only the set number of responses should be marked. The response space should be marked from left to right on each line and then line by line until the required number of responses have been considered. The remaining responses should not then be marked. Examiners will have to apply judgement as to whether a 'second response' on a line is a development of the 'first response', rather than a separate, discrete response. *(The underlying assumption is that the candidate is attempting to hedge their bets and therefore getting undue benefit rather than engaging with the question and giving the most relevant/correct responses.)*

Short Answer Questions (requiring a more developed response, worth two or more marks)

If the candidates are required to provide a description of, say, three items or factors and four items or factors are provided, then mark on a similar basis – that is downwards (as it is unlikely in this situation that a candidate will provide more than one response in each section of the response space.)

Longer Answer Questions (requiring a developed response)

Where candidates have provided two (or more) responses to a medium or high tariff question which only required a single (developed) response and not crossed out the first response, then only the first response should be marked. Examiners will need to apply professional judgement as to whether the second (or a subsequent) response is a 'new start' or simply a poorly expressed continuation of the first response.

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. Award No Response (NR) if:
    - there is nothing written in the answer space

    Award Zero '0' if:
    - anything is written in the answer space and is not worthy of credit (this includes text and symbols).

    Team Leaders must confirm the correct use of the NR button with their markers before live marking commences and should check this when reviewing scripts.

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.

Level of response questions on this paper are **X** and **X**

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)		D or F ✓ **If D is selected** Has the shortest half life (of the beta emitters) ✓ Can be detected outside the body ✓ **If F is selected** **Any two from:** Has the shortest half life (of the gamma emitters) ✓ Least ionising / most penetrating ✓ Can be detected outside the body ✓	3	3.2a	If C is selected maximum 1 mark for the correct explanation: can be detected outside the body If E is selected maximum 2 marks for the correct explanations: can be detected outside the body and least ionising / most penetrating **ALLOW** leaves the body
	(b)		**Any two from:** Wear device that tells you when you've been exposed too long ✓ Store it in (lead-lined) box / container ✓ Wear protective clothing / wear gloves ✓ Do not touch it (if solid) / use tongs ✓ Wash hands after use ✓ Do not point sources directly at people ✓	2	3.3a	**IGNORE** leaving the room as this question asks about 'handling' the source **IGNORE** 'reduce the amount exposed to' unqualified **IGNORE** goggles

Question			Answer	Marks	AO element	Guidance
			Reduce time handling ✓			
	(c)		**First check the answer on answer line** **If answer = 138 award 2 marks** 88 ✓ 226 – 88 = 138 ✓	**2**	**2.2**	
	(d)		2 (electrons) ✓ (Radium is in) group 2 / group number corresponds to number of electrons in outer shell ✓	**2**	**2.1**	
	(e)		Sodium ✓	**1**	**3.2a**	

Question			Answer	Marks	AO element	Guidance
2	(a)		The number of decay events per second ✓	1	1.1	
	(b)		The time for the activity to fall to half. ✓	1	1.1	
	(c)		Random ✓ Match ✓ Trend✓	3	1.1	

Question			Answer	Marks	AO element	Guidance
3	(a)		Identifies bottom right disc ✓	1	3.1a	
	(b)		16 (mm) ✓	1	1.2	**ALLOW** answers between 16-17mm
	(c)		**First check the answer on answer line** **If answer = 200.96 (mm^2) award 3 marks** Calculation of radius: 16/2 = 8 ✓ Substitution: area = 3.14 x 8^2 ✓ = 200.96 (mm^2) ✓	3	1.2	**ALLOW** calculator values **ALLOW ECF** from Q3b **ALLOW** their measured value from 3b divided by 2 for MP1 **ALLOW** the use of π rather than 3.14 to give 201.06 mm^2 **ALLOW** any correctly calculated and rounded value to at least 3 sig fig **IF** 17 is used then correct answer is 226.865 for 3.14 and 226.98 for π
	(d)		**First check the answer on answer line** **If answer = 120 (%) award 3 marks** Substitution: % difference = ((113 – 52) / 52) x 100 ✓ = 117.3076923 ✓ = 120 (%) to 2sf ✓	3	**2.2 x 2** **1.2**	**ALLOW** alternative methods Evaluated mark from the correct equation and substitution of values **ALLOW** ((113 – 52) / 113) x 100 = 53.98 for 1 mark and this correctly rounded to 54 is 2 marks

Question			Answer	Marks	AO element	Guidance
4	(a)	(i)	Water bath ✓ **Any one from:** Maintains / controls the temperature✓ no naked flame ✓ heating more evenly ✓	2	3.3b	**ALLOW** electric heater or description of a water bath
		(ii)	**Any two pairs from:** Use a greater number of temperatures ✓ **AND** Idea that you can see a trend in the data / to improve accuracy ✓ Use same mass of calcium carbonate ✓ **AND** Idea that the comparison is valid ✓ Use a constant concentration of sulfuric acid ✓ **AND** Idea that the comparison is valid ✓ Use data logger (connected to a balance) ✓ **AND** To improve reliability of measurements ✓ Use a measuring cylinder / pipette / burette to measure the 50cm^3 ✓ **AND** To ensure the same volume each time / to get accurate measurements ✓	4	3.3b	**IGNORE** repeats and fair testing

			Measure the change in volume of gas released rather than mass (every 30 seconds) ✓ **AND** Improve the accuracy of the experiment ✓ Record mass more often/frequently ✓ **AND** to collect more valid data to calculate the rate of reaction (using a graph) ✓ Add cotton wool in the top of the conical flask ✓ **AND** To stop loss of acid / improve accuracy of the results ✓ Measure room temperature ✓ **AND** Allows comparison of the rate at two different temperatures ✓			**IGNORE** mention of gas syringe unqualified
	(b)	**(i)**	**First check the answer on answer line** **If answer = 44, award 2 marks** Selection: 12 and 16 from periodic table ✓ ((1 x 12) + (2 x 16)) = 44 ✓	**2**	**2.2**	
		(ii)	**First check the answer on answer line** **If answer = 0.0045 award 3 marks** Calculation of change in mass: (180.0 – 179.8 =) 0.2 (g) ✓ Substitution: 0.2 / 44 ✓ = 0.0045 (mol) ✓	**3**	**2.2**	**ALLOW** alternative methods e.g. subtraction after moles calculation. **ALLOW** correct standard form answers **ALLOW** ECF from b(i) RFM value

		(iii)	**First check the answer on answer line** **If answer = 3.6 x 10^{21} award 2 marks** 0.006 x 6.0 x 10^{23} ✓ = 3.6 x10^{21} (molecules) ✓	**2**	**2.2**	
	(c)	**(i)**	0.2g ✓	**1**	**3.1a**	
		(ii)	Idea that the measurement of 1 cm^3 from the gas syringe allows a calculation of 0.002g which is more accurate than the balance at 0.2g ✓	**1**	**3.3b**	**ALLOW** mass can be calculated to 3 decimal places using the gas syringe (and conversion). E.g.it shows more accurate results given to 3 decimal places when calculating mass. E.g. Measuring the volume using the gas syringe allows a conversion to a mass which is more accurate than the balance **IGNORE** comments about accuracy without qualification It is the conversion that improves the accuracy so answers must reflect this to gain the mark

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>AO element</th><th>Guidance</th></tr>
<tr><td>5</td><td>(a)</td><td></td><td>Parental gametes (alleles) correct (Tall = TT, short = tt) ✓

Genotypes all correct (Tt)✓</td><td>2</td><td>2.2</td><td>ALLOW other letters for parental alleles

ALLOW ECF for incorrect parental alleles

<table><tr><td></td><td>T</td><td>T</td></tr><tr><td>t</td><td>Tt</td><td>Tt</td></tr><tr><td>t</td><td>Tt</td><td>Tt</td></tr></table></td></tr>
<tr><td></td><td>(b)</td><td></td><td>Any two from:

All offspring / 100 / pea plants would be tall ORA ✓

All (offspring) the same genotype /all Tt /all heterozygous / all offspring have a dominant allele / no offspring have genotype tt✓

Idea that 50 short and 50 tall can only be produced from homozygous recessive and a heterozygous pea plant ✓</td><td>2</td><td>3.1b</td><td>ALLOW ECF if both parents on the punnet square are heterozygous offspring probability is 75(%) tall / 25(%) short</td></tr>
</table>

Question			Answer	Marks	AO element	Guidance
6	(a)		**First check the answer on answer line** **If answer = 1.08 (m/s^2) award 2 marks** acceleration = (2.7 – 0) ÷ 2.5 ✓ = 1.08 (m/s^2) ✓	**2**	**2.1**	**ALLOW** correct evaluation from incorrect substitution
	(b)		(10 – 0) = 10 (m/s^2) ✓	**1**	**2.1**	**ALLOW** use of 9.8 or 9.81 for value of acceleration in freefall **IGNORE** any signs

Question			Answer	Marks	AO element	Guidance
7	(a)	(i)	**First check the answer on answer line** **If answer = 0.012 (cm^3/s) award 3 marks** Evidence of triangle method shown on the graph / correct numbers from the graph ✓ Substitution: rate of reaction = 4.4 – 0 / 360 – 0 ✓ = 0.012 (cm^3/s) ✓	**3**	**2.2**	**ALLOW** answer given to 2d.p. **ALLOW** values from 0.012 to 0.013 for 3 marks **ALLOW ECF** from incorrect substitution of values
		(ii)	Place glowing splint inside test tube which contains gas ✓ Splint will relight (if oxygen is present) ✓	**2**	**1.2**	**ALLOW** lighted splint blown out **DO NOT ALLOW** lighted splint going out **DO NOT ALLOW** lighted splint (zero marks)
	(b)	**(i)**	**Any two from:** The student is correct / the rate decreases, the graph shows volume (of gas) produced in 10 minutes decreases with distance from the lamp ✓ Idea that change in rate is small between 0.1m to 0.2 / 0.5m to 0.6m ✓ 0.2 to 0.5 has the largest decrease in rate ✓	**2**	**3.2b**	Must discuss rate or refer to student being correct to score MP1 **IGNORE** negative correlation unqualified **ALLOW** rate is the same between 0.1 to 0.2m or 0.5 to 0.6m
		(ii)	**Any two from:** Temperature ✓ Concentration of carbon dioxide ✓ Type / size of pondweed ✓ Light from external source ✓	**2**	**3.3a**	

Question			Answer	Marks	AO element	Guidance
			Same lamp used ✓			
		(iii)	**First check the answer on answer line** **If answer = 0.08 (cm^3/ min) award 2 marks** Reading value 0.8 cm^3 from the graph✓ (0.8 ÷10) = 0.08 (cm^3 / min)✓	**2**	**2.2**	
	(c)	**(i)**	10.15 **AND** 14.45 ✓	**1**	**3.1a**	**ALLOW** 10.00 to 10.30 **and** 14.30 to 15.00 **ALLOW** Times identified from the intersections on the graph
		(ii)	Photosynthesis curve broader than the photosynthesis curve on the graph ✓ Photosynthesis curve higher than the photosynthesis curve on the graph at all points ✓	**2**	**3.2a**	**DO NOT ALLOW** lines that cover 24 hour period or implies no hours of darkness

Question			Answer	Marks	AO element	Guidance
8	(a)		(Newton) scale(s) / Newton-meter / Use a spring / (top-pan) balance ✓	1	1.2	**ALLOW** mass multiplied by gravitational field strength if mass is measured **DO NOT ALLOW** mass in kg unless converted to Newtons by multiplying by gravitational field strength
	(b)		Weight acting downwards ✓ Tension acting upwards / opposes weight ✓	2	2.1	**ALLOW** gravity **ALLOW** Weight and Tension for 1 mark if no other marks are awarded
	(c)		Two arrows equal in length drawn touching (the diagram) and in opposite directions from the ankles / waist ✓ Both arrows labelled pull of bungee on person / tension / upward force **AND** pull of person on the bungee / weight / alternative labels describing forces acting up and down ✓	2	2.1	**ALLOW** arrows drawn close to the diagram, equal and opposite in length
	(d)		(when the graph is a straight line) force and extension are proportional / extension increases when force increases ✓ (Beyond a certain point) force is no longer proportional to extension / the graph plateaus and extension increases more with the same force ✓	2	1.1	**IGNORE** elastic deformation occurs **ALLOW** positive correlation **IGNORE** plastic deformation occurs

Question			Answer	Marks	AO element	Guidance
9	(a)*		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)** Explains in detail why Nylon is the best material for the rope referring to all properties **AND** identifies why the other materials are not suitable **AND** identifies other factor(s) that may be considered. *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)** Explains in detail why Nylon is the best material for the rope referring to all properties **AND** identifies why the other materials are not suitable **OR** Explains in detail why Nylon is the best material for the rope referring to all properties **AND** identifies other factor(s) that may be considered. *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 explanation of their choice of material *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**	**3.2a**	Indicative content may include: **All three ropes are of suitable strength**. **Nylon** • Has a low spring constant so stretches easily • Has a density greater than water so will sink **Aramid** • Has a high spring constant so doesn't stretch easily • Has a density greater than water so will sink **Polypropylene** • Less dense than water so will float. • Lowest spring constant so stretches the most **Other factors** • Consideration of sustainability of materials • Consideration of cost • Consideration of time for which product can be used / be under stress • Consideration of environmental impact and life-cycle assessment • Consideration of recycling / reuse • Consideration of ease of transport • Consideration of CO_2 emissions in lifespan of product • Consideration of water use

						• Consideration of the impact on the marine environment
	(b)		**Any three from:** Forms 4 covalent bonds ✓ (Carbon) can bond to itself / other elements ✓ (Carbon) can form chains ✓ (Carbon) can form rings ✓ (Carbon) can form double bonds (to enable addition) ✓ (Carbon) can form compounds of different lengths ✓ (Longer chains) gives stronger intermolecular forces ✓ Can form Cross links ✓ (Chains) can be branched ✓ Monomers can join to form polymers ✓ (Carbon) can form compounds of different properties ✓	**3**	**2.1**	**ALLOW** strong intermolecular bonds instead of forces **ALLOW** named properties of polymers e.g. strength, flexibility, density

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