OCR
Oxford Cambridge and RSA

Foundation

GCSE

Combined Science B Twenty First Century Science

J260/03: Physics (Foundation Tier)

General Certificate of Secondary Education

Mark Scheme for June 2022

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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.

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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 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 question on this paper is **11d**

11. Annotations available in RM Assessor

Annotation	Meaning
	Correct response
	Incorrect response
	Omission mark
BOD	Benefit of doubt given
CON	Contradiction
RE	Rounding error
SF	Error in number of significant figures
ECF	Error carried forward
L1	Level 1
L2	Level 2
L3	Level 3
NBOD	Benefit of doubt not given
SEEN	Noted but no credit given
I	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.

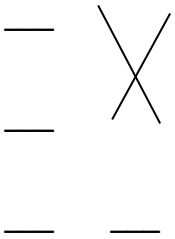
The breakdown of Assessment Objectives for GCSE (9-1) in Combined Science B:

	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)		sound waves ✓	1	1.1	**ALLOW** any unambiguous indication
	(b)	(i)	light ✓ temperature ✓	2	1.1	**ALLOW** any unambiguous indication
		(ii)	Radio / microwave / infrared / UV / X-ray / gamma ✓	1	1.1	**IGNORE** visible / light
	(c)	(i)	B ✓	1	1.1	
		(ii)	A ✓	1	1.1	
	(d)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 343 (m/s) award 2 marks** 196 × 1.75 ✓ = 343 ✓	2	2.1	

Question			Answer	Marks	AO element	Guidance
2	(a)		500 (J) ✓	1	1.2	
	(b)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 60 (%) award 3 marks** useful energy = 750 J ✓ substitution: Efficiency = 750 ÷ 1250 ✓ 0.60 x 100 = 60 % ✓	3	 2.2 2.1 x 2	
	(c)		They transfer energy to cells heating them up. ✓	1	2.1	Tick in 4th box

Question			Answer	Marks	AO element	Guidance
3	(a)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 189 (N) award 3 marks** Recall Force = mass × acceleration ✓ Substitution: Force = 30 × 6.3 ✓ Force = 189 (N) ✓	3	 **1.2** **2.1 x 2**	 **ALLOW** 190 (N) (2sf)
	(b)		B ✓	1	2.1	**ALLOW** any unambiguous indication
	(c)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 18 (m/s) award 3 marks** Recall: speed = distance ÷ time ✓ Substitution: speed = 540 ÷ 30 ✓ speed = 18 (m/s) ✓	3	 **1.2** **2.1 x 2**	

Question			Answer	Marks	AO element	Guidance
4	(a)		protons ✓ 10^{-15} m ✓	2	1.1	Answers ringed **ALLOW** any unambiguous indication
	(b)		**Scientist -----** Description of model **------** *Order* **Thomson** --- The atom contains small negative particles. They are spread through the positive atom. -------- *The second model of the atom* **Dalton** ------- Atoms are small solid particles. Every atom of an element is the same ------- *The first model of the atom* **Rutherford** ------ Most of the mass of the atom is concentrated in the centre of the atom. Very small particles orbit the mass at the centre. ------- *The third model of the atom.* ✓✓✓✓	4	1.1	All 6 lines correct = 4 marks Left side 3 lines correct = 2 marks Left side 1 or 2 lines correct = 1 mark Right side 3 lines correct = 2 marks Right side 1 or 2 lines correct = 1 mark 
	(c)		Electrons ✓ Idea of electrons shells / electron energy levels in Bohr model ✓	2	1.1	
	(d)		False True True False ✓✓✓	3	1.1	All 4 correct = 3 marks 3 correct = 2 marks 2 correct = 1 mark

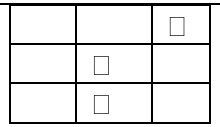
Question			Answer	Marks	AO element	Guidance
5	(a)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 132 (C) or 130 (C) award 3 marks** Conversion: 2 minutes = 2 × 60 seconds = 120 ✓ Substitution: Charge = 1.1 × 120 ✓ Charge = 132 (C) OR 130 (C) ✓	**3**	 **1.2** **2.1 x 2**	**ALLOW** 2 marks if no unit conversion:1.1 x 2 = 2.2
	(b)	**(i)**	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 2.1 (J) award 2 marks** Substitution: G.P.E. = 2.5 × 0.84 ✓ G.P.E. = 2.1 (J) ✓	**2**	**2.1**	
		(ii)	2.1 (J) ✓	**1**	**2.1**	**ALLOW ECF** (bi)

Question			Answer	Marks	AO element	Guidance
6	(a)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 2 (m/s^2) award 3 marks** Recall: acceleration = change in speed ÷ time taken ✓ Substitute: *a* = (28 - 22) ÷ 3 ✓ *a* = 2 (m/s^2) ✓	**3**	 **1.2** **2.1 x 2**	
	(b)		chemical ✓ kinetic ✓ thermal ✓ kinetic ✓ thermal ✓	**5**	**1.1**	
	(c)		$\frac{108 \times 1000}{60 \times 60}$ ✓	**1**	**1.2**	1st answer ringed **ALLOW** any unambiguous indication
	(d)		**Any two from:** Mass (of car) ✓ Speed (of car) ✓ Examples of adverse weather conditions e.g. snow/ice/rain ✓ Examples of road surface conditions e.g. wet/mud/oil ✓ Worn tyres/brakes ✓ Conditions that affect the friction (on the car) ✓	**2**	**1.1**	**IGNORE** factors affecting driver's reaction time **ALLOW** weight / number of people in car
	(e)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 1 300 000 (J) award 3 marks** Substitute: work done = 17 000 × 75 ✓ Work done = 1 275 000 (J) ✓ Work done = 1 300 000 (J) ✓	**3**	 **2.1 x 2** **1.2**	 **ALLOW** this mark for an incorrect answer written to 2 s f

Question			Answer	Marks	AO element	Guidance
7	(a)		Thermistor ✓	1	1.2	3rd box ticked **ALLOW** any unambiguous indication
	(b)		Use a variable resistor / potentiometer ✓	1	3.3b	**DO NOT ALLOW** Resistor
	(c)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 9 ohms/Ω award 4 marks** Read from table: V = 0.81 (V) ✓ Substitution: R = 0.81 ÷ 0.09 ✓ R = 9 ✓ unit = ohms/Ω ✓	4	 1.2 2.1 x 2 1.1	 **ALLOW** a correct answer with correct prefix **ALLOW** unit mark for Ω if numerical answer is incorrect.

Question			Answer	Marks	AO element	Guidance
8	(a)		they move over/around each other **OR** They are no longer in fixed positions ✓	1	2.1	**DO NOT ALLOW** They move faster, gain kinetic energy, move far apart, move freely
	(b)	(i)	freezes ✓	1	2.1	**ALLOW** solidifies / changes state **IGNORE** references to temperature
		(ii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 12 (°C) award 2 marks** 42 (°C) **OR** 30 (°C) ✓ (42 - 30 =) 12 (°C) ✓	2	 2.2 2.1	I**GNORE** minus Sign
	(c)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 2880 (J) award 2 marks** apply: change in internal energy = mass × SHC × change in temperature = 0.15 × 1600 × 12 ✓ change in internal energy = 2880 (J) ✓	2	2.1	**ALLOW ECF** answer to **(b)(ii)** I**GNORE** minus Sign

Question			Answer	Marks	AO element	Guidance
9	(a)		Amir (because radioactive decay is random) ✓	1	3.2a	
	(b)		**beta** because thin aluminium reduces/stops the radiation (more than paper) ✓ **No alpha because:** radiation is not reduced/stopped by paper **OR** because there is no change in radiation with paper **OR** because all the radiation passes through (the paper) ✓ **No gamma because:** (thick) lead does not reduce radiation (more than (thin) aluminium) **OR** because there is no change in radiation (from beta result) with (thick) lead **OR** because the results with thin aluminium and thick lead are the same. ✓	3	3.1b	
	(c)		Half-life in range of 5600 - 5800 (years) ✓	1	3.2b	

Question			Answer	Marks	AO element	Guidance
10	(a)		**Any two from:** solids denser than liquids **OR** liquids less dense than solids ✓ solids denser than gases **OR** gases less dense than solids ✓ liquids denser than gases **OR** gases less dense than liquids ✓	2	2.1	**ALLOW** 2 statements that do not fully describe e.g. solids denser than gases and liquids denser than gases (no comparison of solids and liquids.)
	(b)		**Any three from:** particles in solids are close together / tightly packed ✓ particles in liquids are further apart than in solids ✓ Particles in liquids are not as far apart as in gases ✓ particles in gases are far apart /widely spaced ✓	3	1.1	**DO NOT ALLOW** suggestions that particles have changed size or mass, OR that the number has changed unless explained that it is number per unit volume. **ALLOW** diagrams for marking points
	(c)		mass of the helium gas = stays the same ✓ pressure of the helium gas = increases ✓ average speed of the helium gas particles = increases ✓	3	2.1	

Question			Answer	Marks	AO element	Guidance
11	(a)		Transmitting power at higher voltages is more efficient ✓	1	2.1	tick in 4th box
	(b)		The walls transfer energy / heat (at a) slower (rate) ✓	1	2.1	**ALLOW** Less energy transferred over a specific time
	(c)		Idea that Renewable resources are replaced all the time (so they will not be used up) **OR** non-renewable resources (are being used faster than they are formed) eventually (they) will all be used up. ✓	1	1.1	**ALLOW** non-renewable resources are finite/will run out ORA **ALLOW** renewables can be replaced / made again **ALLOW** non-renewables take a very long time to replace **IGNORE** renewables can be re-used / used again ORA

Question			Answer	Marks	AO element	Guidance
11	(d)*		Please refer to the marking instructions on page 5 of this mark scheme for guidance on how to mark this question. **Level 3 (5–6 marks)** Detailed explanation of how energy resource use has changed, using numerical data from the graph linked to at least two resources *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)** Basic explanation of how energy resource use has changed with some reference to the graph, explanation may contain some errors. *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)** Basic description of how energy resource use changed **OR** Basic isolated facts about resources *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**	**2 x 2.1** **4 x 3.1a**	**AO3.1a Analyse information and ideas to interpret.** • Wind and Solar increased • Coal decreased (overall) • Natural gas stayed about the same overall / only increased slightly • Much greater increase in wind and solar in later years • Natural gas increased from 1998 to 2008, then decreased to 2012 (then increased again) • Coal remained constant until 2008, then increased, before decreasing in 2012 **AO2.1 Apply knowledge and understanding of scientific ideas.** • Wind and solar do not release greenhouse gases • Increased use of wind and solar / decreased use of coal and gas reduces greenhouse gas emissions • Government drive to combat climate change • More gas used after 2012 to meet demand from reduced use of coal • Wind and solar are renewable resources • Fossil fuels cause acid rain • Coal and gas are fossil fuels and will eventually run out

Question			Answer	Marks	AO element	Guidance
12	(a)		(C) B E G F D A B before E E before G G before F F before D D before A ✓✓✓	3	1.2	Before means anywhere to the left All 5 correct = 3 marks 4 correct = 2 marks 2 correct = 1 mark
	(b)		**Any two from:** Draw around the glass block (to ensure it doesn't move) ✓ Mark multiple crosses/points along the ray of light✓ Make sure the room is dark / reduce external light / use brighter lamp✓ Use a thin ray of light✓ Use large protractor✓ Use sharp pencil / draw a thin line✓ Use a ruler to draw ray lines✓	2	3.3a	**IGNORE** repeats
	(c)	(i)	Points plotted correctly ✓ ✓	2	1.2	**ALLOW** range (± 1 small square) All points correct = 2 marks Three points correct = 1 mark
		(ii)	(50, 41) circled on the graph ✓	1	3.1a	**ALLOW** ECF for incorrect plotting of point 50, 41
		(iii)	Curve drawn through points ✓	1	2.2	**DO NOT ALLOW** straight line. **ALLOW** straight line for first three points followed by a curve
		(iv)	Positive correlation ✓	1	3.2b	**ALLOW** as angle of incidence increases, angle of refraction increases **ALLOW** as one increases the other increases **DO NOT ALLOW** proportional

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