OCR
Oxford Cambridge and RSA

Higher

GCSE

Physics B Twenty First Century Science

J259/01: Breadth in physics (Foundation Tier)

General Certificate of Secondary Education

Mark Scheme for June 2023

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.

It is also responsible for developing new specifications to meet national requirements and the needs of students and teachers. OCR is a not-for-profit organisation; any surplus made is invested back into the establishment to help towards the development of qualifications and support, which keep pace with the changing needs of today's society.

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 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**.

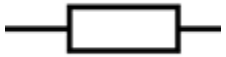
Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

The breakdown of Assessment Objectives for GCSE (9-1) in Biology/Chemistry/Physics/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)		gravitational potential ✓	1	1.1	Third box ticked
	(b)		Steam ✓ Steam ✓ Water ✓	3	1.1	**IGNORE** any ticks in the top row of the table.
	(c)	(i)	400 (J) ✓	1	3.1a	
		(ii)	Lubricate/name a lubricant (oil) ✓	1	2.1	**ALLOW** polish the moving parts **ALLOW** use a coolant.
	(d)		**First check the answer on answer line** **If answer = 1 (MW) award 2 marks** 3600÷3600 ✓ = 1 (MW)✓	2	2.1	**ALLOW** method mark if there is no or incorrect conversion of 1 hour to seconds So either 3600 ÷ 1 or 3600 ÷ 60 would get one mark. No marks awarded if 4000 is the numerator.

Question			Answer	Marks	AO element	Guidance
2	(a)	(i)	Narrow ✓	1	1.1	
	(b)		source **AND** energy ✓	1	1.1	
	(c)	(i)	29, 461, 600 ✓	1	2.1	**ALLOW** Earth, barbecue, Sun
		(ii)	decreases✓	1	1.1	Top box ticked
	(d)	(i)	1 000 000 / 1 million / 10^6 ✓	1	1.2	
		(ii)	100 ✓	1	1.2	Second box ticked

Question			Answer	Marks	AO element	Guidance
3	(a)		Current splits at branches in a parallel circuit ✓	1	1.1	Top box ticked
	(b)	(i)	Circle drawn round this component  ✓	1	1.1	Right hand component indicated clearly
		(ii)	The current decreases ✓	1	2.1	Top box ticked
	(c)		More charge can pass than for either component alone ✓ There are two paths for the current to flow ✓	2	1.1	Top box ticked Bottom box ticked IF there are 3 ticks, 2 in the correct boxes and one incorrect only one mark can be awarded.
	(d)		Potential difference ✓ Potential difference ✓	2	1.2	
	(e)		**First check the answer on answer line** **If answer = 0.8 C award 3 marks** 3.2 ÷ 4 ✓ = 0.8 ✓ C ✓ (unit)	3	 **2.1 x 2** **1.1**	 **ALLOW** coulombs

Question			Answer	Marks	AO element	Guidance
4	(a)	(i)	Light is transmitted **OR** (the clear buttons are) transparent ✓	1	2.1	**ALLOW** light goes through for transmitted. **ALLOW** see-through for transparent. **ALLOW** translucent **IGNORE** reflection, refraction
		(ii)	Light is absorbed **OR** (the black buttons) are opaque ✓	1	2.1	**ALLOW** light can't go through the buttons **DO NOT ALLOW** not transparent
	(b)		(similarity) **Any one from:** both change the direction of the rays ✓ both refract ✓ both allow the middle ray to pass straight through ✓ (difference) **Any one from:** One converges and one diverges (the rays) or **AW** ✓ One forms a real image and one forms a virtual image ✓	2	1.1	**IGNORE** reflection **ALLOW** both are transparent **ALLOW** light or rays go through both lenses. **NOT ALLOW** lines go through the lens **ALLOW** one bends (rays) inwards and one bends (rays) outwards. **DO NOT ALLOW** rays go in different directions without more clarification. **ALLOW** one makes the rays all meet and one makes the rays go away from one another. **ALLOW** convex/concave as a difference

Question			Answer	Marks	AO element	Guidance
	(c)		(the light) changes direction/refracts/disperses ✓ **AND any one from:** (when it) changes medium/material ✓ light slows down in glass **ORA** ✓ (refracts) towards the normal as it enters the glass and/or (refracts) away from the normal as it leaves the glass prism. ✓ Into different colours or spectrum ✓ different wavelengths / frequencies of light are refracted/bent by different amounts. ✓	**2**	**1.1**	**ALLOW** bends instead of refracts **IGNORE** reflection
	(d)		**Any three from:** Repeat the experiment with the same angle and find the average/to improve accuracy/remove outliers ✓ Repeat the experiment for more than 2 angles of incidence ✓ Use a protractor (to measure the angles) ✓ Use a (sharp) pencil ✓ Use a ruler ✓ Draw around glass block (so it stays in some position) ✓ Ensure that there is a slit with the raybox to have a narrow ray of light **AW** ✓ Draw a normal / line at right angles to the side of the block where the light hits and/or leaves the glass block. ✓ Do the experiment in the dark / low ambient light ✓ Repeats will mean that anomalies can be ignored ✓	**3**	**3.3b**	**IGNORE** reference to changing shape of the block.

Question			Answer	Marks	AO element	Guidance
5	(a)		3300 (m) ✓	1	1.2	
	(b)		**First check the answer on answer line** **If answer = 30 m award 3 marks** Substitute values into the given equation: 3300 = 110 × λ ✓ Rearrange (to get λ) = 3300 ÷ 110 ✓ = 30 (m) ✓	3	2.1	If the equation has been rearranged before substitution, the middle can be awarded.
	(c)	(i)	330 (m/s) ✓	1	2.1	
		(ii)	Ring around <u>a shorter</u> ✓	1	2.1	

Question			Answer	Marks	AO element	Guidance
6	(a)	(i)	**First check the answer on answer line** **If answer = 120 (J) award 3 marks** Evidence of selection of correct equation: (Kinetic energy =) ½ x mass x (speed)^2 / ½ mv^2 ✓ Substitution of values into equation KE = ½ x 0.6 x 20^2 ✓ = 120 (J) ✓	3	**1.2** **2.1 x 2**	If the equation has been written down correctly and then the values substituted correctly but the candidate omits to square 20, then 2 marks can be awarded. .
		(ii)	**First check the answer on answer line** **If answer = 72 (km/h) award 2 marks** division by 1000 eg (20 / 1000 = 0.02)✓ multiplication by 3600 eg 0.02 x 3600 (= 72 (km/h))✓	2	1.2	The steps could be in any order.
	(b)	(i)	Air resistance **OR** drag ✓	1	2.1	**ALLOW** friction with the air, but not friction on its own. **ALLOW** wind resistance .
		(ii)	**EITHER** Kinetic energy store of the ball decreases **OR** Gravitational energy store of the ball increases. ✓	1	2.1	**IGNORE** thermal energy store of surroundings or air increases. **ALLOW** thermal store of ball increases.
		(iii)	**First check the answer on answer line** **If answer = 18 J award 3 marks** Correct substitution into equation; work done = 3.5 × 5.2 ✓ (Evaluation) = 18.2 ✓ (Correct to 2 sf) =18 (J) ✓	3	**2.1 x 2** **1.2**	
	(c)		0 ✓	1	2.2	

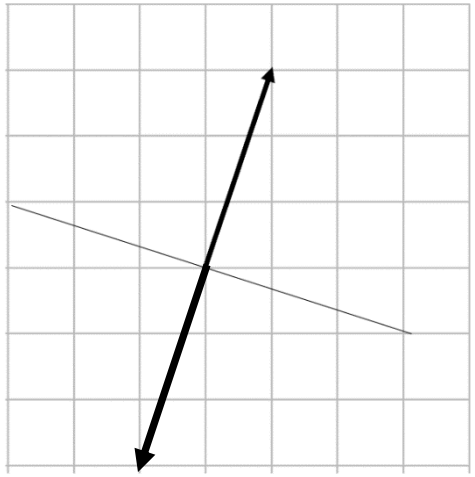
Question			Answer	Marks	AO element	Guidance
7	(a)		At least 3 arrows, all of which, point towards the outside of the bottle (opposite the printed arrows) ✓ All drawn arrows are at right-angles towards the bottle surface. ✓	2	2.1	**IGNORE** arrows pointing towards open lid. If only 2 arrows are drawn, then max 1 mark if both statements correct. If the arrows are pointing away from the bottle, no marks are awarded.
	(b)	(i)	air pressure higher at the bottom of mountain **ORA** ✓ **Any one from:** pressure outside bottle now greater (than pressure inside) **ORA**. ✓ force outside bottle now greater (than force inside) **ORA**. ✓ there is a net force from the outside of the bottle. ✓	2	3.2a	
		(ii)	**Any two from:** Gravitational force acts on air particles ✓ The weight of air above causes air pressure. ✓ Less air above means lower air pressure. ✓ Density of air decreases with height. ✓ Air particles will collide less high up. ✓	2	1.1	
	(c)	(i)	(final speed)^2 – (initial speed)^2 = 2 × acceleration × distance $v^2 - u^2 = 2as$ ✓	1	1.2	**ALLOW** any subject
		(ii)	distance = $2^2 - 0^2$ / (2 x 0.5) ✓	1	2.1	Bottom left expression clearly indicated.

Question			Answer	Marks	AO element	Guidance
8	(a)		Unstable ✓ Emit ✓	2	1.1	
	(b)		Beta ✓	1	1.1	Middle box ticked
	(c)		They have different numbers of protons ✓	1	1.1	Bottom box ticked

Question			Answer	Marks	AO element	Guidance
9	(a)	(i)	Nina (Is there life on other planets?) **AND** Jack (Was there ever liquid water on the moon?) ✓	1	3.1b	Names can be in either order.
		(ii)	Mei (Should we mine asteroids for metals and minerals?) ✓	1	3.1b	
	(b)		The direction and speed a galaxy is moving as it emits light ✓	1	1.1	Middle box ticked
	(c)	(i)	Both points plotted (within ½ small square in the x- and y- directions) ✓ Line of best fit is straight (goes through the origin) and passes through or close to plotted points ✓	2	2.2	If the plots are correct the line should pass through all the plots. If only one plot off the straight line, it needs to pass within about 1 square diagonally of the plotted points. If both plotted are incorrect then a line with even distribution of plotted points is acceptable.
		(ii)	Directly proportional ✓	1	2.2	Top box ticked
		(iii)	Straight line ✓ Through origin ✓	2	1.2	**IGNORE** positive trend or positive correlation or similar description.
		(iv)	**Any two from:** Universe is expanding ✓ More distant galaxies are moving faster (away from us) **ORA** ✓ Universe began at a point/singularity (in time or space) ✓ several (10+) billion years ago ✓	2	1.1	**IGNORE** description of the birth of solar system.

Question			Answer	Marks	AO element	Guidance
10	(a)		**Any two from:** Friction (between child and slide) ✓ <u>Charge/electrons</u> transferred/gained/lost (between slide and child) ✓ (Like) charges <u>repelling</u> (on hair) ✓	2	3.2a	**IGNORE** references to static electricity **ALLOW** rubbed against slide **ALLOW** build up/increased for gained **DO NOT ALLOW** protons / positive charge transferred / positive electrons **DO NOT ALLOW** if opposite charges repel **IGNORE** attraction/repulsion between slide and hair / opposite charges attract
	(b)		Transfer ✓	1	1.1	
	(c)	(i)	Arrows show the direction of the force (on a positive charge) ✓ Spacing of lines shows the strength (of the electric field) / wider spacing means weaker field ORA ✓	2	1.1	**DO NOT ALLOW** reference to magnetic fields in both parts **ALLOW** direction of movement of a positive charge **DO NOT ALLOW** force on a negative charge/electron **IGNORE** direction of field (stem) **ALLOW** idea of strength/weakness but ignore eg. it is strong
		(ii)	Positive (charge) ✓	1	1.1	

Question			Answer	Marks	AO element	Guidance
11	(a)		The distance from peak to peak **AND** The number of waves in 1 second ✓	1	1.1	Third row ticked
	(b)	(i)	Ruler (or alternative) ✓	1	1.2	tape measure / metre stick / scale
		(ii)	(Count the) number of waves/peaks/troughs (that pass a point) in 1 second / per second / divide by time (or other certain time limit) ✓ With a stop watch / using the timer (on the smart phone) ✓	2	3.3a	**ALLOW** how many waves in the time taken for the video / find the time it takes one wavefront to pass a point **ALLOW** idea that the video can be used to check/measure time/how long
		(iii)	Multiply the wavelength by the frequency ✓	1	1.2	**ALLOW** wavelength ÷ time <u>period</u> **ALLOW** f λ

Question			Answer	Marks	AO element	Guidance
12	(a)		(Use stop clock to) record time taken to reach light gate ✓ Change in speed = / is recorded by light gate (because trolley starts from rest) / speed from light gate ÷ time ✓	2	1.2	**ALLOW** pass through for reach **ALLOW** speed at the light gate – initial speed/0
	(b)		 Arrow in equal and opposite direction ✓	1	2.2	**ALLOW** if no part of arrow tail is drawn inside block

Question			Answer	Marks	AO element	Guidance
13	(a)		(The ratio of) mass divided by volume ✓	1	1.1	**ALLOW** mass over 1volume / mass per volume / mass per unit volume / correct use of units and quantities in any form
	(b)		**Any three from:** As the temperature increases, the speed/energy of the molecules increases ✓ As the temperature increases, the pressure (of the molecules) increases ✓ (With increased temperature) there are more frequent collisions of molecules (with the boat/material) ✓ The (rate of) change in momentum increases (with T) ✓ Pressure = force/area (any subject)✓	3	3.2b	**ALLOW** as the speed of molecules increases the pressure increases **IGNORE** more collisions

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