Foundation

GCSE

Physics B Twenty First Century Science

J259/03: Breadth in physics (Higher 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.

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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 questions on this paper are **X** and **X**

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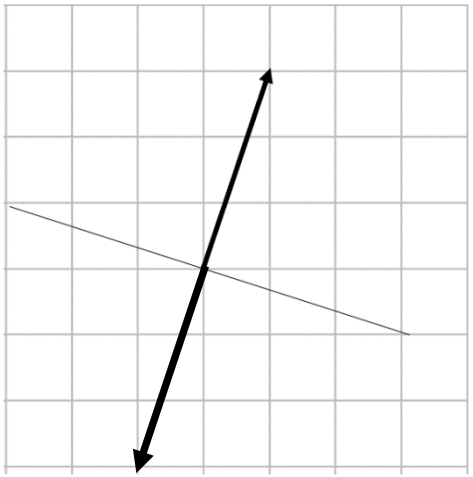
Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

The breakdown of Assessment Objectives for GCSE (9-1) in Physics 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)		**Any two from:** Friction (between child and slide) ✓ Charge/electrons transferred/gained/lost (between slide and child) ✓ (Like) charges repelling (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
2	(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
3	(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
4	**(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

Question			Answer	Marks	AO element	Guidance
5	**(a)**	**(i)**	No energy is lost **or** the thicknesses of the arrows add up to the input (arrow thickness) ✓	1	1.2	**ALLOW** output widths = input width **ALLOW** total input = total output (not just output)
		(ii)	(200 – 160 =) 40 (W) ✓	1	2.1	
	(b)		More energy supplied/transferred from stand mixer ORA ✓ More energy gained by the stores of the stand mixer ✓	2	2.1	**ALLOW** more energy released by stand mixer / more energy due to more power **IGNORE** energy used / produced / given out **IGNORE** kinetic energy of cake mix **ALLOW** cake mix/surroundings **gains** more energy from stand mixer
	(c)		**First check the answer on answer line** **If answer = 19.6 W award 3 marks** Power = (current)^2 x resistance / P = I^{2}R ✓ Correct substitution Power = 0.7^2 x 40 ✓ = 19.6 (W) ✓	3	 1.2 2.1 x 2	

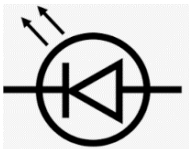| Question			Answer	Marks	AO element	Guidance
6	(a)		**Any two from:** Particles (of matter) carry/move the smell/the dye ✓ Sound wave is faster than the smell **or** water waves is faster than the dye ORA ✓ Waves carry/ transfer energy ✓ Waves do not transfer matter / the smell / the dye ✓	2	3.2b	
	(b)	(i)	0.90 (m) ✓	1	2.2	
		(ii)	0.48 (m) ✓	1	2.2	
		(iii)	2 (s)✓	1	2.2	
	(c)		The vibration is at <u>right angles/perpendicular to</u> ✓ the direction of travel / energy transfer ✓	2	1.1	**ALLOW** both marks from a labelled diagram **ALLOW** rope moves up and down for vibration (not just rope moves) **ALLOW** direction of energy transfer is perpendicular to the vibration = 2 marks

	Question		Answer	Marks	AO element	Guidance
7	(a)	(i)	**First check the answer on answer line** **If answer = 100 A award 3 marks** $V_p \times I_p = V_s \times I_s$ ✓ $I = 25\,000 \times 1600 / 400\,000$ rearrangement ✓ $= 100$ (A) ✓	3	1.2 2.1 x 2	**ALLOW** $P = V \times I$ or $40{,}000\,000$ $40\,000\,000 \div 400\,000$ $= 100$ **ALLOW** 1×10^n = 2 marks
		(ii)	The current (at 400kV) is lower (16 times) (than at 25kV) / 400kV allows a lower current ✓ Less energy dissipated / more efficient **or** 400kV is more efficient / 400kV reduces energy loss ✓ to (inaccessible) thermal energy stores of cables (through resistive heating) and surroundings ✓	3	1.1	**ALLOW** lost for dissipated **ALLOW** power loss = I^2R Dependent mark **ALLOW** e.g. less energy lost to heat = 2 marks
		(iii)	**First check the answer on answer line** **If answer = 8 award 2 marks** $1600 \div 200$ ✓ $= 8$ (trains) ✓	2	2.1	
	(b)	(i)	230 (V) 50 (Hz) ✓	1	1.1	
		(ii)	The current/it changes direction (repeatedly) for a.c. **AND** flows in one direction for d.c. ✓	1	1.1	**ALLOW** diagrams to show the difference **ALLOW** a.c. changes polarity / changes from positive and negative and d.c. always positive **IGNORE** a.c. moves in both directions / a.c. can change direction

	Question		Answer	Marks	AO element	Guidance
8	(a)		Ling ✓	1	3.2a	
	(b)		**First check the answer on answer line** **If answer = 0.52 kg award 3 marks** Mass = weight ÷ g (in any form) ✓ m = 5.2 ÷ 10 ✓ = 0.52 (kg) ✓	3	 1.2 2.1 x 2	
	(c)		5.2 N x 10 m = 52 Nm ✓ Nm is equivalent to J ✓	2	2.1 1.1	Tick in box 2 Tick in box 5

Question			Answer	Marks	AO element	Guidance
9	(a)		1×10^{-10} m ✓	1	1.1	Tick in box 4
	(b)		Beachball and white blood cell ✓	1	3.1b	Tick in box 2
	(c)		From top to bottom on the answer lines: 4, 2, (1), 3 ✓	1	1.1	

Question			Answer	Marks	AO element	Guidance
10	(a)	(i)	17 (proton no of Chlorine) ✓ 0 in top box AND -1 in lower box for electron ✓	2	1.2	
		(ii)	Same number of nucleons/neutrons and protons together / 16p+19n **and** 17p+18n ✓ Chlorine has one more proton than sulfur / the different number of protons changes the element (from S to C*l*) ✓ One neutron has turned into a proton and released an electron/beta from nucleus (for conservation of charge) ✓	3	3.1a	**ALLOW** Different number of protons / different number of neutrons **ALLOW** Mark Point 2 also for 16p+19n **and** 17p+18n **IGNORE** references to mass number / atomic number
	(b)	(i)	**Any two from:** They are isotopes ✓ All chlorine atoms have the same number of protons ✓ Some chlorine atoms will have different number of neutrons ✓	2	1.1	
		(ii)	**First check the answer on answer line** **If answer = 35.625 award 2 marks** (11 x 35 + 5 x 37)/16 or 570/16 ✓ = 35.625 ✓	2	1.2	**ALLOW** correct rounding to 2, 3 or 4 s.f.

Question			Answer	Marks	AO element	Guidance
11	**(a)**		Pin column top to bottom: neutral, earth, live ✓ P.d. column top to bottom: 0, (0), 230 ✓	2	1.1	One mark for each correct column
	(b)		The case is at 230V / mains voltage ✓ Someone touching metal case makes a circuit to earth so current will flow ✓	2	2.1	**ALLOW** the case is live **IGNORE** The live wire touches/is in contact with the case (stem) **ALLOW** the case is at 230V the person touching is at 0V = 2 marks
	(c)	**(i)**	 ✓	1	1.1	**MUST** be in this orientation, with outwards arrows, in the gap **ALLOW** without circle **DO NOT ALLOW** without arrows OR on a wire line
		(ii)	**First check the answer on answer line** **If answer = 45 C award 3 marks** (Conversion of time 50 x 60 =) 3000 s ✓ Q = 0.015 x 3000 ✓ = 45 (C) ✓	3	1.2 2.1 x 2	**ALLOW** Q = 0.75 (no time conversion) MAX 2 marks
		(iii)	**First check the answer on answer line** **If answer = 0.075 A award 3 marks** 3 ÷ 50 ✓ = 0.06 ✓ Total current = 0.06 + 0.015 = 0.075 (A) ✓	3	2.1	**IGNORE** rearrangement of formula

Question			Answer	Marks	AO element	Guidance
12	(a)		**Any two from:** In solids and in liquids particles are packed/arranged closely together/in contact with each other ✓ Liquids and solids are both incompressible ✓ Similar number of particles per unit volume in both liquids and solids (so similar density)) ✓	2	1.1	**IGNORE** references to bonds / movement of particles **ALLOW** the same mass (of liquid or solid methane) will have a similar volume
	(b)	(i)	100 g ✓ There are the same number of <u>particles</u> before and after changing state / mass is conserved meaning no <u>particles</u> are lost or gained ✓	2	2.1	**ALLOW** the same mass **ALLOW** 100g **and** the particles are further apart
		(ii)	**First check the answer on answer line If answer = 14 cm³ award 4 marks** volume = mass ÷ density ✓ (Calculate the difference in volume =) 90 ÷ 0.42 − 200 ✓ = 14.2857143 (cm³) ✓ = 14 (cm³) ✓	4 1.2 2.1 x 2 1.2		**ALLOW** evidence of rearranged formula e.g. 90 ÷ 0.45 **or** 90 ÷ 0.42 **or** 214.285714 **or** 100 ÷ 0.42 **ALLOW** internal ecf using a correctly calculated volume **MAX 3** **ALLOW** for mark point 3 an answer that rounds to 14 **ALLOW** a calculated value seen in working converted to 2 s.f. on answer line (i.e. candidate thinks it's a volume) OR a 2 s.f. calculation seen in working and transferred to answer line

Question			Answer	Marks	AO element	Guidance
	(c)		Particles closer together, **and** will collide with walls of container more frequently ✓ Greater outward pressure exerted ✓	2	1.1	**ALLOW** particles closer together **and** more/faster/harder collisions with the walls (of the container)

Question			Answer	Marks	AO element	Guidance
13	(a)	(i)	All points plotted within one small square ✓ Smooth curve among the points ✓	2	2.2	
		(ii)	Value between 10 - 11.4 km/s given ✓	1	2.2	**ALLOW** ecf from straight line by eye and between 13 and 10
		(iii)	As the distance (from Jupiter) increases, the orbital speed decreases in a non-linear way / at a decreasing rate ✓	1	3.1a	Candidates must describe the relationship and the sense of decrease N.B. the 'graph' here is judged on the plotted points, not the best fit line
	(b)	(i)	A man-made object that orbits around a body in space, e.g. planet / star ✓	1	1.1	
		(ii)	**First check the answer on answer line** **If answer = 50 kg award 4 marks** Mass = momentum ÷ velocity (in any form) ✓ Convert 190 km/s to 190 000 m/s ✓ $9.5 \times 10^6 \div 190\,000 =$ ✓ 50 (kg) ✓	4	1.2 x 2 2.1 x 2	 **ALLOW** no conversion of km to m gives 50 000 = 3 marks **ALLOW** 5×10^n = 3 marks

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