OCR
Oxford Cambridge and RSA

Higher

GCSE

Physics A Gateway

J249/02: Paper 2 (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. 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 the annotation SEEN to confirm that the work has been read.

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.

Level of response questions on this paper is **17(a).**

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 carefully read **Appendix 5 Introduction to Script Marking: Notes for New Examiners**.

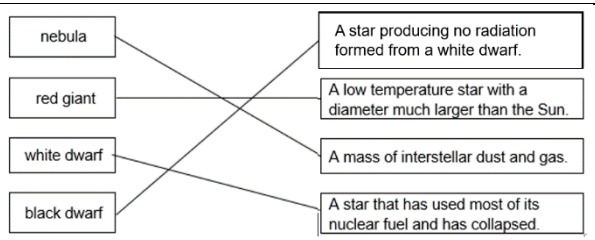
Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

The breakdown of Assessment Objectives for GCSE (9-1) in Physics A:

	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.

For answers to Section A if an answer box is blank ALLOW correct indication of answer e.g. circled or underlined.

Question	Answer	Marks	AO element	Guidance
1	B	1	1.1	
2	C	1	1.2	
3	A	1	1.2	
4	C	1	1.1	
5	C	1	1.1	
6	D	1	2.1	
7	D	1	2.1	
8	A	1	1.2	
9	C	1	1.1	
10	A	1	2.1	
11	A	1	1.1	
12	D	1	2.1	
13	B	1	1.1	
14	B	1	1.1	
15	D	1	2.1	

Question			Answer	Marks	AO element	Guidance
16	(a)	(ii)	 ✓✓	2	2 × 1.1	All 4 correct = 2 marks Any 2 or 3 correct = 1 marks
		(ii)	Main sequence star ✓	1	1.1	
	(b)	(i)	Gravity ✓	1	1.1	
		(ii)	Equal to ✓	1	1.1	
	(c)	(i)	B ✓	1	1.1	
		(ii)	D ✓	1	1.2	

Question			Answer	Marks	AO element	Guidance
17	(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)** Detailed description of extra equipment and what it measures **AND** a detailed method **AND** a control variable identified *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 method **AND** either control variable identified or some relevant extra equipment chosen **OR** Basic method outlined **AND** a control variable identified **AND** some relevant equipment chosen *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 method outlined **AND** either a control variable identified or some relevant equipment chosen **OR** Some relevant equipment chosen **AND** a control variable *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 × 1.2** **2 × 2.2** **2 × 3.3a**	**AO1.2 – Demonstrates knowledge and understanding of scientific techniques to choose equipment for the experiment** • measure time with stopwatch • measure the temperature of water with a thermometer • measure the volume of water with a measuring cylinder **or** the mass of water with a balance • measure thickness of insulation with a ruler **AO2.2 – Applies knowledge and understanding of scientific enquiry to develop a valid experiment by controlling variables** • the starting temperature • the time / end temperature / change in temperature • volume / mass of water • room temperature **AO3.3a – Analyses information and ideas to develop the method for the practical** • measure temperature of water at the start • measure temperature at regular time intervals or at a fixed time • change the thickness of cardboard and repeat experiment • repeat each measurement for each thickness • calculates a mean temperature change • use at least 5 thicknesses of cardboard • safety consideration for hot water

Question			Answer	Marks	AO element	Guidance
	(b)	(i)	(As time increases) temperature decreases / **ORA** ✓	1	3.1a	**ALLOW** it cools / gets colder
		(ii)	Values / repeats / results (at each time) are close together / almost the same / similar ✓	1	3.1b	**ALLOW** the same results
		(iii)	**Any two from:** The line is curved / not a straight line / not linear ✓ The line does not pass through origin / zero ✓ The line has a negative gradient ✓	2	2 x 3.2a	 **ALLOW** gradient changes **ALLOW** there is an intercept / non-zero starting temperature **ALLOW** (as time increases,) temperature decreases / line 'goes down' / negative correlation

Question			Answer	Marks	AO element	Guidance
18	(a)		Coal ✓ Solar ✓	2	2 x 3.2b	In either order
	(b)		**First check the answer on answer line** **If answer = 24 - 26 (%) award 3 marks** Angle is approximately 90 ° ✓ (% =) 90 / 360 or 1 / 4 or 0.25 ✓ (% =) 25 (%)✓	3	3 x 1.2	 **ALLOW** one mark for (62 ± 2) / 360 (2019 data) **ALLOW** two marks for 17% or 18% (2019 data)
	(c)		Gas ✓ Wind ✓	2	2 × 2.2	In either order **IGNORE** direction of change
	(d)		**First check the answer on answer line** **If answer = 7.7 (%) award 3 marks** 0.3 ✓ (% change =) (0.3 ÷ 3.9) × 100 or ((4.2 – 3.9) ÷ 3.9) × 100 or 7.692….(%) ✓ (% change =) 7.7 (%) (1dp) ✓	3	3 × 2.1	 **ALLOW** one mark for ((4.2-3.9) ÷ 4.2) × 100 **ALLOW** two marks for 7.1 (%) **ALLOW** two marks for 7.6 (%) **ALLOW** this mark for clear evidence of an incorrect answer correctly rounded to one decimal place (not a bald answer to 1 d.p.)

Question			Answer	Marks	AO element	Guidance
	(e)	(i)	**Any one from:** Public opinion / government committed to renewable / green energy resources ✓ Coal is a non-renewable / finite energy resource ✓ Reduces pollution / named pollutant e.g., CO_2 / SO_2 ✓ Reduces global warming / climate change / greenhouse gases ✓	1	1.1	**ALLOW** Coal produces pollution / named pollutant CO_2 / SO_2 **ALLOW** Coal contributes to global warming / climate change / greenhouse gases ✓
		(ii)	**Any two from:** Not enough sun (for photovoltaic cells) ✓ Not enough wind (for turbines) ✓ To avoid power cuts ✓ Increase in demand **with** reason e.g., it may have been colder on that day ✓ Some power stations may have broken down ✓	2	2 × 3.2a	**IGNORE** costs e.g., coal is cheap **IGNORE** meeting demand / gap **IGNORE** there is a high demand for electricity

Question			Answer	Marks	AO element	Guidance
19	(a)	(i)	ultra-violet | X-ray | gamma rays ✓✓	2	2 x 2.1	All three correct = 2 marks One (or two) correct = 1 mark **ALLOW** UV for ultra-violet
		(ii)	Decreases ✓	1	1.1	
	(b)		**First check the answer on answer line** **If answer = 0.5 (μm) award 2 marks** Vertical line drawn on graph (in approximately correct position) ✓ λ = 0.5 (μm) ✓	2	2 × 3.1a	
	(c)	(i)	Microwaves ✓	1	3.2b	
		(ii)	Big bang (theory) / expanding universe ✓	1	1.1	

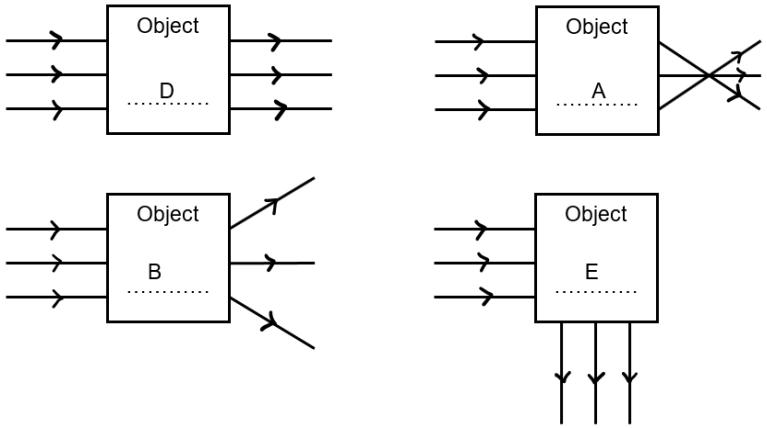
Question			Answer	Marks	AO element	Guidance
20	(a)		**First check the answer on answer line** **If answer = 96 000 (J) award 2 marks** (Potential energy =) 800 × 10 × 12 ✓ (Potential energy =) 96 000 (J) ✓	**2**	**2 × 2.1**	
	(b)		**First check the answer on answer line** **If answer = 40 000 (J) award 2 marks** (Kinetic energy =) ½ × 800 × 10^2 ✓ (Kinetic energy =) 40 000 (J) ✓	**2**	**2 × 2.1**	
	(c)		Energy is transferred to the thermal energy (store) ✓ **And any one from:** (Work is done against) friction / drag / resistive forces ✓ Energy is transferred in the surroundings / brakes ✓	**2**	**2 × 2.1**	**ALLOW** heat for thermal energy **ALLOW** energy transferred to the surroundings by heating scores two marks
	(d)		**First check the answer on answer line** **If answer = 0.4 award 2 marks** (efficiency =) 48 000 ÷ 120 000 ✓ (efficiency =) 0.4 ✓	**2**	**2 × 2.1**	**ALLOW** for one mark 0.4% **ALLOW** for two marks 40%

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>AO element</th><th>Guidance</th></tr>
<tr><td>21</td><td>(a)</td><td></td><td>Thinking distance bar plotted correctly to within ± ½ square ✓

Braking distance bar plotted correctly to within ± ½ square ✓</td><td>2</td><td>2 × 1.2</td><td></td></tr>
<tr><td></td><td>(b)</td><td></td><td>Thinking distance in range 17 - 19 m ✓

Braking distance in range 44 - 64 m ✓</td><td>2</td><td>2 × 3.2a</td><td></td></tr>
<tr><td></td><td>(c)</td><td></td><td>(Overall) <u>stopping</u> distance ✓</td><td>1</td><td>1.1</td><td></td></tr>
<tr><td></td><td>(d)</td><td></td><td><table><tr><th>Factor</th><th>Thinking distance</th><th>Braking distance</th></tr><tr><td>Drinking alcohol</td><td>increases</td><td>no effect</td></tr><tr><td>Higher speed</td><td>increases</td><td>increases</td></tr><tr><td>Wet road</td><td>no effect</td><td>increases</td></tr></table>✓✓✓</td><td>3</td><td>3 × 2.1</td><td>1 mark for each correct row</td></tr>
<tr><td></td><td>(e)</td><td>(i)</td><td>First check the answer on answer line
If answer = 112 000 J award 3 marks

(Work done =) 5600 × 20 ✓
(Work done =) 112 000 ✓
J OR N m ✓</td><td>3</td><td>2.1
2.1
1.1</td><td>Unit mark is independent</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>Double-decker bus has more mass ✓</td><td>1</td><td>2.1</td><td>ALLOW more kinetic energy / heavier / greater weight / greater load</td></tr>
</table>

Question			Answer	Marks	AO element	Guidance
22	(a)		D ✓ A ✓ B ✓ E ✓ 	4	4 × 1.2	
	(b)		**First check the answer on answer line** **If answer = 4.6 × 10^{14} (Hz) award 4 marks** Rearrange to give: (f =) v ÷ λ✓ (f =) 2 × 10^{8} ÷ (4.33 × 10^{-7}) ✓ (f =) 4.62… × 10^{14} (Hz) ✓ (f =) 4.6 × 10^{14} (Hz) (2sf) ✓	4	 1.2 2.1 2.1 1.2	 **ALLOW** 1 mark for correct substitution into unrearranged equation e.g., 2 x 10^{8} = f x 4.33 x 10^{-7} **ALLOW** 4.62… × 10^{n} for 2 marks **ALLOW** 4.6 × 10^{n} for 3 marks **ALLOW** this mark for clear evidence of an incorrect answer (correctly rounded) to two significant figures (not a bald incorrect answer to 2 s.f.)

	(c)	**(i)**	(shirt) Black (number) Blue ✓	**1**	**2.1**	Both required for 1 mark
		(ii)	(White) number (and shirt) reflects red (light only) / (white) number (and shirt) looks red / (white) number and shirt look the same colour ✓	**1**	**2.1**	**ALLOW** (idea that) both look red / whole shirt looks red / both look the same colour **DO NOT ALLOW** red is absorbed by shirt/number / both look any incorrect colour **IGNORE** they blend in **IGNORE** any other colours absorbed

Question			Answer	Marks	AO element	Guidance
23	(a)	(i)	(Idea that half-life is short enough) so water/surroundings don't remain radioactive for too long ✓ (Idea that half-life is long enough) to allow repeat readings / for examination to take place ✓	2	2 × 3.1b	**ALLOW** so it doesn't contaminate/irradiate/emit radiation/stay unstable for too long **IGNORE** less damage/harm **ALLOW** (idea that) it stays in pipe long enough to detect the leak / enough time to be detected / enough time to reach leak **IGNORE** it lasts for a long time / long enough to be used/useful
		(ii)	(Tracer/radiation/beta/gamma) can be detected above earth/ground ✓	1	1.2	**ALLOW** beta/gamma can penetrate/pass through/get through the ground/earth **IGNORE** beta/gamma are very penetrating **IGNORE** ideas about alpha
		(iii)	(Stable isotope) does not emit (ionising) radiation / **ORA** ✓	1	3.2b	**ALLOW** (stable isotope) is not radioactive / does not contaminate/irradiate/decay / **ORA** **IGNORE** so it is no longer dangerous / so it becomes safe
	(b)		**Any two from:** Tracer is added to pipe/water / detector is moved along the surface of the ground ✓ Reading (on the detector) will increase (above the leak) ✓ (Reading on the detector will increase when the detector is) above/around the leak ✓	2	2 × 2.2	 **ALLOW** detector is placed above the ground/pipe **ALLOW** more radiation is detected (above the leak) **ALLOW** (more radiation is detected) above/around the leak

	(c)		**First check the answer on answer line** **If answer = 3 (mg) award 2 marks** (30 ÷ 15 =) 2 (half-lives) ✓ (Mass remaining = 12 × $(0.5)^2$ = 3 (mg) ✓	**2**	 **2.1** **2.1**	 **ALLOW** any indication of two halvings shown, e.g., of 24 or 15

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