OCR
Oxford Cambridge and RSA

F

GCSE (9–1)

Combined Science B (Twenty First Century Science)

J260/03: Physics (Foundation Tier)

General Certificate of Secondary Education

Mark Scheme for Autumn 2021

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.

© OCR 2021

1. 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

2. 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

3. **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:

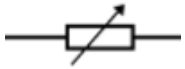
	Assessment Objective
AO1	**Demonstrate knowledge and understanding of scientific ideas and scientific techniques and procedures.**
AO1.1	Demonstrate knowledge and understanding of scientific ideas.
AO1.2	Demonstrate knowledge and understanding of scientific techniques and procedures.
AO2	**Apply knowledge 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)		Wood warms up when it absorbs infrared radiation ✓ Some metals are shiny because they reflect visible light ✓ Windows are made out of glass because glass transmits visible light ✓ An X-ray scan be hazardous because human bodily tissue absorbs X-rays ✓	4	1.1	
	(b)	(i)	shorter ✓	1	1.1	
		(ii)	longer ✓	1	1.1	
		(iii)	longer ✓	1	1.1	

Question			Answer	Marks	AO element	Guidance
2	(a)	(i)	Iron is a magnetic (material) ✓	1	1.1	
		(ii)	Increase the current in the coil ✓ increase the number of turns of wire in the coil ✓	2	1.1	tick in 1st and 2nd boxes
	(b)	(i)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 0.5 (Ω) award 2 marks** Substitute: resistance = 0.95 (V) ÷ 1.9 (A) ✓ resistance = 0.5 (Ω) ✓	2	2.1	
		(ii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 57 (C) award 2 marks** Substitute: charge = 1.9 (A) × 30 (s) ✓ charge = 57 (C) ✓	2	2.1	

Question			Answer	Marks	AO element	Guidance
3	(a)	(i)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 0.035 (m) award 2 marks** (8.5 – 5 =) 3.5 cm ✓ = 0.035 (m) ✓	2	1.2	
		(ii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 220 (N/m) award 2 marks** substitute: spring constant = 7.7 ÷ 0.035 ✓ = 220 (N/m) ✓	2	2.1	**ECF** from **(ai)**
		(iii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 0.13 (J) award 3 marks** Select & apply: energy stored = 0.5 × spring constant × extension^2 = 0.5 × 220 × (0.035)^2 ✓ = 0.13475 (J) ✓ = 0.13 (J) ✓	3	2.1 x 2 1.2	**ECF** from **(aii) and (ai)** **ALLOW** Any number of d.p. greater or equal to 2 that rounds to 0.13 Must be to 2d.p. correctly rounded **ALLOW** use of energy = 0.5 × force × extension
	(b)	(i)	Wear googles / Place foam under the weights /use small masses / clamp retort to bench ✓	1	1.1	**ALLOW** weight
		(ii)	Initial ✓ Extension ✓ Mass ✓	3	3.3a	

Question			Answer	Marks	AO element	Guidance
		(iii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 1 (J) award 3 marks** area of triangle = 0.5 × 5 × 0.4 **OR** counts squares: 1 cm^2 = 0.1 J number = (20÷2) cm^2 = 10 cm^2 work done = 10 × 0.1 ✓✓ work done = 1 (J) ✓	3	2.2	

Question			Answer	Marks	AO element	Guidance
4	(a)		(1st box) chemical (in battery) ✓ (2nd box) electrical working **OR** current ✓ (3rd box) kinetic (in air/bubbles) ✓	3	2.1	**ALLOW** and thermal (machine and surroundings) but not thermal on its own
	(b)	(i)	 ✓	1	1.2	
		(ii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 2.1 (Ω) award 2 marks** (Total resistance =) 1.54 (Ω) + 0.56 (Ω) ✓ = 2.1 (Ω) ✓	2	2.1	
	(c)	(i)	decreases ✓	1	1.1	
		(ii)	decreases ✓	1	2.1	
		(iii)	stays the same ✓	1	2.1	

Question			Answer	Marks	AO element	Guidance
5	(a)		(absorbed and re-emitted by carbon dioxide) infrared ✓ (absorbed by oxygen to produce ozone) ultraviolet ✓ (emitted from nuclei) gamma rays ✓	3	1.1	tick in correct boxes
	(b)		All electromagnetic radiation is transmitted through space at the same speed ✓ Atoms can become ions by losing their outer electrons. ✓	2	1.1	
	(c)		ionising radiation **OR** removes electrons from atoms ✓ damages/kills cells/ causes cancer/DNA mutation ✓	2	1.1	

Question			Answer	Marks	AO element	Guidance
6	(a)	(i)	volume = 3 x 3 x 3 = 27 (cm^3) ✓	1	1.2	
		(ii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 19 OR 19.3 (g/cm^3) award 2 marks** Substitute: Density = 513 (g) ÷ 27 (cm^3) ✓ Density = 19 (g/cm^3) ✓	2	2.1	**ECF** from **(ai)**
	(b)	(i)	gases have lower density than liquids ✓ liquids have lower density than solids ✓ **OR** The density increases from gas to liquid to solid ✓✓	2	3.1a	**ORA** **ALLOW** 1 mark for gases have lower density than solids if neither of these marks are awarded **ORA** **ALLOW** 1 mark if only 2 phases given **IGNORE** the density increases down the table.
		(ii)*	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)** Uses diagrams to correctly describe solids liquids and gases, including differences in spacing **AND** explains idea that more particles in the same space or that the closer the particles the higher the density **AND** Links data from the table to different spacing *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.*	6	4 x 1.1 2 x 3.1a	**AO1.1 Demonstrate knowledge and understanding of arrangement, spacing and density** **For example: diagrams** • solid showing regular arrangement • liquid showing irregular arrangement • gas showing irregular arrangement of far fewer particles widely spaced • particles do not change in size between phases. **For example: In diagrams or written** • particles are much closer together in solids and liquids than in gases • Spacing about the same for liquid and solid or more for liquid. **For example**: density • Idea that closer together means more

Question			Answer	Marks	AO element	Guidance
			Level 2 (3–4 marks) Uses diagrams to correctly describe solids liquids and gases, including differences in spacing **AND** Links data from the table to different spacing **OR** Explains idea that more particles in the same space or that the closer the particles the higher the density *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)** Uses diagrams to describe solids liquids and gases **AND** these correctly show the difference in spacing of particles, although other details may be incorrect. **OR** Statement showing understanding that particle spacing increases from solid to liquid to gas *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.*			particles (mass) in the same space (volume) • The closer the particles the higher the density **AO3.1 Analyse information and ideas to evaluate the trend shown in the table.** • Use of data from the table to compare solids liquids and gases • Use of data from the table to compare the gases, or the liquids or the solids

Question			Answer	Marks	AO element	Guidance
7	(a)		equal to the friction forces ✓	1	1.1	ringed
	(b)	(i)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 6 000 (N) award 2 marks** substitute: braking force = 1 200 (kg) × 5 (m/s^2) ✓ = 6 000 (N) ✓	2	2.1	**IGNORE** negative signs
		(ii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 330 000 (N) award 2 marks** substitute: work done = 6 000 (N) × 55 (m) ✓ = 330 000 (J) ✓	2	2.1	**ECF** from **a(i)**
	(c)	(i)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 30 (m/s) award 2 marks** 12 ÷ 0.4 ✓ = 30 (m/s) ✓	2	2.1	
		(ii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 3 (m/s^2) award 3 marks** recall: acceleration = change in speed ÷ time taken ✓ substitute: acceleration = (30 – 0) ÷ 10 ✓ = 3 (m/s^2) ✓	3	1.2 2.1 x 2	**ALLOW ECF** from **(ci)**
	(d)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 15 (m/s) award 3 marks** Conversion of 54 km to 54 000 metres ✓ 60 x 60 = 3600 s ✓ 54000/3600 = 15 (m/s) ✓	3	1.2 x 2 2.1	

Question			Answer	Marks	AO element	Guidance
8	(a)		(Isotopes of an element have the same number of) protons ✓ (Isotopes of an element have a different number of) neutrons ✓	2	1.1	lines join 1st statement to 3rd box and 2nd statement to 2nd box
	(b)	(i)	Caesium-137 ✓	1	2.1	
		(ii)	**Any two from:** The tellurium will decay and be gone quickly **OR** most will have gone in a day **OR** isotopes with short half-lives will decay and be gone quickly ✓ Most of the plutonium and selenium will not decay **OR** isotopes with very long half-lives won't produce much radiation. ✓ idea that the caesium will be present and decaying steadily for many years ✓	2	1.1	
	(c)	(i)	alpha is more ionising **OR** gamma is less ionising ✓ gamma may leave body without being absorbed **OR** alpha will be absorbed ✓	2	1.1	**ALLOW** (ionising radiation) damages/kills cells/ causes cancer/DNA mutation
		(ii)	gamma is more penetrating **OR** beta is less penetrating ✓	1	1.1	**ALLOW** example e.g. beta will not go far into the body **OR** beta can be stopped by thin aluminium

Question			Answer	Marks	AO element	Guidance
9	(a)	(i)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 52.5 (kW h) award 3 marks** Recall: Energy = power × time ✓ Substitution: E = 7 kW × 7.5 h ✓ = 52.5 (kW h) ✓	3	 **1.2** **2.1 x 2**	
		(ii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 92 (%) award 3 marks** Recall: Efficiency = $\frac{\text{useful energy output}}{\text{total energy input}}$ × 100% ✓ Substitution: Efficiency = $\frac{48.3}{52.5}$ × 100% ✓ = 92 (%) ✓	3	 **1.2** **2.1 x 2**	 **ALLOW** ECF from (a)(i) **ALLOW** answer of 0.92 for 2 marks
		(iii)	Alternating (voltage) changes direction **AND** Direct (voltage) always in same direction ✓	1	1.1	**DO NOT ALLOW** idea that it changes without idea that direction changes/alternates **ALLOW** constant **ALLOW** graphs showing direct = negative **or** positive voltage against time **and** alternating = positive **and** negative voltage against time
	(b)	(i)	Curve of best fit through points ✓	1	2.2	**DO NOT ALLOW** straight line or lines
		(ii)	Value shown by drawn line at 2019	1	3.2b	**ECF** from (c)(i)

Question			Answer	Marks	AO element	Guidance
			OR If no drawn line at 2019, answer between 270,000 and 330,000 ✓			
	(c)	**(i)**	(people want to) reduce CO_2 emissions/ reduce carbon footprint/ reduce global warming / environmentally more friendly / environmentally safer **OR** (people want to) reduce pollution/ NOx / particulates/incidence of asthma **OR** government incentives **OR** Becoming cheaper to buy **OR** Charging points more readily available ✓	**1**	**2.1**	e.g. tax cuts, subsidies
		(ii)	**Any two from:** Not enough power stations **OR** Not enough generating capacity ✓ High peak demand when all being charged at the same time ✓ Distribution network would need to deliver more energy/power or have higher current/higher voltage or more cables ✓	**2**	**2.1**	**ALLOW** not enough electricity

Question			Answer	Marks	AO element	Guidance
10	(a)		weigh the pan (without the stone) ✓ Subtract (the weight of the pan from the total weight) ✓	2	3.3b	If no other mark scored **ALLOW** check for zero error on forcemeter for 1 mark **DO NOT ALLOW** use a top pan balance unless also states × *g* or × 10 for 2 marks
	(b)	(i)	Jupiter ✓	1	1.1	
		(ii)	**Any four from:** Identifies Jupiter as not fitting the pattern of increasing density and increasing gravitational field strength ✓ The gravitational field strength increases as the mass of the planet increases **OR** There is a correlation between the gravitational field strength and the mass. ✓ Use of data from the table to justify suggested relationship ✓ g increases with density for first three planets ✓ g of Jupiter larger than other planets but doesn't fit pattern between density and mass ✓	4	3.2b	

OCR (Oxford Cambridge and RSA Examinations)
The Triangle Building
Shaftesbury Road
Cambridge
CB2 8EA

OCR Customer Contact Centre

Education and Learning
Telephone: 01223 553998
Facsimile: 01223 552627
Email: general.qualifications@ocr.org.uk

www.ocr.org.uk

For staff training purposes and as part of our quality assurance programme your call may be recorded or monitored

Cambridge Assessment