OCR
Oxford Cambridge and RSA

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GCSE (9–1)

Combined Science A (Physics) A (Gateway Science)

J250/12: Paper 12 (Higher Tier)

General Certificate of Secondary Education

Mark Scheme for June 2019

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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.

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

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

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 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	A ✓	1	2.1	
2	B ✓	1	2.1	
3	A ✓	1	1.1	
4	D ✓	1	2.2	
5	D ✓	1	1.2	
6	B ✓	1	1.1	
7	B ✓	1	2.1	
8	D ✓	1	2.1	
9	D ✓	1	2.1	
10	B ✓	1	2.1	

Question			Answer	Marks	AO element	Guidance
11	(a)	(i)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 1.2 (ms) award 1 mark** t = 0.2 × 6 = 1.2 (ms) ✓	1	2.2	
		(ii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 90 000 (m) award 2 marks** d = (3 × 10^8 ×) 0.0003 ✓ d = 90 000 (m) ✓ **OR** d = (3 × 10^8 × 0.0006 =) 180 000 (÷ 2) ✓ d = (180000 ÷ 2) = 90 000 (m) ✓	2	2 × 2.1	
		(iii)	<u>energy</u> lost (to the surroundings/air) / AW ✓	1	3.2b	**ALLOW** energy is dissipated / not all energy reflects / some energy is absorbed
	(b)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 1.5 (m) award 4 marks** Recall and rearrange to give: λ = v ÷ f ✓ (Conversion 200(MHz) =) 2 × 10^8 (Hz) ✓ (λ =) 3 × 10^8 ÷ 2 × 10^8 ✓ (λ =) 1.5 (m) ✓	4	1.1 1.2 2 × 2.1	**ALLOW** correct formula in words **ALLOW** λ = 3 × 10^8 ÷ 2 x 10^n for two marks **ALLOW** 1.5 x 10^n for correct calculation but incorrect conversion of MHz to Hz for 3 marks

Question			Answer	Marks	AO element	Guidance
12	(a)		Mean is all the numbers added together and then divided by the total number ✓ Mode is the number which occurs most often **AND** 14 ✓ Median is the middle number **AND** 14 ✓	3	3 × 1.2	**ALLOW** Mean is the average **AND** 14.3 / 14 **ALLOW** the number that occurs twice/most frequent/most popular / AW **AND** 14 **ALLOW** method to find the median **AND** 14 if no other marks awarded **ALLOW** correct values for mode **AND** median for one mark
	(b)		Half-life = 4 (throws) ✓	1	2.1	**IGNORE** decimal answers that round to 4

Question			Answer	Marks	AO element	Guidance
13	(a)		use a Geiger counter / G-M tube (as detector) ✓ use of paper **AND** a drop in count rate/no count rate means alpha / AW ✓ use of aluminium **AND** a drop in count rate/no count rate means beta / AW✓ use of lead **AND** a drop in count rate/no count rate means gamma / AW✓ **OR** aluminium **AND** no drop/no change in count rate means gamma / AW✓	4	4x1.2	**ALLOW** answers from a labelled diagram **ALLOW** paper stops alpha **ALLOW** any appropriate material e.g. aluminium/thin metal/glass/wood stops beta **ALLOW** lead/concrete stops gamma **ALLOW** any appropriate material e.g. aluminium/thin metal/glass/wood lets gamma through
	(b)	(i)	When an <u>electron</u> drops energy levels ✓	1	1.1	**ALLOW** <u>electron</u> from excited energy level to ground / <u>electron</u> from higher shell to lower shell **IGNORE** just when electrons move between energy levels **DO NOT ALLOW** ideas of ionisation / when an electron moves up and down
		(ii)	radio /microwave / infra-red / (visible) light / named coloured light e.g. red light / ultra-violet / X-rays ✓	1	1.1	**DO NOT ALLOW** gamma or γ

Question			Answer	Marks	AO element	Guidance
14	(a)		Renewable (energy) can be regained in your lifetime / does not run out / infinite / sustainable **OR** Non-renewable (energy) will run out / cannot be regained in your lifetime / finite / cannot be replenished / used faster than it is made ✓ Renewable examples: wind / geothermal / tidal / wave / solar / biomass / wood / biofuel ✓ Non-renewable examples: fossil fuel / coal / oil / gas / nuclear ✓	**3**	**3× 1.1**	 **ALLOW** examples of use of renewable energy e.g. solar panels or solar cells / wind turbines / hydroelectric **IGNORE** just power stations
	(b)		(step up transformers) increases <u>voltage</u> / power transmitted at high <u>voltage</u> / (step up transformers) decreases <u>current</u> ✓ idea of less power wasted / less energy wasted / less heat in power lines / less thermal transfer ✓	**2**	**2 × 1.1**	**ALLOW** pd for voltage **IGNORE** just ideas about efficiency **DO NOT ALLOW** so no power wasted / no energy wasted (as heat in power lines) / no thermal transfer
	(c)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = in inclusive range 3600 to 3900 (A) award 3 marks** (secondary pd) in inclusive range 2.4×10^5 to 2.6×10^5 ✓ answer to marking point one × 2400 = current in primary coil × 160 000 ✓ (Current in primary coil =) in inclusive range 3600 to 3900 (A) ✓	**3**	 **2.2** **2 × 2.1**	 **ALLOW** vertical line in inclusive range 2.4×10^5 to 2.6×10^5 (V) **ALLOW ECF** from their reading of secondary pd

Question			Answer	Marks	AO element	Guidance
15	(a)		**selects the correct apparatus** use of appropriate named light source / protractor / slit ✓ **correct procedure** change or measure the angle(s) of incidence / use of normal line / measure the angle(s) of refraction / trace the rays to show the angles ✓	2	2 × 3.3a	**ALLOW** answers from a labelled diagram **IGNORE** just use light / use the sun / ruler **IGNORE** just trace the rays / just measure the angles
15	(b)		**using a ray box** bulb gets hot / bulb can burn or start a fire / AW ✓ do not leave on for long periods of time / switch off when not in use / allow to cool (between readings) / keep paper away from bulb / don't touch the bulb / AW ✓ **OR** **using a glass block** block may smash / block may fall on feet/toes / AW ✓ do not carry out experiment near end of bench / use a Perspex block / wear appropriate footwear / AW ✓ **OR** **using a (very) bright light or laser** light (very) bright / can damage eyes / may cause (temporary) blindness / AW ✓ do not look at filament directly / do not use high voltages / AW ✓ **OR** **working in low light conditions** may trip over / knock into people/ can't see easily ✓ place bags / coats /stools and other equipment out of the way / AW ✓	2	2 × 3.3b	Marks answers anywhere in answer space **IGNORE** don't touch the apparatus **ALLOW ECF** from (a) e.g. mirror may break **IGNORE** be careful / wear gloves **IGNORE** wear protective glasses/goggles/dark glasses **ALLOW** use low light intensity

	(c)	**(i)**	All points plotted correctly to within ± ½ square ✓ Acceptable curve of best fit through 0,0 and taking into account all points on graph ✓	**2**	**2 × 2.2**	points plotted angle i: 50, 60, 70 angle r: 28, 32, 35 **ALLOW** including or not including the plot at 40,30 **DO NOT ALLOW** a totally straight line
		(ii)	**any two from:** As the angle of incidence increases the angle of refraction increases ✓ angle of incidence is (always) greater than the angle of refraction ✓ **For smaller angles/to start with** angle of incidence directly proportional to angle of refraction / linear / straight line **OR** **For larger angles/then** change becomes non-linear / change in angle of refraction is less / non-linear for angles bigger than around 30° / AW ✓	**2**	**2 × 3.2b**	**ALLOW** there is a positive correlation / proportional **ALLOW** correct statement for candidates drawn line of best fit **ALLOW** directly proportional to start with **ALLOW** idea of being non-linear e.g. curve becomes less steep / curve levels out
		(iii)	23(˚) or 24(˚) ✓	**1**	**3.1b**	**ALLOW** 22-25(˚) inclusive **ALLOW ECF** from candidates line of best fit if not in this range **IGNORE** units
	(d)		blue light ray refracts/bends more than red light / ORA ✓ blue light travels more slowly than red light in the glass / blue light has a higher refractive index than red light / ORA ✓	**2**	**2 × 2.1**	**ALLOW** answers on a labelled diagram **ALLOW** comparative answers in terms of wavelength or frequency e.g. red has the longest wavelength / blue light has the highest frequency

Question			Answer	Marks	AO element	Guidance
16	(a)		0.5 (kg) ✓	3	1.2	**IGNORE** ½ and 0.5 when clearly used as the ½ in the KE equation
			(KE =) ½ mv^2 ✓		1.2	**ALLOW** speed for velocity
			(KE =) ½ × 0.5 × $(2.2)^2$ = (1.2) (J) ✓		2.1	**IGNORE** answers of 1.2 (J) with no working / just 1200 divided by 1000
	(b)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 0.024 (m) award 4 marks**	4		**ALLOW ECF** from candidates value in (a)
			x^2 = 2 × E / k ✓		3 × 2.1	
			x^2 = 2 × 1.2 / 4200 ✓			
			x = 0.02(390457) ✓			**ALLOW** correct answer with incorrect sig. figs for 3 marks
			= 0.024 (m) (2 sig. figs)		1.2	**IGNORE** minus sign

Question			Answer	Marks	AO element	Guidance
16	(c)*		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 evaluation of the effectiveness of the model **AND** detailed understanding of how crumple zones make cars safer. *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 evaluation of the effectiveness of the model. **AND** outline understanding of how crumple zones make cars safer. **OR** An attempt at an evaluation of the effectiveness of the model. **AND** detailed understanding of how crumple zones make cars safer. *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)** Detailed evaluation of the effectiveness of the model. **OR** Detailed understanding of how crumple zones make cars safer. **OR** An attempt at an evaluation of the effectiveness of the model **AND** an understanding of how crumple zones make cars safer. *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**	**3 × 1.1** **3 × 3.1b**	**AO3.1b Analyses information to evaluate the effectiveness of the model** model is poor or different because… • spring returns to its original shape / spring compresses and bounces back / ORA • springs on cars may be dangerous/impractical / crumple zones are an integral part of the car / spring add length to the model • differences in speed / differences in mass or weight • suggest improvement to the model e.g. egg boxes closer in structure to a crumple zone model is good or similar because… • the both show a change in shape during a collision • they both offer protection / both absorb energy / both increase the time taken / both reduce force **AO1.1 Demonstrates knowledge and understanding of crumple zones** • store energy/absorb energy/spreads out energy/transfer energy • increase time taken to stop / increases the time of the collision • reduce acceleration • reduce rate of change of momentum • reduce force on people • reduce injury to people **ALLOW** spring for model throughout

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

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