F

GCSE (9–1)

Combined Science B (Twenty First Century Science)

J260/03: Physics (Foundation 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 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)		reflected ✓	1	1.1	
	(b)		A wave transfers energy from one place to another ✓ In air, sound waves travel at about 330m/s ✓	2	1.1 x 2	

Question			Answer	Marks	AO element	Guidance
2	(a)		(Rate of) flow of (electric) charge ✓	1	1.1	**ALLOW** flow of electrons
	(b)		battery ✓ complete circuit ✓	2	1.1x2	
	(c)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 12 (C) award 2 marks** Substitution in equation: charge = (current × time) = 0.4 x 30 ✓ = 12 (C) ✓	2	2.1x2	
	(d)		Place (a magnetic compass) next to the wire ✓ (current on) compass needle will be deflected /line up with new magnetic field✓ (No current) compass needle will return to original position /line up with earth's magnetic field✓	3	1.1 x 3	

Question			Answer	Marks	AO element	Guidance
3	(a)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 360 000 (J) award 2 marks** Substitution in equation: kinetic energy = 0.5 x 1 800 × $(20)^2$ ✓ = 360 000 (J) ✓	**2**	**2.1x2**	**ALLOW** correct answers in standard form or using prefixes e.g. 3.6 x 10^5, 360kJ
	(b)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 810 000 (J) award 3 marks** Recall equation work done = force × distance ✓ Substitution in equation: work done = 9000 × 90 ✓ = 810 000 (J) ✓	**3**	**1.2** **2.1x2**	**ALLOW** correct answers in standard form or using prefixes e.g. 8.1 x 10^5, 810kJ
	(c)	**(i)**	(when the roads are wet) braking distance greater/increases/longer ✓ (because) friction reduced / more slippery / less grip ✓	**2**	**3.1a** **2.1**	
		(ii)	(when the bus is faster) / braking distance greater/increases/longer ✓ (because) bus has more (kinetic) energy (to transfer)/ more work must be done (by braking force) / more energy needed to stop ✓	**2**	**3.1a** **2.1**	**ALLOW** momentum

Question			Answer	Marks	AO element	Guidance
4	(a)		3rd box infra red ✓ 5th box ultra violet ✓	2	1.1 x 2	**ALLOW** one mark if answers reversed
	(b)		a very small ✓	1	1.1	

Question			Answer	Marks	AO element	Guidance
5	(a)	(i)	car ✓	1	3.1b	
		(ii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 7.2 (J) award 3 marks** Keyboard potential difference = 4.5 (V) ✓ Substitution in equation: energy transferred = 1.6 × 4.5 ✓ = 7.2 (J) ✓	3	 2.2 2.1x2	
	(b)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 1.8 (W) award 3 marks** Recall equation: power = p.d. × current ✓ Substitution in equation: power = 9 × 0.2 ✓ = 1.8 (W) ✓	3	 1.2 2.1x2	

Question			Answer	Marks	AO element	Guidance
6	(a)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 4 (s) award 3 marks** Recall equation: speed = distance ÷ time ✓ Substitution in equation: 30 = 120 ÷ time ✓ time = (120 ÷ 30) = 4 (s) ✓	**3**	 **1.2** **2.1x2**	 **IGNORE** triangle relationship
	(b)		Accelerates/speeds up (then) travels at constant speed (then) decelerates/slows down ✓ Identifies constant speed 18 m/s ✓ Further detail e.g. acceleration/deceleration is constant **OR** correctly refers to time 21 s / 35 s / 47 s OR constant speed for 14 s ✓	**3**	**3.1a** **2.2x2**	 **ALLOW** identification as max speed OR 'accelerates to'

Question			Answer	Marks	AO element	Guidance
7	(a)		(because they are) unstable ✓	1	1.1	
	(b)	(i)	Beta particles ✓	1	2.1	
		(ii)	**Any two from:** Beta/*β* (particles) because they go through the cardboard but be stopped by the paper-clips ✓ (Not) alpha/*α* (particles) as they are absorbed by cardboard/packet ✓ (Not) gamma/*γ* (rays/radiation) as they will go straight through the cardboard and paper-clips ✓	2	3.2ax2	**IGNORE** references to paper
		(iii)	Radioactive emissions are harmful / dangerous ✓ Damages body tissues/cells/DNA **OR** is ionising **OR** can cause cell mutation. ✓	2	2.1x2	**ALLOW** alpha/beta/gamma **ALLOW** causes cancer **DO NOT ALLOW** ionising cells/tissues/organs
	(c)	(i)	Top line 4 ✓ Bottom line 2 ✓	2	1.2 2.1	
		(ii)	Top line 0 ✓ Bottom line -1 ✓	2	1.2 2.1	

Question			Answer	Marks	AO element	Guidance
8	(a)		(AB) magnet (PQ) iron bar (XY) magnet ✓	1	3.2a	All three need to be correct to award the mark
	(b)	(i)	Zero/nothing/0 ✓	1	1.1	
		(ii)	down arrow (starting on black spot) labelled *W*/weight/*mg* ✓ up arrow (starting on black spot) labelled *F*/(magnetic) force ✓ 2 arrows equal length opposite direction ✓	3	2.2x3	**ALLOW** gravity Vertical arrows judged by eye. Equal length arrows judged by eye.
		(iii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 2.2 (N) award 4 marks** Recognise magnetic force = weight ✓ Convert 220 (g) to 0.22 (kg) ✓ Recall & Substitution in equation: magnetic force = weight = 0.22 × 10 ✓ Magnetic force = 2.2 (N) ✓	4	 1.2x2 2.1x2	 **ALLOW** recognition of magnetic force = weight if not explicitly stated 2200 (N) scores 3 marks

Question			Answer	Marks	AO element	Guidance
9	(a)		Amplitude = 0.5 m ✓ Wavelength = 1.8 m ✓ Frequency = 3 times/waves per second **OR** frequency = 3Hz ✓	3	1.1 x 3	Must link word with value. **ALLOW** answers on diagram
	(b)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 240 (N) award 4 marks** Mass = 1.6 x 15 (= 24) ✓ Recall weight = mass x gravitational field strength ✓ Weight = 24 x 10 ✓ Weight = 240 (N) ✓	4	 2.1 1.2 2.1 2.1	 24 without evidence of calculation is insufficient
	(c)	(i)	Chemical (store) **OR** energy (store) in her muscles ✓	1	2.1	
		(ii)	Kinetic (energy) **OR** mechanical working **OR** by the moving rope **OR** (energy) in the wave ✓	1	2.1	**DO NOT ALLOW** idea that the rope transfers the energy, it must be the movement or wave. **ALLOW** by the wave
		(iii)	Thermal (store) **OR** (energy store) in the surroundings ✓	1	2.1	**ALLOW** Heat
	(d)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 3.3 (m/s) award 3 marks** Recall wave speed = frequency × wavelength ✓ Wave speed = 2.2 × 1.5 ✓ Wave speed = 3.3 (m/s) ✓	3	 1.2 2.1x2	

Question			Answer	Marks	AO element	Guidance
10	(a)		Ice: regular pattern/array close together✓ Water: irregular but still close together ✓ **Any two from:** particles in ice cannot change their position relative to other particles/neighbours ✓ particles in water can change their position relative to other particles/slide over other particles ✓ Particles in water have more energy / **ORA** ✓ Particles in water have weaker attractive forces / **ORA** ✓	**4**	**1.1 x 4**	**ALLOW** atoms or molecules for particles **DO NOT ALLOW** obvious change in particle size/much larger spaces between particles in water than in ice i.e. a gas
	(b)		**Any one from:** (melted ice) particles: have more (potential/internal) energy/energy has been transferred to them ✓ **OR** have weaker forces between them ✓ **OR** Are slightly further apart ✓ **AND** (but) there are still the same number of particles **OR** the mass of the particles has not changed ✓	**2**	**1.1 x 2**	**ALLOW** atoms or molecules for particles **ALLOW** the particles have not changed **DO NOT ALLOW** the mass has not changed
	(c)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 16700 (J) award 2 marks** Select and apply equation: energy to cause a change of state = mass × specific latent heat E = 50 x 334 ✓ = 16700 (J) ✓	**2**	**2.1x2**	

Question			Answer	Marks	AO element	Guidance
11	(a)		transformers ✓	1	1.1	**ALLOW** transformer **IGNORE** step up, step down
	(b)		increased decreased ✓	1	1.1	**DO NOT ALLOW** answers in incorrect order (must have both answers in this order)
	(c)	(i)	230 (V) ✓	1	1.1	**ALLOW** values in range 220-240 (V)
		(ii)	(The high voltage/p.d.) may cause a high current ✓ Which may overheat wires /cause fires **OR** may cause electric shock/stop heart ✓ **OR** (The high voltage/p.d.) is a.c. ✓ can affect muscles / so you can't let go **OR** may cause electric shock/stop heart✓	2	1.1x2	**ALLOW** electrocution **ALLOW** electrocution

Question			Answer	Marks	AO element	Guidance
12	(a)		**Safety (max. 2 from):** Don't boil the liquid **OR** Suggestion of sensible max temperature. ✓ Take care not to touch hot parts ✓ Allow apparatus to cool before dismantling ✓ **Measurements (max. 2 from):** Measure initial and final temperature of liquid/oil/water ✓ Measure mass of liquid/oil/water ✓ Record energy on joulemeter ✓ Stir before taking temperature readings ✓	3	1.2 x 3	**ALLOW** goggles or other sensible safety precaution e.g. heat proof gloves **IGNORE** gloves unqualified, apron **IGNORE** measure temperature **IGNORE** measure temperature difference **ALLOW** measure energy used **ALLOW** measure time to heat and power of heater **ALLOW** measure time to heat, p.d. and current in heater. **ALLOW** one mark (in measurements) for idea of substitution of measurements in the specific heat capacity equation
	(b)		**FIRST CHECK ANSWER ON ANSWER LINE** **If answer = 2.05 (kJ/kg °C)** (1.94 + 2.23 + 1.98) / 3 ✓ = 2.05 (kJ/kg°C) ✓	2	1.2 x 2	**ALLOW** any answer that rounds to 2.05 **ALLOW** one mark for 1.96 if 2.23 is explicitly identified as an outlier
	(c)		(accurate value is) lower ✓ (Because) energy is required to heat up apparatus and/or surroundings ✓ Lag the container **OR** add a lid ✓	3	3.1a 3.1b 3.3b	**ECF ORA** **ALLOW** only improvements that reduce the energy transfer to apparatus/surroundings

Question			Answer	Marks	AO element	Guidance
13	*		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)** Interprets the charts to describe trends in detail. **AND** Gives an explanation for the trends including a reference to renewables and coal. *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)** Interprets the charts to describe a trend in detail. **OR** Gives an explanation for the trend in renewables and coal. **OR** States a basic trend shown in the charts **and** explain a trend by referring to either coal decreasing or renewables increasing. *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)** States a basic trend shown in the charts **OR** Explains a trend by referring to either coal decreasing or	6	3.1a x 4 2.1 x 2	**AO3.1a Analyse information and ideas to interpret** **For example:** **Basic trend:** • coal use has fallen • gas use not much changed /no clear trend /up and down • nuclear not much changed /no clear trend /up and down • renewables increased • other and oil not much changed /no clear trend /up and down/unchanged overall • quoting data e.g. coal from 36.5% to 22.0% **More detail:** • coal use falling every year • renewables increasing every year • the increase in renewables is increasing every year • using data for coal e.g. coal fell by (36.5-22.0 =) 14.5% • using data for renewables **AO2.1 Application of knowledge and understanding** **For example:** **Explains that:** • coal/gas result in CO_2 emissions • which cause global warming • coal fired power stations / mines are being closed • coal fired stations produce SO_2 • nuclear does not cause CO_2 emissions • renewables increasingly used as more

Question			Answer	Marks	AO element	Guidance
			renewables increasing. *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.*			sustainable • renewables increasingly used as no CO_2 emissions when generating • lots of wind farms and offshore wind farms have been built • lots of solar farms have been built.

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