Oxford Cambridge and RSA

H

GCSE (9–1)

Combined Science A (Physics) A (Gateway Science)

J250/12: Paper 12 (Higher Tier)

General Certificate of Secondary Education

Mark Scheme for November 2020

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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

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

Question			Answer	Marks	AO element	Guidance
11	(a)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 2 (°C / min) award 3 marks** 10 ✓ 10 / 5 ✓ = 2 (°C / min) ✓	3	 **2.2** **2.2** **2.2**	 **ALLOW** 60/5 for 1 mark
	(b)	**(i)**	(As time increases), temperature decreases / ORA ✓ Decrease in temperature rapid at start / temperature decreases at a decreasing rate / ORA ✓	**2**	**3.1a** **3.1a**	**ALLOW** examples e.g. (in the first minute) it goes down (from 70°C to 67°C) **ALLOW** inverse relationship **IGNORE** negative correlation **ALLOW** value for temperature getting smaller as time increases **ALLOW** not linear / not proportional / change is less gradual / (change) slower at end / ORA **ALLOW** comparison of two data points

		(ii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 8000 (J) award 3 marks** 0.2 × 4200 × 10 ✓ 8400 (J) ✓ = 8000 (J) (1sf) ✓	**3**	 **2.1** **2.1** **1.2**	 **ECF** from 11(a) for temperature change **ALLOW** answer of = 1680 (J) for 1 mark **ALLOW** answer of = 2000 (J) for 2 marks **ALLOW** correct sf from candidate's calculation
	(c)		Thermal/energy/heat <u>store</u> (in water) decreases / AW ✓ Thermal/energy/heat <u>store</u> in surrounding/air increases / AW ✓	**2**	**1.1** **1.1**	 **ALLOW** energy is transferred from the thermal/energy/heat <u>store</u> (of the water) to the surroundings for 2 marks
	(d)	**(i)**	Any line with a smaller gradient than the line on the graph ending at a temperature between 61 °C and 69 °C ✓	**1**	**3.2a**	**DO NOT ALLOW** horizontal line at 70 °C
		(ii)	Increase thickness of the beaker or insulation / decrease thermal conductivity of the beaker or insulation / put the insulation on the top of the beaker / use a lid / put insulation under the beaker / AW ✓	**1**	**1.1**	**ALLOW** increase the temperature of the room / keep the room temperature the same as the water **IGNORE** reduce the temperature of the water / put in the sun / use a (hot) water bath

Question			Answer	Marks	AO element	Guidance
12	(a)	(i)	(Atoms of same element) with different numbers of neutrons / AW ✓	1	1.1	**ALLOW** same atomic/proton number but different mass number
	(b)	(i)	Beta ✓	1	1.2	
		(ii)	Mass: stays the same / unchanged ✓ Charge: increases by 1 ✓	2	2.1 2.1	
	(c)		Electron absorbs/gains radiation/photon ✓ Electron lost (from atom) / AW ✓	2	1.1 1.1	**ALLOW** ionisation is the loss/gain of electrons (from atom)
	(d)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 8:1 award 3 marks** (17100 =) 3 half lives ✓ (Amount left $(1/2)^3$ =) 1/8 ✓ (Ratio =) 8:1 ✓	3	 2.1 2.1 2.1	 **ALLOW** 17100 ÷ 5700 = 3 for 1 mark **ALLOW** 8.1 or 8 to 1 for 3 marks

Question			Answer	Marks	AO element	Guidance
13	(a)		**Any one from:** Light is faster (than sound) / ORA ✓ Light is transverse / sound is longitudinal ✓ Light does not need a medium (to travel through) / sound needs a medium ✓ Light is an EM wave / sound is a mechanical wave ✓ Light has vibrations at 90° to the direction of propagation / sound has vibrations parallel to it ✓	1	1.1	**ALLOW** light has a shorter wavelength (than sound) / ORA **IGNORE** sound waves are not visible
	(b)	(i)	Force up > force down / resultant force up on cork ✓	1	2.1	**ALLOW** force of water on the cork is greater than force of Earth on cork
		(ii)	The cork vibrates up and down **and** the wave moves across the tray / AW✓	1	1.1	
	(c)	(i)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 0.02 (s) award 1 mark** (4 × 0.005 =) 0.02 (s) ✓	1	2.2	
		(ii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 50 (Hz) award 3 marks** Use of f = 1/T OR understanding of frequency as number of waves per second ✓ 1 / 0.02 ✓ = 50 (Hz) ✓	3	 1.2 2.1 2.1	 **ALLOW** ECF from (c)(i)

Question			Answer	Marks	AO element	Guidance
	(d)	(i)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 348 (m/s) award 3 marks** Recall wave speed = frequency × wavelength / (v =) f ×λ ✓ 1200 × 0.29 ✓ = 348 (m/s) ✓	**3**	 **1.2** **2.1** **2.1**	
		(ii)	**Any one from:** Use lower frequencies so distance is longer or easier to measure ✓ Repeat experiment and average readings / repeat with a distance to two wavelengths ✓ Calibrate sound from speaker ✓ Calibrate signal generator ✓ Use equipment with higher resolution ✓	**1**	**3.3b**	**ALLOW** remove zero error from signal generator/oscilloscope
		(iii)	**Any three from:** Measure distance to wall ✓ Make a clap / noise / shout / use a speaker ✓ Time how long it takes to hear the echo ✓ Divide time by 2 / multiply distance by 2 ✓ Use s = d/t to calculate speed ✓	**3**	**3 x 3.3a**	

Question			Answer	Marks	AO element	Guidance
14	(a)	(i)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 500 (A) award 3 marks** $I^2 = P / R$ ✓ $I^2 = 750\,000 / 3 = 250\,000$✓ I = 500 (A) ✓	3	 **1.2** **2.1** **2.1**	
		(ii)	**Any two from:** Step up transformers (used after power station) / AW ✓ (Transformers) increase voltage (before grid) / AW ✓ (Transformers) decrease current ✓ Reduces heat loss (in wires) / AW ✓ **AND** Doubling voltage reduces power loss by a factor of 4 / inverse square law / ORA / AW ✓	3	**2 × 1.2** **3.2b**	**ALLOW** any correct numerical comparison, e.g. quadrupling V decreases P loss by factor of 16, halving V quadruples power loss.
	(b)		**Any three from:** Connecting live to earth ✓ A person may be part of the live to earth connection✓ A person may touch the water / AW ✓ There is a potential difference between the live wire and the person/Earth✓ (Which may cause) an electrical shock ✓	3	**3 × 1.2**	

Question			Answer	Marks	AO element	Guidance
15	*		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 comparison of advantages and disadvantages of each type of turbine. **AND** Detailed analysis of data which is used to make judgements about each energy source. *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 comparison of advantages and disadvantages of each type of turbine. **AND** Some analysis of data which is used to make judgements about each energy source. **OR** Comparison of advantages and disadvantages of each type of turbine. **AND** Detailed analysis of data which is used to make judgements about each energy source. *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.*	6	2 × 1.2 4 x 3.1b	**AO1.2 – Demonstrates knowledge and understanding of wind and wave power.** **Advantages** • Both are renewable / sustainable / give free energy once set up • Tidal turbines do not take a lot of land • Tidal turbines can be placed further from people, so noise or visual pollution reduced • Both do not produce carbon dioxide / greenhouse gases • Tidal reliably happen twice a day **Disadvantages** • Wind is unreliable / turbines do not work if there is not enough wind or too much wind • Tide times and size vary • Both can damage wildlife / produce visual and noise pollution • Wind farms take a lot of land (which can be used for crops) • Both are expensive to build / set up **AO3.1b – Analyses information to evaluate wind and wave power.** • Density of water > density of air • Need a greater volume of air through wind turbine (per s) • m (= d × V = 1.20 × 38000) = 45 600 kg • m (= d × V = 1020.00 × 8) = 8160 kg • KE(/s) (= ½mv^2 = ½×45600×25) = 570 000 J(/s) • KE(/s) (= ½mv^2 = ½×8160×25) = 102 000J(/s) • Wind turbine produces more energy than the wave turbine (per s) at same speed

Question			Answer	Marks	AO element	Guidance
			Level 1 (1–2 marks) Comparison of advantages and disadvantages of each type of turbine. **OR** An attempt to calculate the energy produced by each source. *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.*			**AO3.2a - Analyses information to make judgements on wind and wave power** • Wave turbine has higher overall efficiency • More wave turbines needed for same speeds / ORA • Radius of wind turbine must be larger than radius of water turbine for same speed / ORA

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