

H

GCSE (9–1)

Combined Science B (Twenty First Century Science)

J260/08: Combined Science (Higher Tier)

General Certificate of Secondary Education

Mark Scheme for Autumn 2021

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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.

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1. 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

2. Abbreviations, annotations and conventions used in the detailed Mark Scheme (to include abbreviations and subject-specific conventions).

Annotation	Meaning
/	alternative and Allowable 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 Allowed
()	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)	<p>Any four from:</p> <p>She should use a quadrat ✓ placed randomly in the garden / use a transect ✓ Count the number of buttercup plants (in the quadrat) ✓ Take more samples✓ Find the mean number of plants✓</p>	4	3.3b	IGNORE the idea of counting all the plants						
	(b)	<p>✓✓</p> <table border="1"> <tr> <td>Shade from trees</td> <td>Less sunlight is available for photosynthesis</td> </tr> <tr> <td>Waterlogged soil</td> <td>Fewer leaves to absorb light</td> </tr> <tr> <td>More slugs to eat plants</td> <td>Less oxygen available for respiration in root cells</td> </tr> </table>	Shade from trees	Less sunlight is available for photosynthesis	Waterlogged soil	Fewer leaves to absorb light	More slugs to eat plants	Less oxygen available for respiration in root cells	2	2.1	All 3 correct scores 2 marks 2 or 1 correct scores 1 mark
Shade from trees	Less sunlight is available for photosynthesis										
Waterlogged soil	Fewer leaves to absorb light										
More slugs to eat plants	Less oxygen available for respiration in root cells										
	(c) (i)	260 ✓	1	3.1a							
	(ii)	75(th) ✓	1	3.1a							

Question		Answer	Marks	AO element	Guidance
2	(a)	Equipment B AND water will evaporate and then condense ✓ Equipment A won't filter sea water as salt is dissolved ✓ Equipment C will boil the water away and just leave salt / crystals ✓	3	3.2a	
	(b)	(i) petrol (top) kerosene diesel (oil) (bottom) ✓✓	2	3.1b	All 3 correct scores 2 marks 2 or 1 correct scores 1 mark ALLOW alternative wording for petrol e.g gasoline
	(ii)	Any one from: fractionating tower is hottest at the bottom and coolest at the top ✓ AND any one from: Naphtha molecules are smaller/ have fewer C atoms/ shorter C chain (than fuel oil) ✓ Naphtha molecules have weaker intermolecular forces (than fuel oil) ✓ Naphtha molecules condense at a lower temperature (than fuel oil) ✓	2	2.1	Assume 'it' refers to naphtha

Question		Answer	Marks	AO element	Guidance
3	(a) (i)	<p>The typical speed for walking 1.5 m / s ✓</p> <p>The typical speed for cycling is 7 m/ s ✓</p> <p>The typical speed for a car is 90 km / h ✓</p>	3	1.1	
	(ii)	<p>FIRST CHECK THE ANSWER ON ANSWER LINE</p> <p>If answer = 6.700... m/s award 4 marks</p> <p>Speed = distance ÷ time ✓</p> <p>Conversion of 20km to 20 000m ✓</p> <p>Conversion of 49mins 45 seconds to 2985 seconds ✓</p> <p>$(20\ 000 \div 2985) = 6.700\dots$ ✓</p>	4	<p>1.2 x 3</p> <p>2.1</p>	
	(iii)	<p>FIRST CHECK THE ANSWER ON ANSWER LINE</p> <p>If answer = 720 kg m/s award 2 marks</p> <p>Momentum = mass x velocity ✓</p> <p>$60 \times 12 = 720 \text{ kg m/s}$ ✓</p>	2	<p>1.2</p> <p>2.1</p>	
	(b)	<p>EITHER increases ✓ duration✓ force ✓</p> <p>OR Decreases ✓ force ✓ force ✓</p>	3	2.1	Only award marks from one combination of marking points
	(c)	<p>Maximum of two from: (Improves precision) use light gates/dataloggers ✓ measure time in milliseconds rather than seconds ✓</p> <p>Maximum of two from: (Improves accuracy) Increase the distance / length of the ramp ✓ Repeat the experiment to find a mean and identify anomalous results ✓ Repeat the experiment with different gradients ✓</p>	3	3.3b	Candidates must comment on both accuracy and precision to score 3 marks

Question		Answer	Marks	AO element	Guidance
4	(a)	<p>(i) Any two from: over time (1960-2010) mean blood cholesterol levels for men have fallen ✓ over time (1960-2010) mean blood cholesterol levels for women have fallen ✓ men have lower mean blood cholesterol levels than women ✓ the fall in cholesterol levels over time was greater for women than for men (1mg/dL) ✓</p>	2	3.2b	ALLOW any correct conclusion ALLOW ORA
		<p>(ii) Any one from: Collect a greater range of samples / increase sample size ✓ sample a greater range of ages ✓ equal sample size for men and women ✓ sample a greater range of ethnicities ✓ sample a greater range of areas e.g urban/rural ✓</p>	1	3.2a	ALLOW any correct suggestion
		<p>(iii) FIRST CHECK THE ANSWER ON ANSWER LINE If answer is 12% award 3 marks $220 - 194 = 26$ ✓ $(26 \div 220) \times 100 = 11.81818182$ ✓ = 12 (2sf) ✓</p>	3	2.2 x 2 1.2	ALLOW any correct conversion to 2 sig figs.
	(b)	<p>(i) Any two from: very few people develop cardiovascular disease without any risk factors✓ males have slightly more risk factors than females✓ around 98% of those sampled had at least one risk factor✓ very few people had six or more risk factors✓</p>	2	3.2b	ALLOW any correct conclusion drawn from the data ALLOW % conclusions based on each category
		<p>(ii) Any one from: (To combat obesity) lose weight ✓ (To combat a lack of physical activity) be more active ✓ (To combat high blood cholesterol) take statins ✓ (To combat poor diet) eat more healthy food ✓ (To combat high blood pressure) take medication ✓ (To combat smoking) stop smoking ✓ (To combat alcohol use) reduce alcohol consumption ✓</p>	1	1.1	ALLOW any answer that correctly describes the reduction of one of the risk factors for cardiovascular disease

Question		Answer	Marks	AO element	Guidance
5	(a)	Electron Ions +1 Electron Ions -1 ✓✓✓	3	2.1	Electrons = 1 mark Ions = 1 mark +1 and -1 = 1 mark ALLOW 1 mark for the first 3 missing words correctly identified (potassium) OR second 3 missing words correctly identified (bromine) if no other mark is scored.
	(b)	Any one from: (group 1) good electrical conductors ✓ good thermal conductors ✓ react with water ✓ react with moist air ✓ Shiny / lustrous when cut ✓ Soft and can be easily cut ✓ Any one from: (group 7) do not conduct electricity ✓ have low melting points ✓ have low boiling points ✓	2	1.1	DO NOT ALLOW group 1 react with group 7 or vice versa ALLOW any correct property

Question		Answer	Marks	AO element	Guidance
6	(a)	<p>Any three from: Measure original length of the spring (without mass) ✓ place a mass on the spring and measure the new length of the spring ✓ Measure the length in mm ✓ use a range of masses / example of masses to be used ✓ Calculate (mean) extension ✓</p> <p>AND any one from: (accuracy). wait for the spring to stop moving before taking the measurement ✓ use the pointer to determine the measurement ✓ Repeat each measurement of length 3 times / repeat the experiment 3 times with the same spring ✓</p>	4	2.2	
	(b)	<p>FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 4 (N/m) award 4 marks</p> <p>Spring constant = force exerted by a spring ÷ extension ✓ 50mm converted to m = 0.05m ✓ Convert mass to weight $0.02\text{g} \times 10 = 0.2\text{N}$ ✓ $0.2 \div 0.05 = 4$ ✓</p>	4	1.2 x 2 2.1 x 2	
	(c)	<p>(at 30g) the material is no longer elastic so does not return to its original shape ✓ (at 30g) the material has become plastic / the spring has reached/exceeded its elastic limit ✓ the material is permanently distorted/plastic deformation ✓</p>	3	2.1	ALLOW higher level answers that use the particle model to explain the difference between elastic and plastic deformation

Question		Answer	Marks	AO element	Guidance
7		<p>Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.</p> <p>Level 3 (5–6 marks) Explain several factors that affect the decision to recycle plastic bottles AND include supporting calculations <i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i></p> <p>Level 2 (3–4 marks) Explain some factors that affect the decision to recycle plastic bottles AND include a supporting calculation <i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i></p> <p>Level 1 (1–2 marks) List some factors that affect the decision to recycle plastic bottles OR include a calculation <i>There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.</i></p> <p>0 marks <i>No response or no response worthy of credit.</i></p>	6	2 x 2.1 4 x 3.2a	<p>AO2.1 Apply knowledge and understanding of scientific ideas</p> <p>Factors to be considered.</p> <ul style="list-style-type: none"> • Energy use (in obtaining raw materials, production of bottles and disposal of waste) • Cost of recycling • Ease of recycling • Disposal options • Environmental impact • Can the bottles be reused <p>AO3.2a Analyse information and ideas to make judgements - uses calculations to support recycling</p> <ul style="list-style-type: none"> • Energy used in manufacture from raw materials is $8.810 \times 10^6 + 1.687 \times 10^6 = 10.497 \times 10^6 \text{ J}$ • Energy used in production per bottle through recycling is 1.688×10^6 • Using recycled pellets to make new bottles uses 84% less energy or $10.497 / 1.688 = 6.2$, so uses about 6 x less energy ORA • Energy use in incineration of bottles is more than the energy used in recycling the bottles • Total energy cost from raw material to incineration is $1.2517 \times 10^7 \text{ J}$

Question		Answer	Marks	AO element	Guidance
8	(a)	(i) Any two from: concentration of (sodium hydrogencarbonate/carbon dioxide) solution ✓ temperature ✓ using the same piece of pondweed each time. ✓ Same lamp ✓	2	2.2	
		(ii) move the lamp to different distances from the pondweed ✓	1	2.2	
	(b)	inversely square distance ✓✓	2	1.2	All 3 correct scores 2 marks 2 or 1 correct scores 1 mark
	(c)	(i) all plots correct ✓ line of best fit ✓	2	2.2	ALLOW plots within $\frac{1}{2}$ square
		(ii) (after 600ppm) the rate of photosynthesis remains constant / reaches a maximum✓ carbon dioxide is no longer a limiting factor ✓ light intensity/temperature is a limiting factor ✓	3	3.1a 3.2b x 2	
	(d)	(i) global temperatures fluctuate✓ overall the general trend is that global temperatures have risen✓	2	3.1	ALLOW any correct comment comparing two different data points e.g. temperature in 1910 is lower than that in 1980
		(ii) Any two from: Graph of the observations do not match the pattern of natural factors ✓ Observed rise must be a result of human factors (not natural alone)✓ human factors such as burning fossil fuels / industrialisation could account for the difference ✓ human factors such as deforestation could account for the difference✓	2	3.2a	

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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