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 June 2019

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.

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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)	(i)	**Any two from:** Incomplete combustion / not complete combustion ✓ Not enough oxygen ✓ Particulates/(unburnt) carbon ✓	**2**	**2 x 2.1**	**ALLOW** soot for particulates
		(ii)	evaporate✓ cooled✓	**2**	**2 x 1.1**	
		(iii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = C_4H_9 award 3 marks** ratio of C:H = 8:18 ✓ simplest ratio = 4:9 ✓ C_4H_9 ✓	**3**	**3 x 2.2**	**ALLOW** 2 marks for the correct displayed formula of C_4H_9 **NOT** C_8H_{18} alone as this is in the stem of the question
	(b)		**Max. any two for any 2 similarities from:** (both are) mixtures ✓ (both contain) LPG ✓ (both contain) Petrol ✓ (both contain) Diesel ✓ diesel and petrol form roughly the same proportion(~15% each in crude oil/~30% each in condensate oil) of each mixture ✓ **Max. any two for any 2 differences from:** crude oil has more fractions / condensate has fewer fractions / crude oil has 7 fractions and condensate has (only) 3 fractions ✓ (only) crude oil has residue ✓ (only) crude oil has fuel oil ✓ (only) crude oil has heating oil ✓ (only) crude oil has paraffin ✓ crude oil has less LPG ✓ crude oil has less petrol ✓ crude oil has less diesel ✓ condensate has equal distribution of fractions ✓	**4**	**4 x 3.1a**	**ALLOW** ORA throughout

	(c)	**(i)**	The oils contain different fractions ✓	**1**	**3.1a**	
		(ii)	**Identification of property of condensate** (condensate oil) has lower flash point / lower temperature the vapour will catch fire ✓ is less viscous ✓ **Max two from:** **Identification of danger/environmental effect** (has lower flash point) – more likely to catch fire/explode ✓ (is less viscous) – more likely to move/leak out/spread ✓ (is less viscous) idea of less environmental issues with condensate such as easier to clean animals and beaches ✓	**3**	**3 x 3.1b**	To score 3 marks Candidates should identify either two properties and link one of these to a correct danger OR identify two dangers and link one of these to a property **ORA** for crude oil **IGNORE** boiling point, colour and density **ALLOW** alternative wording for viscosity e.g. runny Property comparison must be explicit to score the mark e.g. quoting data or information from the table such as 'thick liquid' without comparison does not score

Question			Answer	Marks	AO element	Guidance
2	(a)		**Any four from:** Cut (anthocyanin) gene out (of DNA) ✓ using (restriction) enzyme ✓ replicate (anthocyanin) gene ✓ use a plant virus/vector/plasmid ✓ put the (anthocyanin) gene into the vector ✓ Use plant virus/vector/plasmid to transfer gene to tomato (cell) ✓ Select modified (tomato) cells ✓	**2**	**2 x 2.1**	4 correct = 2 marks 2/3 correct = 1 mark 1 correct = 0 marks
	(b)	**(i)**	**Any two from:** resistant to a range of conditions such as drought/flood/salinity/extremes of temperature ✓ resistant to pests ✓ resistant to diseases ✓ higher yield/faster growing / idea of overcoming food shortages ✓ modified to have a longer shelf life ✓ modified to have additional nutritional value ✓ modified to have better flavour ✓	**2**	**2 x 1.1**	**IGNORE** ideas of immunity, unqualified reference to disease, cost and cell damage

		(ii)	**Any two from:** Gene might transfer to wild species ✓ Uncertainty over long term effects ✓ Idea of increased risk of mutations ✓ Idea of impact on a food chain / effect other species✓	**2**	**2 x 1.1**	
	(c)		**Any three from :** Extract juice from tomatoes by crushing/mashing ✓ Add tomato extract as a spot to the pencil line ✓ Place the solvent/water into a suitable container ✓ Ensure the baseline is above the solvent/water ✓ Allow solvent/water/pigment to move up the paper ✓ remove paper before solvent/water reaches the top / mark solvent front ✓	**3**	**3 x 2.2**	
	(d)	**(i)**	blue tomatoes do contain lycopene <u>and</u> beta carotene / blue extract contain two pigments that are in the red tomatoes / both pigments are in both tomatoes ✓ Only blue tomato has anthocyanin✓	**2**	**2 x 3.1a**	

Question			Answer	Marks	AO element	Guidance
		(ii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 0.53 award 3 marks** Solvent front = 10.0cm/100mm ✓ anthocyanin spot = 5.3cm/53mm ✓ 53/100 = 0.53 (2SF) OR 5.3/10.0 = 0.53 (2SF) ✓	**3**	**3 x 2.2**	**ALLOW** range of 0.51 to 0.55 for 3 marks **ALLOW ECF** if measurement of spot is not correct (+/- 2mm for spot only) **ALLOW** 1 mark for 2sf provided it has been produced correctly from an incorrect calculation

Question			Answer	Marks	AO element	Guidance
3	(a)		**Any two from:** Idea of fixed distance from lamp to film/sensor✓ Fixed intensity light/ use same lamp for all readings✓ Idea of making cream same thickness ✓ Clean sheet between each different cream / use a different sheet ✓ Idea of removing other sources of UV light/carry out in dark ✓	**2**	**3.3a** **3.3b**	**ALLOW** any other acceptable improvements **ALLOW** same amount of cream
	(b)	**(i)**	**Any one from:** No protection/SPF in the sunscreen ✓ Idea that the UV can get through ✓	**1**	**2.2**	
	(b)	**(ii)**	**Any two from:** Different UV lamp/intensity of UV ✓ Different UV detector/sensor/meter ✓ Different material/thickness of plastic sheet ✓ Different distances between lamp/sunscreen/detector✓ Different brand/type of sunscreen ✓ Not done in the dark / no additional UV sources ✓ Different thickness cream✓	**2**	**2 x 3.2a**	**ALLOW** Different equipment used as an alternative to marking points one to three for one mark **ALLOW** different amount of cream

	(b)	**(iii)**	no units for y-axis (mW/cm^2)✓ x-axis scale is non-linear (or words to that effect) ✓ Points for SPF 10 is incorrectly plotted ✓	**3**	**3 x 3.1a**	**IGNORE** no line of best fit **ALLOW** SPF 30 point is incorrectly plotted
	(c)	**(i)**	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 1 hour(s) 40 (minutes) award 3 marks** SPF 30 × 5 (mins) = 150 and SPF 50 × 5 (mins) = 250 ✓ 150/60=2 hrs 30 mins and 250/60=4 hrs 10 mins OR identify that the difference between 250 minutes and 150 minutes is 100 minutes ✓ 4 hrs 10mins – 2hrs 30 mins = 1 hour 40 minutes ✓	**3**	 **2.2** **1.2** **2.2**	**ALLOW ECF** for correct conversion into hours and minutes for last marking points 1 mark e.g. if difference is 80 minutes then conversion to 1 hour 20 minutes is ECF
		(ii)	(YES) If she re-apply after 2 hours ✓ if she re-apply after swimming ✓ If she doesn't exceed the calculated protection time ✓ **OR** (NO) After a given time her skin will burn ✓ SPF factor increases the time but doesn't prevent burning ✓	**2**	**2 x 3.1b**	 **ALLOW** use of candidate's stated protection time from c(i)
		(iii)	**Any one from:** makes vitamin D ✓ kills bacteria / sterilisation ✓ detecting forged banknotes / security marker pens ✓ UV's role in heating the planet ✓	**1**	**1.1**	**ALLOW** other correct uses e.g. tanning, mood enhancer, photography, black light for detecting substances, solar cells etc.

Question			Answer	Marks	AO element	Guidance
4	(a)		**Any three from:** Enzymes work best at optimum temperatures ✓ Above optimum temperature the enzymes are denatured ✓ (at higher temperatures) the active site will change shape ✓ (at higher temperatures) the substrate can no longer fit in the active site / the enzyme substrate complex can no longer form ✓ At lower temperatures there are fewer successful collisions / fewer enzyme substrate complexes formed ✓ Higher or lower temperatures will result in cellular processes / reactions slowing down/stopping ✓	**3**	**3 x 2.1**	**ALLOW** metabolism slows
	(b)	**(i)**	Radiation ✓	**1**	**2.1**	
		(ii)	Insulation ✓	**1**	**2.1**	
		(iii)	Dissipation✓ Radiation✓	**2**	**2 x 2.1**	Answers can be in either order
	(c)	**(i)**	(Shivering may occur) any time between the hours of midnight and 8am✓ Shivering takes place when the air/enclosure temperature is lowest/drops to the lowest /11°C ✓	**2**	**2 x 3.2a**	

		(ii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 907200000 (J) award 4 marks** Recall energy transferred = power × time ✓ 7 x 12 = 84 (hours) ✓ 84 x 60 x 60 = 302400 (s) ✓ 3000 × 302400 = 907200000 ✓	**4**	 **1.2** **2.2** **1.2** **2.2**	**129600000 (J)** scores 3 marks **252000 (J)** scores 3 marks **ALLOW** conversions to KJ, MJ **ALLOW** standard form (e.g. $9.1x10^8$(J))

Question			Answer	Marks	AO Element	Guidance
5	(a)	(i)	**FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 373.7 award 3 marks** 217.1 x (100/58.1) ✓ =373.6(6609)✓ =373.7 (1 decimal place) ✓	**3**	**2 x 2.2** **1.2**	**ALLOW** correctly rounded values to an incorrect number of decimal places e.g. 373.67 / 374 for 2 marks **ALLOW** evidence of an incorrectly calculated value quoted to 1 decimal place
		(ii)	**Any three from:** more countries sampled ✓ more continents sampled ✓ larger sample size / sample more people (within a country) ✓ more frequent sampling ✓ more accurate data collection of TB / TB and HIV cases ✓ idea of using the resources of medical/hospital records to collect accurate data ✓	**3**	**3 x 3.3b**	
	(b)		Having HIV makes it harder for your body to kill pathogens ✓ HIV reduces the number of white blood cells ✓	**2**	**2 x 1.1**	

Question			Answer	Marks	AO Element	Guidance
6	(a)*		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)** Evaluate Jack's decision to buy house B based on the data in Fig. 6.2 and the correctly calculated efficiencies or wasted energy using data from Fig. 6.1 *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)** Evaluate Jack's decision to buy house B based on the data in Figs. 6.2 and 6.1 without full efficiency calculation. **OR** Evaluate Jack's decision to buy house B based on the correctly calculated efficiencies or wasted energy using data from Fig. 6.1 *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)** Draws a conclusion using the data in Fig. 6.1 or 6.2 *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.* **0 marks** *No response or no response worthy of credit.*	**6**	**1 x 1.2** **2 x 2.1** **3 x 3.2b**	**AO1.2 Recall of efficiency equation** Efficiency = useful energy transferred ÷ total energy transferred **AO2.1 application of recalled equation** House A Useful energy = 72.3 – 31.7 = 40.6 Efficiency = 40.6 ÷ 72.3 = 0.56 / 56 / 56.1% Energy wasted = 43.8 / 44% House B Useful energy = 57.9 – 18.6 = 39.3 Efficiency = 39.3 ÷ 57.9 = 0.68 / 67.8 / 68% Energy wasted = 32.1 / 32% **AO3.2b Analyse information and ideas to draw conclusions.** - House B is currently more efficient than A - Both houses could be made more efficient - House A could be made much more efficient than house B House B: - But it will not be the most efficient in the long term - Will be cheaper to run from the day of purchase - Investment in improving efficiency will not bring large savings House A: - Could save lots of money - Investment in improvements could result in savings in the long term

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>AO Element</th><th>Guidance</th></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td>FIRST CHECK THE ANSWER ON ANSWER LINE If A = £500, B = £275 and C = £800 award 2 marks

A = £400
B = £625
C = £100
✓

A saves £500/year
B saves £275/year
C saves £800/year
✓</td><td>2</td><td>1.2

2.1</td><td>ALLOW 1 mark for 2 correct values from the amount of money saved</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>
<table>
<tr><th>Boiler</th><th>Cost of installation</th><th>Gas usage</th><th>Idea of Payback time</th><th>Running costs</th></tr>
<tr><td>A</td><td>Quite expensive</td><td>Uses moderate amount of gas</td><td>2.10 years</td><td>moderate</td></tr>
<tr><td>B</td><td>Cheap</td><td>Uses a lot of gas</td><td>2.16 years</td><td>high</td></tr>
<tr><td>C</td><td>Very expensive</td><td>Uses little gas</td><td>10.31 years</td><td>low</td></tr>
</table>
Justifies the choice of boiler using any three statements from the table ✓✓✓</td><td>3</td><td>3 x 3.2b</td><td>Comparative statement using two items from the table award two marks</td></tr>
</table>

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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Facsimile: 01223 552553