

**GCSE (9–1)**

**Combined Science B (Twenty First Century Science)**

**J260/05: Biology (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.

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## 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).

<b>Annotation</b>	<b>Meaning</b>
/	alternative and acceptable answers for the same marking point
✓	Separates marking points
<b>DO NOT ALLOW</b>	Answers which are not worthy of credit
<b>IGNORE</b>	Statements which are irrelevant
<b>ALLOW</b>	Answers that can be accepted
( )	Words which are not essential to gain credit
<u>—</u>	Underlined words must be present in answer to score a mark
<b>ECF</b>	Error carried forward
<b>AW</b>	Alternative wording
<b>ORA</b>	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:

	<b>Assessment Objective</b>
<b>AO1</b>	<b>Demonstrate knowledge and understanding of scientific ideas and scientific techniques and procedures.</b>
AO1.1	Demonstrate knowledge and understanding of scientific ideas.
AO1.2	Demonstrate knowledge and understanding of scientific techniques and procedures.
<b>AO2</b>	<b>Apply knowledge and understanding of scientific ideas and scientific enquiry, techniques and procedures.</b>
AO2.1	Apply knowledge and understanding of scientific ideas.
AO2.2	Apply knowledge and understanding of scientific enquiry, techniques and procedures.
<b>AO3</b>	<b>Analyse information and ideas to interpret and evaluate, make judgements and draw conclusions and develop and improve experimental procedures.</b>
<b>AO3.1</b>	Analyse information and ideas to interpret and evaluate.
AO3.1a	Analyse information and ideas to interpret.
AO3.1b	Analyse information and ideas to evaluate.
<b>AO3.2</b>	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.
<b>AO3.3</b>	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)	27 22 16 22 9 ✓✓	2	1.2	27 and 9 correct = 1 mark 22, 16 and 22 correct = 1 mark
	(b)	(i)	2	2.2	<b>IGNORE</b> bird names  <b>ALLOW</b> 1/2 square margin of error in plotting <b>ALLOW ECF</b> from part 1 (a)
		(ii)	1	2.2	<b>ALLOW ECF</b> <b>DO NOT ALLOW</b> extrapolation beyond 1 and 5
	(c)	(i)	1	3.1a	<b>ALLOW</b> negative correlation if the axes are transposed.  <b>ALLOW</b> 1 mark if outlier identified
		(ii)	2	3.1b	<b>IGNORE</b> identification of outlier  <b>ALLOW</b> any reasonable suggested factor e.g. aggression/different food preferences
	(d)	<b>Any two from:</b> <i>idea</i> that species rely on each other for many different resources ✓ example of resources species provides for other species or require from another species e.g. food, shelter, building materials, habitat etc ✓ <i>idea</i> that species keep the population of another species constant/affect the population of other species ✓	2	1.1	<b>ALLOW</b> 2 marks for named resources linked to the idea of interdependence.

Question		Answer	Marks	AO element	Guidance
2	(a)	chlorophyll oxygen respiration glucose energy ✓✓✓	3	1.1	All five correct for 3 marks Any four or three correct for 2 marks Any two or one correct for 1 mark
	(b) (i)	B ✓  (The indicator turned purple showing that the carbon dioxide level decreased as) used by the pondweed/plant ✓	2	3.1a 3.2b	<b>ALLOW</b> C if explanation is correct e.g. carbon dioxide produced by snail is equal to carbon dioxide taken in by pondweed/plant.
	(ii)	A ✓  (The indicator turned yellow showing that the carbon dioxide level increased) the plant was not using carbon dioxide in photosynthesis/ was only carrying out respiration ✓	2	3.1a 3.2b	
	(iii)	Carbon dioxide produced by (respiration) snail (and plant) ✓  Is the same amount as carbon dioxide use (by plant /photosynthesis) ✓	2	2.1	
	(iv)	<b>Any one from:</b> Same length/ mass of pond weed ✓ Same type of pond weed ✓ Same size test tube ✓ Same light intensity ✓ Same temperature ✓ Same species of snail/ same size snail ✓ Same volume of bicarbonate indicator ✓ Same volume of water ✓ Same amount of indicator ✓	1	3.3b	<b>ALLOW</b> amount of pondweed



Question		Answer	Marks	AO element	Guidance															
3	(a)	<p><b>Any two from:</b>                      (polymer of) nucleotides ✓                      with two strands ✓                      forming a double helix ✓</p>	2	1.1	<b>ALLOW</b> Complementary base pairs/A=T and G=C for 1 mark, and named for 2 <sup>nd</sup> mark															
	(b)	light can pass through ✓	1	1.2	<b>ORA</b>															
	(c)	(i)	1	1.2																
		<table border="1"> <thead> <tr> <th>Objective lens</th> <th>Focusing Knob</th> <th></th> </tr> </thead> <tbody> <tr> <td>x10</td> <td>coarse</td> <td></td> </tr> <tr> <td>x4</td> <td>coarse</td> <td>✓</td> </tr> <tr> <td>x10</td> <td>fine</td> <td></td> </tr> <tr> <td>x4</td> <td>fine</td> <td></td> </tr> </tbody> </table>				Objective lens	Focusing Knob		x10	coarse		x4	coarse	✓	x10	fine		x4	fine	
Objective lens	Focusing Knob																			
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		(ii)	1	1.2																
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Objective lens	Focusing Knob																			
x10	coarse																			
x4	coarse																			
x10	fine	✓																		
x4	fine																			

Question	Answer	Marks	AO element	Guidance
<p>4 (a)</p>	<p>✓✓</p>	<p>2</p>	<p>1.1</p>	<p>All lines correct = 2 marks</p> <p>Left hand side correct = 1 mark</p> <p>Right hand correct = 1 mark</p>
<p>(b)</p>	<p>1 mark from each section and one other from either section.</p> <p><i>Exchange surfaces:</i></p> <p>Increases the SA:Vol ratio ✓</p> <p>more <u>diffusion</u> can take place (into and out of cells)</p> <p>decrease the distance the substances have to diffuse. ✓</p> <p><i>Transport systems:</i></p> <p>moves substances around the body ✓</p> <p>named example of substance ✓</p>	<p>3</p>	<p>1.1</p>	<p><b>ALLOW</b> deliver/remove substances</p>

Question		Answer	Marks	AO element	Guidance
5	(a)	<p><b>FIRST CHECK THE ANSWER IN ON ANSWER LINE</b>  <b>If answer = 21(%) award 3 marks</b></p> <p>115-95x100/95 ✓            = 21.05 ✓            = 21 (%) ✓</p>	3	2.2x2  1.2	<p><b>ALLOW</b> ECF</p> <p><b>ALLOW</b> One mark for two significant figures.</p>
	(b)	<p><b>Any three from:</b></p> <p>idea that the coal tits will compete with each other on island for food/insects/seeds/ other named resources ✓</p> <p>idea that larger coal tits outcompete smaller coal tits ✓</p> <p>idea that larger tits more likely to mate with other larger tits ✓</p> <p>idea that conditions on island and mainland are different this process happens separately ✓</p> <p>idea that there may be no interbreeding between species on the island and mainland ✓</p>	3	2.1	<p><b>DO NOT ALLOW</b> survival of the fittest  <b>ALLOW</b> mutation only occurred on island</p> <p>Allow explanation of different conditions i.e. different predators and food on island compared to island.</p>
	(c)	(i)	1	2.1	Mainland hatchlings will grow to be bigger ✓
		(ii)	1	2.1	because size is affected by genes and not environment ✓

Question		Answer					Marks	AO element	Guidance		
6	(a)		Athlete's foot	HIV/AIDS	Influenza	Malaria	Salmonella	4	1.1		
		Pathogen	Bacterium								✓
			Fungus	✓							
			Protist				✓				
			Virus		✓	✓					
		Spread	Coughing			✓					
			Food								✓
			Mosquito bite				✓				
			Sexual contact		✓						
			Surfaces	✓		✓					
				✓	✓	✓	✓				
		(b)	Acid in the stomach kills many bacteria ✓  Idea that <i>Salmonella</i> need to be able to successfully compete with bacteria already attached to the cells in the small intestine ✓								2
(c)	(i)	<b>FIRST CHECK THE ANSWER ON ANSWER LINE</b> <b>If answer = <math>2.56 \times 10^8</math> award 2 marks</b>  $1 \times 10^6 \times 2^8$ ✓  $= 2.56 \times 10^8$ ✓					2	2.2			

Question		Answer	Marks	AO element	Guidance
	(ii)	<p><b>Any two from:</b>            Infected individual's immune system will kill <i>Salmonella</i> / white blood cells engulf/phagocytose <i>Salmonella</i> ✓</p> <p>The more antibiotics that are used the greater the risk of resistance ✓</p> <p>Antibiotics are not very effective ✓</p> <p>Antibiotics may be vomited up/out (before they work) ✓</p>	2	2.1	
	(d)	<p>To reduce the length/severity of symptoms ✓</p> <p>To prevent/ eliminate the cause of /pathogens causing the disease ✓</p>	2	1.1	<b>ALLOW</b> reduces chance of infecting others/spread
(e)	(i)	<p><b>FIRST CHECK THE ANSWER ON ANSWER LINE</b>  <b>If answer = 314 (mm<sup>2</sup>) award 3 marks</b></p> <p><math>10^2 = 100</math> ✓  <math>3.14 \times 100</math> ✓  <math>= 314 (.159)</math> ✓</p>	3	2.2	<b>ALLOW</b> ECF
	(ii)	To be sure that the difference between the growth of the salmonella bacteria around the control disc and the antibiotic discs is entirely due to the antibiotic alone ✓	1	2.2	<b>ALLOW</b> the idea that it is the antibiotic that has an effect.

Question		Answer					Marks	AO element	Guidance	
(f)		<b>Stage</b>	<b>Preclinical</b>	<b>Clinical</b>	<b>Safety</b>	<b>Effectiveness</b>	<b>4</b>	<b>1.1</b>	<b>IGNORE</b> any tick in the effectiveness/volunteers.	
		<b>Animal cells</b>	✓		✓	✓				✓
		<b>Cultured cells</b>	✓		✓	✓				✓
		<b>Healthy volunteers</b>		✓	✓					✓
		<b>Humans with the disease</b>		✓	✓	✓				✓
(g)		Salmonella 4000nm and virus 100 nm ✓  (Not the same order of magnitude as bacteria) are more than 40 times bigger ✓					<b>2</b>	<b>1.2</b>		

Question		Answer	Marks	AO element	Guidance									
7	(a)	<table border="1" style="margin-left: 20px;"> <tr> <td></td> <td>R</td> <td>W</td> </tr> <tr> <td>R</td> <td>RR</td> <td>RW</td> </tr> <tr> <td>W</td> <td>RW</td> <td>WW</td> </tr> </table> <p>(Yes because)            Correct parent genotype ✓            Correct offspring genotype ✓</p> <p>Expected 1:2:1 ratio from numbers provided by farmer ✓</p> <p>The ratio of cows produced is close to expected 25% or <math>\frac{1}{4}</math> red,            25% or <math>\frac{1}{4}</math> white and 50% <math>\frac{1}{2}</math> roan ✓</p>		R	W	R	RR	RW	W	RW	WW	4	2.2	<b>ALLOW ECF</b> if Punnett square is incorrect for correct ratio and subsequent conclusion.
	R	W												
R	RR	RW												
W	RW	WW												

Question	Answer	Marks	AO element	Guidance
(b)*	<p>Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.</p> <p><b>Level 3 (5–6 marks)</b> Detailed description of how selective breeding has been used to breed cows that produce meat. <b>AND</b> Explains the differences between selective breeding and natural selection.</p> <p><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><b>Level 2 (3–4 marks)</b> Detailed description of how selective breeding has been used to breed cows that produce meat. <b>OR</b> Explains the differences between selective breeding and natural selection.</p> <p><b>OR</b> An outline description of how selective breeding has been used to breed cows that produce meat. <b>AND</b> Explains the differences between selective breeding and natural selection.</p> <p><i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i></p> <p><b>Level 1 (1–2 marks)</b> An outline description of how selective breeding has been used to breed cows that produce meat. <b>OR</b> An attempt to explain the differences between selective breeding and natural selection.</p> <p><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><b>0 marks</b> <i>No response or no response worthy of credit.</i></p>	6	2 x 1.1 4 x 2.1	<p><b>AO1.1 Recall ideas about selective breeding</b></p> <ul style="list-style-type: none"> <li>• Variation is present in all species</li> <li>• Individuals are selected for desired characteristics</li> <li>• Breeding</li> <li>• Offspring produced with desired characteristic are selected and bred</li> <li>• Continues over generations</li> </ul> <p><b>AO2.1 Application of knowledge and understanding of natural selection to shorthorn cattle</b></p> <ul style="list-style-type: none"> <li>• Idea that cows and bulls are selected based on their ability to produce beef</li> <li>• Variation in offspring beef production/mass/size</li> <li>• Most productive offspring selected and mated with each other</li> <li>• Over many generations/200 years leads to increase in beef production</li> </ul> <p><b>AO2.1 Application of knowledge and understanding of the difference between selective breeding and natural selection</b></p> <ul style="list-style-type: none"> <li>• Selected characteristics are beneficial to humans</li> <li>• Natural mating does not occur, cows and bulls which mate are chosen by humans</li> <li>• In Natural selection alleles are advantageous to the organism</li> </ul>



Question		Answer	Marks	AO element	Guidance
8	(a)	Genome Chromosomes Amino Acids Proteins Phenotype Alleles Environment ✓✓✓	3	1.1	All seven correct for 3 marks Any six, five or four for 2 marks Any three or 2 for 1 mark One correct = 0 mark
	(b)	(i)	2	2.1	
		(ii)	2	1.1	
		(iii)	2	2.2	

		(iv)	Journal: other scientists can check/ repeat/ compare work ✓	1	1.1	Allow any relevant example.
			Newspapers: general public need to know so they can make use of the advances ✓	1	2.1	

Question		Answer	Marks	AO element	Guidance
9	(a)	<p><b>Any two from:</b>            These are unspecialised ✓            have some genes switched off ✓            Less variation in what can be made from adult (connective tissue) stem cells ✓</p>	2	1.1	<b>ALLOW</b> contain undifferentiated cells
	(b)	The scientists could confirm the source of each tissue in the artificial oesophagus ✓	1	2.1	
	(c) (i)	(Risk -) stem cells may become cancerous/risk of tissue rejection ✓	1	2.1	
	(ii)	(Ethical -) may be against religious views/may involve the death of embryos/animals ✓	1	2.1	
	(d)	<p><b>Any two from:</b>            Plants have Meristem cells ✓            where no genes are switched off ✓            can differentiate/specialise into all cell types ✓</p>	2	1.1	

Question		Answer	Marks	AO element	Guidance												
10	(a)	<table border="1"> <thead> <tr> <th>Statement</th> <th>Model A</th> <th>Model B</th> </tr> </thead> <tbody> <tr> <td>Upright humans and modern humans both evolved in Africa</td> <td style="text-align: center;">✓</td> <td style="text-align: center;">✓</td> </tr> <tr> <td>Modern humans evolved separately and continuously in three continents</td> <td></td> <td style="text-align: center;">✓</td> </tr> <tr> <td>Modern humans migrated out of Africa 100 000 years ago, ✓✓✓</td> <td style="text-align: center;">✓</td> <td></td> </tr> </tbody> </table>	Statement	Model A	Model B	Upright humans and modern humans both evolved in Africa	✓	✓	Modern humans evolved separately and continuously in three continents		✓	Modern humans migrated out of Africa 100 000 years ago, ✓✓✓	✓		3	3.1a	One mark for each statement correct
		Statement	Model A	Model B													
		Upright humans and modern humans both evolved in Africa	✓	✓													
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Modern humans migrated out of Africa 100 000 years ago, ✓✓✓	✓																
(b)	<table border="1"> <thead> <tr> <th>New evidence</th> <th>Model A</th> <th>Model B</th> </tr> </thead> <tbody> <tr> <td>A fossil modern man dated as 200 000 years old has been found outside of Africa.</td> <td></td> <td style="text-align: center;">✓</td> </tr> <tr> <td>About 2% the DNA found in modern Europeans is from humans who lived in Europe more than 100 000 years ago.</td> <td></td> <td style="text-align: center;">✓</td> </tr> <tr> <td>Mitochondrial DNA suggest all modern humans share a single African female common ancestor who lived 200 000 years ago. ✓✓✓</td> <td style="text-align: center;">✓</td> <td style="text-align: center;">✓</td> </tr> </tbody> </table>	New evidence	Model A	Model B	A fossil modern man dated as 200 000 years old has been found outside of Africa.		✓	About 2% the DNA found in modern Europeans is from humans who lived in Europe more than 100 000 years ago.		✓	Mitochondrial DNA suggest all modern humans share a single African female common ancestor who lived 200 000 years ago. ✓✓✓	✓	✓	3	3.2a	One mark for each statement correct	
	New evidence	Model A	Model B														
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Mitochondrial DNA suggest all modern humans share a single African female common ancestor who lived 200 000 years ago. ✓✓✓	✓	✓															
(c)	<p><b>Any one from:</b> Many scientists don't think there is enough new evidence to change their minds ✓</p> <p>Many scientists are waiting for a better hypothesis to explain all of the data ✓</p>	1	1.1														

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