Oxford Cambridge and RSA

H

GCSE (9–1)

Biology B (Twenty First Century Science)

J257/03: Breadth in Biology (Higher Tier)

General Certificate of Secondary Education

Mark Scheme for Autumn 2021

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.

1. 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

2. 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

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.

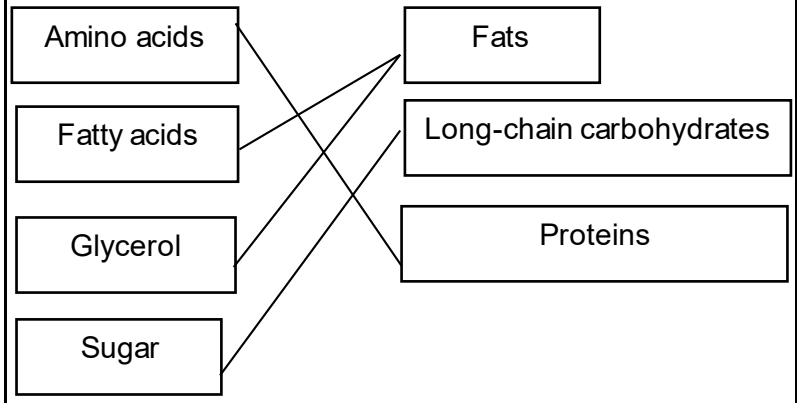
You should ensure that you have copies of these materials.

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 Biology 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)		 ✓✓	2	1.1	4 correct lines = 2 marks 2/3 correct lines = 1 mark
	(b)		Carbon, hydrogen, and oxygen ☐ Carbon, hydrogen, nitrogen, and oxygen ✓ Nitrogen and carbon ☐ Only carbon ☐ ✓	1	1.1	

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>AO element</th><th>Guidance</th></tr>
<tr><td>2</td><td>(a)</td><td></td><td>Any two from:
take blood sample ✓

(to perform) genetic test (of DNA or genome) ✓

idea of looking for the recessive/faulty/Tay Sachs allele ✓</td><td>2</td><td>2.1</td><td>ALLOW saliva

ALLOW genetic screening

ALLOW faulty gene</td></tr>
<tr><td></td><td>(b)</td><td></td><td>Heterozygous ✓</td><td>1</td><td>2.1</td><td></td></tr>
<tr><td></td><td>(c)</td><td></td><td><table><tr><td></td><td>T</td><td>t</td></tr><tr><td>T</td><td>TT</td><td>Tt</td></tr><tr><td>t</td><td>Tt</td><td>tt</td></tr></table>✓✓

probability = 25% / 0.25 / 1/4 ✓</td><td>3</td><td>2.1</td><td>1 mark for the gametes transferred correctly
1 mark for the completion of the punnet square

ECF for punnet square if gametes incorrect

ALLOW correct use of other letters to represent alleles/genotypes

ECF for %
DO NOT ALLOW ratio</td></tr>
<tr><td></td><td>(d)</td><td></td><td>Any two from:
(genetic) testing of embryos (only allow pregnancy to continue if result is negative) ✓

testing amniotic fluid ✓

gamete/egg/sperm donation ✓

adoption/fostering ✓</td><td>2</td><td>2.1</td><td>ALLOW description of IVF and screening process
ALLOW PGD

ALLOW amniocentesis/description of procedure

ALLOW surrogacy if qualified</td></tr>
</table>

Question			Answer	Marks	AO element	Guidance
3	(a)		Tree ✓	1	2.1	**IGNORE** producer
	(b)		biomass decreases as trophic level increases/along the food chain ✓ **AND any two from:** uneaten ✓ egestion / undigested parts ✓ (cellular) respiration ✓ movement ✓ excretion ✓	3	3.1a 2.1 x 2	**ALLOW** up the pyramid **ALLOW** correct named examples of uneaten parts **ALLOW** faeces **IGNORE** waste **ALLOW** correct named examples of movement **ALLOW** correct named examples of excretion **IGNORE** waste products **ALLOW** correct reference to heat
	(c)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 30% award 3 marks** Uses only figures 11 and 37 from diagram ✓ 11 ÷ 37 x 100 ✓ = 29.729 = 30 (%) (to 1sf) ✓	3	2.2 x 2 1.2	29.729 / 29.73 / 29.7 = 2 marks **ALLOW** 1 mark for any number to 1 sig fig where no working or value is incorrect

Question			Answer	Marks	AO element	Guidance
4	(a)		ethene ✓	1	1.1	
	(b)		auxin ✓	1	1.1	
	(c)		LH ✓	1	1.1	
	(d)		ADH ✓	1	1.1	
	(e)		Thyroxine ✓	1	1.1	
	(f)		Progesterone ✓	1	1.1	**ALLOW** oestrogen and progesterone **IGNORE** oestrogen on its own

Question			Answer	Marks	AO element	Guidance
5	(a)		(DNA in eukaryotes is) in the nucleus / found as chromosomes ✓ (DNA in prokaryotes is) found in the cytoplasm/floats freely in the cytoplasm / found as plasmids/circular pieces of DNA ✓	2	1.1	**ALLOW** ref to some DNA being stored in eukaryote organelles (mitochondria / chloroplast)
	(b)	(i)	**Any three from:** is a polymer✓ made of two strands✓ ref to double helix✓ each strand is made of monomers/nucleotides✓ (nucleotides) are formed from a sugar, phosphate, and base✓ there are four bases/ bases A, T, C and G/correct ref to complementary base pairs✓	3	1.1	**ALLOW** labelled drawing of nucleotide
		(ii)	**Any one from:** a feature (is often) a result of many genes/polygenes/only some features are a result of single gene inheritance ✓ environment plays a role (in the phenotype) ✓	1	2.1	**ALLOW** idea of gene interactions to determine a feature

Question			Answer	Marks	AO element	Guidance
6	(a)	(i)	Cheviot and East Friesian✓ **AND any one from:** less wool on backside so less urine on backside/less smell of urine so blowfly are not attracted✓ less blowfly attracted so less eggs laid/ less maggots likely to hatch✓	2	2.1	 **ALLOW** easier to see if there is flystrike
		(ii)	**Any two from:** allow male and female selected to breed✓ select offspring with desired characteristics ✓ breed again / continue for many generations✓	2	1.1	**IGNORE** named sheep breed
	(b)	(i)	**Any two from:** idea that adds equal volumes of milk and number of drops of Benedict's to milk ✓ add solutions to a test tube and swirl/gently shake✓ heat (to 95 °C)✓ correct reference to suitable heating apparatus✓ **AND** observes the different colours that result/ idea of semi quantitative result✓	3	2.2 x 2 3.2a	 **ALLOW** description of semi quantitative result
		(ii)	Biuret ✓	1	1.2	

Question			Answer	Marks	AO element	Guidance
7	(a)	(i)	x and y axes correct and labelled ✓ axes scales correct ✓ all bars plotted correctly✓	3	1.2	if a line graph is drawn max 2 marks X axis scale for line graph must be equidistant **ALLOW** +/- half square tolerance
		(ii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 62.9 % award 3 marks** 140 000 – 52 000 = 88 000 ✓ 88 000 ÷ 140 000 x 100 **OR** 0.62857✓ 62.857= 62.9(%) (3sf) ✓	3	 2.2 x 2 1.2	 **ECF** for incorrect calculated difference **ALLOW** percentage change calculation where no calculated difference shown **ALLOW** 1 mark for any number to 3 sig figs where no working or value is incorrect
	(b)		**Any two from:** Devil Facial Tumour Disease (DFTD) is communicable / (human) cancer is non-communicable ✓ Devil Facial Tumour Disease (DFTD is not caused by a mutation / (human) cancer is caused by a mutation ✓ some human cancers can be caused by lifestyle factors e.g. smoking, alcohol✓ ref to genetic cause in humans✓	2	2.1	Assume “it” refers to Devil Facial Tumour Disease **ALLOW** DFTD is transmissible / (human) cancer is not transmissible/not spread from one person to another/not spread by biting ✓

Question			Answer	Marks	AO element	Guidance
	(c)		use genetic/genome testing ✓ to see if the parent and offspring have the same allele ✓ **OR** description of breeding experiments e.g. breed resistant with resistant or resistant with non-resistant ✓ genetic test/screen offspring for allele ✓ **OR** sample population over time✓ you would expect to see greater numbers in the population over time due to natural selection ✓	**2**	**3.3a**	

Question			Answer	Marks	AO element	Guidance
8	(a)		**Any two from:** the number of chemicals the beetles are resistant to is increasing ✓ idea that there are less chemicals available to control the pest ✓ how this increase in resistance will reduce the potato crop in the future / wipe out potato crops ✓ **AND any one from:** from 1975-2000 resistance doubled✓ rate is rapid after 2000✓	**3**	**3.2b x 2** **3.2a**	
	(b)		**Any one from:** use a natural predator ✓ introduce a competitor✓	**1**	**2.1**	**ALLOW** biological control/ description of biological control/named predators **ALLOW** genetically engineer crops to be insect resistant
	(c)		**Any two from:** increasing (human) population✓ changing diets (in wealthier populations)✓ (new) pathogens✓ environmental change/climate change✓ unsustainable farming practices/unsustainable use of resources✓ (increasing) cost of agricultural inputs✓	**2**	**1.1**	**ALLOW** named examples e.g. drought, floods **ALLOW** named examples e.g. overfishing

Question			Answer	Marks	AO element	Guidance
9	(a)		(phagocytes)engulf (and digest) pathogens ✓ (lymphocytes) produce antibodies produces memory cells✓	2	1.1	**ALLOW** description/named pathogen
	(b)		speeds up (transmission) of electrical impulses ✓	1	1.1	**ALLOW** insulates the axon/neuron
	(c)		stem cells are unspecialised cells ✓ they can differentiate into the (blood) cells killed by chemotherapy ✓	2	1.1 2.1	**ALLOW** stem cells can become specialised cells **ALLOW** idea that stem cells need to be transferred after chemotherapy, so they are not killed by the chemotherapy
	(d)		idea that patients had advanced MS this treatment whilst risky could be more beneficial ✓ idea that this treatment could be the only option now available to treat their MS ✓	1	2.1	**ALLOW** any sensible suggestion **DO NOT ALLOW** only option unqualified **DO NOT ALLOW** a high percentage showed no sign of disease because the question is about the patients taking part in that study
	(e)		(it is a peer reviewed journal so) the findings have been reviewed/checked by other scientists✓	1	2.1	
	(f)		**Any one from:** long term (side) effects not known ✓ not much data on whether the benefits last beyond 3 years✓ idea that you don't know what happened to the other patients that took part in the study✓ idea that the sample size is already small, and by having only half followed up after 3 years, this means that sample size is even smaller and therefore less significant/representative ✓	1	2.1	**ALLOW** some of those not followed could have died because of the trial drug

Question			Answer	Marks	AO element	Guidance
10	(a)		**Any three from:** at low / high temperatures the rate is low✓ idea that as temperature increases the rate increases but only up to a point✓ highest rate is at the optimum (temperature) ✓ if optimum/(temperature) is exceeded rate decreases ✓ enzymes denature/enzyme active site changes shape at temperatures beyond the optimum ✓	3	1.1	**ALLOW** as temperature increase the rate will increase up to the optimum (temperature) = 2 marks **ALLOW** 37 °C for optimum temperature **ALLOW** rate will decrease at higher temperatures because enzymes denature = 2 marks
	(b)		toad ✓ idea that (toad) optimum is 15°C which is close to the14 °C optimum (on graph)✓	2	2.1	

Question			Answer	Marks	AO element	Guidance
11	(a)		general trend gonorrhoea is increasing in numbers✓ identifies difference between rate of increase pre or post 2010 ✓ **AND any one from:** less people using barrier contraceptives/named barrier contraceptives✓ poor infection detection rates (so continues to transmit)✓	**3**	**3.1a x 2** **2.1**	**ALLOW** more unprotected sex **DO NOT ALLOW** a lack of contraception **ALLOW** any sensible suggestion
	(b)		**Any two from:** the resistance problem is likely to worsen✓ idea that not many drugs are in development so future treatment could be problematic✓ doctors are unable to treat gonorrhoea in some patients (resistance/lack of drugs in development)✓ with few drugs able to treat gonorrhoea the number of cases is likely to increase✓ idea that gonorrhoea is likely to become resistant to new drugs developed✓	**2**	**3.2a**	**ALLOW** idea that development of drugs is slow/new drugs are not currently available
	(c)		for safety ✓ for efficacy/effectiveness (people with disease only)✓	**2**	**1.1**	**ALLOW** harmful side effects for safety **ALLOW** a description of efficacy **DO NOT ALLOW** shows how effective the drug is when stated this is an outcome from both groups

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>AO element</th><th>Guidance</th></tr>
<tr><td>12</td><td>(a)</td><td></td><td>
<table>
<tr><th>Statement</th><th>Both insulin and glucagon</th><th>Only Insulin</th><th>Only Glucagon</th></tr>
<tr><td>Decreases the amount of blood glucose</td><td></td><td>✓</td><td></td></tr>
<tr><td>Increases the amount of blood glucose</td><td></td><td></td><td>✓</td></tr>
<tr><td>Increases the rate of glucose uptake by cells</td><td></td><td>✓</td><td></td></tr>
<tr><td>Produced by the pancreas</td><td>✓</td><td></td><td></td></tr>
<tr><td>Stimulates the conversion of glucose to glycogen</td><td></td><td>✓</td><td></td></tr>
<tr><td>Stimulates the conversion of glycogen to glucose</td><td></td><td></td><td>✓</td></tr>
</table>
✓✓✓</td><td>3</td><td>1.1</td><td>6 correct ticks = 3 marks
5 correct ticks = 2 marks
4 correct ticks = 1 mark</td></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td>FIRST CHECK THE ANSWER ON ANSWER LINE
If answer = x 500 award 2 marks
correct measurement from A to B = 4cm or 40 mm and conversion to 40 000 µm✓
Division of 40 000 by 80 = X 500✓</td><td>2</td><td>1.2

2.2</td><td>ALLOW 2mm margin of error on measurement

ECF incorrect measurement/incorrect converted measurement evaluated correctly</td></tr>
</table>

Question			Answer	Marks	AO element	Guidance
		(ii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 4.985 x 10^5 award 3 marks** correct conversion out of standard form = 1500 and 500 000✓ 500,000 – 1500 = 498 500✓ correct conversion back into standard form 4.985 x 10^5✓	3	1.2	**ALLOW** 498 500 = 2 marks **ALLOW** an incorrect calculated number that has been correctly converted to standard form award 1 mark

Question			Answer	Marks	AO element	Guidance
13	(a)		$6\ CO_2 + 6\ H_2O$ ✓ → $C_6H_{12}O_6 + 6\ O_2$ ✓	2	1.2	
	(b)		the rate of photosynthesis depends on light intensity ✓ when the distance is doubled (20 cm compared to 10cm) the light intensity is one quarter (¼ or $1/2^2$) ✓	2	1.1 2.1	**ALLOW** as light intensity decreases rate of photosynthesis decreases ORA **ALLOW** correct demonstration using inverse square law to show that the light intensity has increased at 10cm/decreased at 20cm
	(c)		A –light intensity B – temperature C – carbon dioxide concentration/ temperature ✓ ***Justification*** A (must be light intensity) as when light intensity increases the rate increases ✓ B – (must be temperature) as on the second line increasing temperature increases the rate further ✓ C (could be temperature) don't know if increasing the temperature beyond 30 would have any effect **OR** C (could be carbon dioxide) temperature is high suggesting could be another limiting factor ✓	4	3.2a x 1 3.2b x 3	All 3 points must be correct for 1 mark Award 1 mark for each justification. **ALLOW** idea water will not be the limiting factor as the plant is submerged in water.

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