GCE

Biology B

H422/02: Scientific literacy in biology

Advanced GCE

Mark Scheme for June 2019

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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
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

Marking Annotations

Annotation	Use
BOD	Benefit of Doubt
CON	Contradiction
	Cross
ECF	Error Carried Forward
GM	Given Mark
	Extendable horizontal wavy line (to indicate errors / incorrect science terminology)
I	Ignore
	Large dot (various uses as defined in mark scheme)
	Highlight (various uses as defined in mark scheme)
NBOD	Benefit of the doubt not given
	Tick
^	Omission Mark
BP	Blank Page
L1	Level 1 answer in Level of Response question
L2	Level 2 answer in Level of Response question
L3	Level 3 answer in Level of Response question

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**.

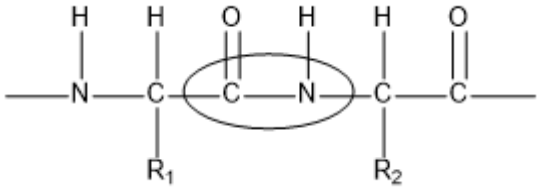
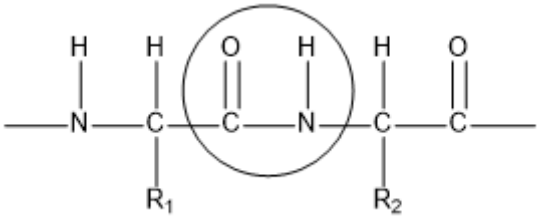
Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

Question			Answer	Marks	Guidance
1	(a)	(i)	1. sequence of, DNA / nucleotides / bases, that code for a polypeptide ✓ 2. a gene variant ✓	2	**Mark the first answer. If an additional answer is given that is incorrect, then = 0 marks** **ALLOW** protein /amino acid sequence for 'polypeptide' **ALLOW** different versions of the same gene
		(ii)	1. <u>founder</u>(s) effect ✓ 2. <u>genetic bottleneck</u> ✓	2	**Mark the first answer. If an additional answer is given that is incorrect, then = 0 marks**
		(iii)	1. small / decreasing , gene pool ✓ 2. limited number / loss, of <u>alleles</u> ✓	2	
	(b)		Label cells with fluorescent marker ✓ (fluorescence attached to) antibodies ✓ (antibodies bind to) <u>antigens</u> on (white blood) cells ✓ (alternative) fluorescent DNA probe ✓ counts / sorts, cells (with genetic variant) ✓	4 max	 **IGNORE** red blood cells **IGNORE** fluorescent marker binds to antigens **ALLOW** section of DNA for 'DNA probe'
	(c)		base / nucleotide, substitution ✓ mRNA codon changes OR different amino acid (attached) ✓	3 max	**ALLOW** named bases **ALLOW** glutamic acid changed to valine **ALLOW** different primary structure

Question			Answer	Marks	Guidance
			changes haemoglobin, (tertiary) structure / (3D) shape ✓ (abnormal) haemoglobin, clumps / crystallises (clumping) at low O_2 concentration ✓ (only present in) homozygous recessive individuals ✓		**IGNORE** mutations in haemoglobin protein **IGNORE** red blood cells clump together **ALLOW** H^S H^S for 'homozygous recessive'
	(d)		*advantages of the IMF approach:* (may) give a more accurate diagnosis ✓ treat / intervene, earlier ✓ identify people (at risk) who do not have family history **OR** removes worry for people that do have a family history ✓ *disadvantages of IMF approach:* results of the MGUS screening may give false positives ✓ more expensive (than pedigree analysis) ✓	**4 max**	**ALLOW** ora throughout **ALLOW** prevents / cures, myeloma

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td></td><td>(e)</td><td></td><td>
<table>
<tr><th>Feature</th><th>Trans-cription only</th><th>Trans-lation only</th><th>Both</th><th>Neither</th></tr>
<tr><td>C pairs with G</td><td></td><td></td><td>✓</td><td></td></tr>
<tr><td>A pairs with T</td><td>✓</td><td></td><td></td><td></td></tr>
<tr><td>Phospo-diester bonds are made</td><td>✓</td><td></td><td></td><td></td></tr>
<tr><td>Peptide bonds are made</td><td></td><td>✓</td><td></td><td></td></tr>
</table>
</td><td>4</td><td>Mark the first answer. If an additional answer is given that is incorrect, then = 0 marks

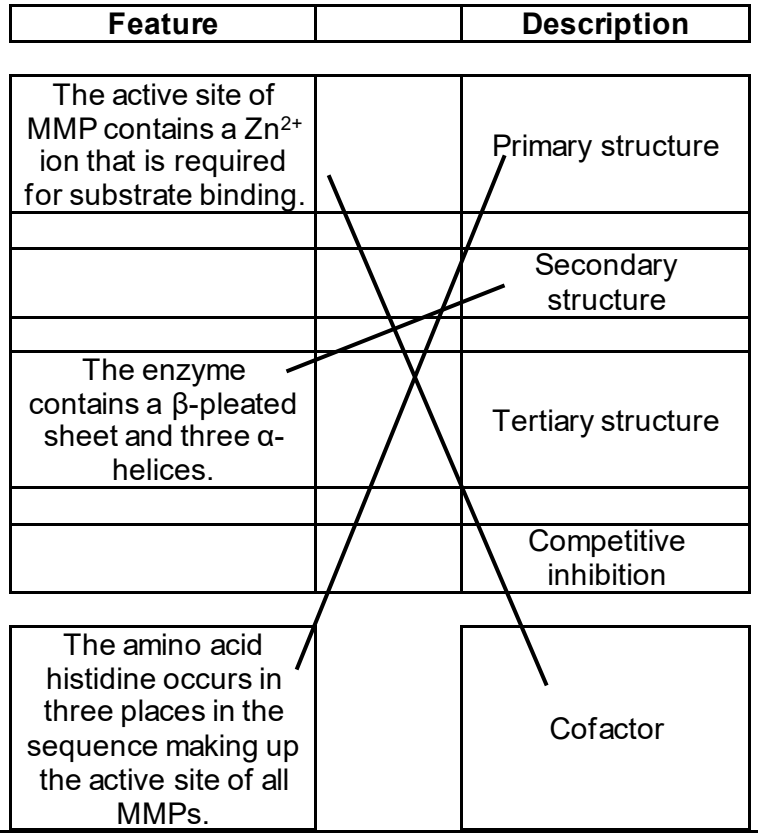
ALLOW crosses or any other unequivocal symbol as alternative to ticks.</td></tr>
</table>

Question			Answer	Marks	Guidance
2	(a)	(i)	 ✓	1	**ALLOW** 
		(ii)	condensation ✓	1	**Mark the first answer. If an additional answer is given that is incorrect, then = 0 marks** **IGNORE** polymerisation
	(b)	(i)	1. to <u>hydrolyse</u> , peptide bonds / protein / peptide ✓ 2. to avoid contamination (with amino acids from skin) ✓	2	**IGNORE** reference to microorganisms
		(ii)	$R_f = \frac{(45)}{(88)} = 0.51$ ✓ Correct identification = methionine ✓	2	**ALLOW** answer in range 0.50 – 0.52 (2 d.p.) **ALLOW ECF** from incorrect R_f value

Question	Answer	Marks
(c)*		

Level 3 (5–6 marks) A comprehensive explanation that describes the role of phagocytes and mast cells in the body's non-specific defence mechanisms, with reference to first defence *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)** A simple explanation for the role of phagocytes and mast cells in the body's non-specific defence mechanisms. **OR** A detailed explanation for the role of phagocytes or mast cells in the body's non-specific defence mechanisms. *There is a line of reasoning with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1–2 marks)** A simple explanation for the role of phagocytes or mast cells in the body's non-specific defence mechanisms. *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.*	**6**	**Indicative scientific points may include** ***Pathogenic bacteria, fungi, virus in first defence*** Barrier AMP destroy pathogen before , entry (into intestines, respiratory tract etc) / can spread Skin / mucus NK cells APC's / dendritic cells Complement proteins Acidic pH (of vagina) ***Mast cells*** inflammation vasodilation / redness swelling /increased blood flow / oedema histamine / serotonin / prostaglandins ***Phagocytes*** macrophages / neutrophils aggregation attracts phagocytes cytokines engulf pathogen phagolysosome / phagosome, formation (hydrolytic) enzymes destroy pathogen monocyte differentiation **IGNORE** reference to the specific immune response

Question			Answer	Guidance
	(d)	(i)	(sperm can't) reach the, oviduct / fallopian tube ✓ (so) fertilise a <u>secondary oocyte</u> ✓	
		(ii)	0.47 ✓✓	**Correct answer = 2 marks** even if no working shown. If answer is incorrect then award 1 mark if; *answer not to 2 sig figs:* 0.469 q^2 / p^2: 0.22 √ *(incorrect q^2 or p^2)*
		(iii)	(heterozygotes) have a selective advantage **OR** No effect on heterozygotes ✓	**IGNORE** ref to IVF **ALLOW** only affects homozygous recessive

Question			Answer	Marks	Guidance
3	(a)			3	1 mark for each correct joining line
	(b)	(i)	there is no (significant) difference (in MMP activity) between grade III tumours and all other groups ✓	1	**ALLOW** the difference (between grade III tumour activity and other groups) is due to chance
		(ii)	there is less than, 0.01% / 0.0001, <u>probability</u> that the differences in activity (between the two groups / grade III and other tumours) are due to <u>chance</u> ✓	1	**ALLOW** <0.01% for 'less than 0.01%'

Question			Answer	Marks	Guidance
		(iii)	*yes* **Y1** the activity is significantly greater in, grade III / the most malignant, tumours ✓ **Y2** <u>positive correlation</u> (between MMP activity and severity of breast cancer) ✓ *No* **N1** activity is, the same in grade II and benign / lower in grade I than benign ✓ **N2** other factors may be involved **OR** **N2** correlation does not imply causation ✓	**3 max**	**ALLOW** severity of breast cancer increases as activity of malignant grade tumour increases.

Question	Answer	Marks	Guidance
(c)	*Competitive inhibitor* (Marimastat) binds to / blocks , the <u>active site</u> of, MMPs / proteases / enzyme ✓ (this) prevents / competes with, binding of, substrate / proteins ✓ **OR** *Non-competitive inhibitor* Marimastat binds to allosteric site of, MMPs / proteases / enzyme ✓ (therefore) changes (3D) <u>shape</u> of <u>active site</u> ✓	**2**	

Question			Answer	Marks		Guidance
4	(a)		**1.** to ensure the algae are photosynthesising (at a constant rate) **OR** to allow the, algae / suspension, to equilibrate ✓ **2.** to prevent the suspension from overheating **OR** to prevent denaturation of (photosynthetic) enzymes ✓ **3.** to kill the, algae / cells **OR** to stop the (photosynthetic) reactions ✓	**3**		**ALLOW** light dependent stage / LDR , of photosynthesis **3. ALLOW** stop photosynthesis for 'stop the reactions'
	(b)	(i)	ribulose-bisphosphate carboxylase (oxygenase) ✓	**1**		**ALLOW** RUBISCO / rubisco
		(ii)	GP produced first as radioactivity present by 2 seconds. ✓ TP produced, second / after GP, as radioactivity present by 10 seconds ✓ amino acids **AND** sucrose **AND** sugar phosphates are produced, last / from TP, as radioactivity present by 30 seconds ✓	**3**		**ALLOW** any correct alternative name for GP and/or TP throughout. **ALLOW** s for seconds
	(c)		because CO_2 reacts with, RuBP /	**2**		

Question			Answer	Marks		Guidance
			ribulose bis-phosphate / 5C compound ✓ the first reaction produces an, unstable / 6C, compound that breaks down to form two 3-C compounds ✓			
	(d)	(i)	465.6 / 466 ✓✓	2		**Correct answer = 2 marks** even if no working shown. If answer is incorrect then award 1 mark if; *max uptake per m^2:* 8.0 x 0.97 / 7.76 *max uptake in 1 min:* 8.0 x 60 / 480 *incorrect calculated value for max uptake per m^2* x 60
		(ii)	there is no net (named) gas exchange ✓ (the rate of) photosynthesis and respiration are equal / compensation point ✓	1 max		
	(e)		<u>vernalisation</u> ✓ (cold and moist conditions) promote, transcription / expression, of genes (associated with flowering) ✓	2		**ALLOW** production of transcription factors for 'promote transcription of genes'.
	(f)		chrysanthemums are , short day / long night , plants ✓ P_{fr} is converted (slowly) to P_r during darkness ✓	3 max		

Question			Answer	Marks		Guidance
			light, converts P_r to P_{fr} ✓ ratio of P_{fr} : P_r / relative amounts of P_{fr} and P_r , determines when flowering occurs ✓			
5	(a)	(i)	**C** = glaucoma ✓ (increased pressure) damages optic nerve ✓ **D** = cataract ✓ lens (protein) becomes opaque ✓	4		**ALLOW** cloudy for 'opaque'
		(ii)	preventing / reversing , growth of (new) blood vessels into the, retina / macula / fovea✓ (so) reduces / prevents, damage to, retina / macula / fovea ✓	2		**ALLOW** scarring for 'damage'
	(b)	(i)	convert <u>light</u> energy to <u>chemical</u> energy✓	1		**ALLOW** electromagnetic energy for light energy

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th></th><th>Guidance</th></tr>
<tr><td></td><td></td><td>(ii)</td><td>
<table>
<tr><th>Process in rod cell</th><th>Rest or Light</th></tr>
<tr><td>Rhodopsin is broken down to form opsin and trans-retinal</td><td>Light</td></tr>
<tr><td>Rod cell membrane is hyperpolarised</td><td>Light</td></tr>
<tr><td>Neurotransmitter is released by exocytosis from rod cell into the synaptic cleft</td><td>Rest</td></tr>
<tr><td>Sodium ion channels open</td><td>Rest</td></tr>
</table>
✓✓</td><td>2</td><td></td><td>3 correct = 2 marks
2 correct = 1 mark
1 or 0 correct = 0 marks</td></tr>
<tr><td></td><td>(c)</td><td></td><td>(fault) on the X chromosome ✓

no corresponding <u>allele</u> on Y chromosome ✓

only one (faulty) <u>allele</u> needed for colour blindness (in males) ✓</td><td>2 max</td><td></td><td></td></tr>
</table>

Question			Answer	Marks		Guidance
6	(a)	(i)	chromosome number is halved / <u>haploid</u> cells are produced from <u>diploid</u> cells ✓	1		**DO NOT ALLOW** diploid cell changes to haploid cell
		(ii)	translocation / non-disjunction ✓	1		**ALLOW** description
		(iii)	Down's / Turner's / Klinefelter's ✓	1		
		(iv)	somatic / body, cells divide by mitosis **OR** meiosis produces gametes ✓	1		**DO NOT ALLOW** meiosis occurs in gametes

Question	Answer	Marks		Guidance
(b)*	***Summary of instructions to markers:*** *Read through the whole answer. (Be prepared to recognise and credit unexpected approaches where they show relevance.)* *Using a 'best-fit' approach based on the science content of the answer, first decide which of the level descriptors,* ***Level 1****,* ***Level 2*** *or* ***Level 3****, best describes the overall quality of the answer.* *Then, award the higher or lower mark within the level, according to the* ***Communication Statement*** *(shown in italics):* ○ *award the higher mark where the Communication Statement has been met.* ○ *award the lower mark where aspects of the Communication Statement have been missed.* • ***The science content determines the level.*** • ***The Communication Statement determines the mark within a level.***			

			Level 3 (5–6 marks) A comprehensive response that covers the effects of alcohol **AND** evaluation of the evidence *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)** A description of the effects of alcohol with an evaluation of the evidence. **OR** A detailed description of the effects of alcohol or comprehensive evaluation of the evidence *There is a line of reasoning with some structure. The information presented is relevant and supported by some evidence* **Level 1 (1–2 marks)** A description of the effects of alcohol or evaluation of the evidence. *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.*	**6**		**Indicative scientific points may include** ***Effects of alcohol*** Ethanol crosses placenta Moderate drinking can cause language and speech problems *(Fetal Alcohol Syndrome / FAS)*: damage to the CNS psychological or behavioural problems after birth learning difficulties other signs include facial features (small eye openings, thick upper lip) and growth deficiency Fetal liver is less able to detoxify ethanol ***Evaluation of evidence*** Advice is based on excessive drinking May not be valid to extrapolate to moderate drinking Individual women may respond differently Limited sample number Study may be biased Evidence, not long term / only recent No (conclusive) evidence between, light alcohol consumption and birth weight / light to moderate consumption and fetal alcohol syndrome.

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th></th><th>Guidance</th></tr>
<tr><td>7</td><td>(a)</td><td></td><td>pollen is produced in large amounts ✓

anthers / stigmas, hang outside the flower ✓</td><td>1 max</td><td></td><td>ALLOW in the air for ‘outside the flower’</td></tr>
<tr><td></td><td>(b)</td><td></td><td>double fertilisation ✓

pollen tube delivers two, sperm cells / male gametes ✓

one, sperm cell / male gamete, fertilises egg cell to form embryo ✓

(nucleus of) other sperm cell fuses with (two) polar nuclei to form endosperm ✓</td><td>3 max</td><td></td><td></td></tr>
<tr><td></td><td>(c)</td><td>(i)</td><td>parental genotypes: AaBb x aabb ✓

gametes: AB, Ab, aB, ab (and ab) ✓</td><td>2</td><td></td><td>ALLOW marks for correct information given in genetic diagram if candidate has not used the prompt lines.

ALLOW ecf from incorrect parental genotypes</td></tr>
<tr><td></td><td></td><td>(ii)</td><td><table><tr><td></td><td>AB</td><td>Ab</td><td>aB</td><td>ab</td></tr><tr><td>ab</td><td>AaBb</td><td>Aabb</td><td>aaBb</td><td>aabb</td></tr><tr><td></td><td>yellow, smooth</td><td>yellow, wrinkled</td><td>colourless, smooth</td><td>colourless, wrinkled</td></tr></table>
genotype AND phenotype of offspring ✓

phenotypic ratio = 1 : 1 : 1 : 1 ✓</td><td>2</td><td></td><td>ALLOW marks for correct information given in genetic diagram if candidate has not used the prompt lines.

ALLOW ecf from incorrect gametes in 7ci</td></tr>
<tr><td></td><td></td><td>(iii)</td><td></td><td>3</td><td></td><td>ECF from phenotypic ratio given in 7cii</td></tr>
</table>

			<table><tr><th>Phenotype</th><th>[O]</th><th>[E]</th><th>O–E</th><th>$(O–E)^2$</th><th>$(O–E)^2/E$</th></tr><tr><td>Smooth yellow</td><td>275</td><td>250</td><td>25</td><td>625</td><td>2.50</td></tr><tr><td>Wrinkled yellow</td><td>277</td><td>250</td><td>27</td><td>729</td><td>2.916</td></tr><tr><td>Smooth colourless</td><td>235</td><td>250</td><td>-15</td><td>225</td><td>0.90</td></tr><tr><td>Wrinkled colourless</td><td>213</td><td>250</td><td>-37</td><td>1369</td><td>5.476</td></tr><tr><td></td><td></td><td></td><td></td><td>χ^2 =</td><td>11.792</td></tr></table> χ^2 = 11.79 / 11.8 ✓✓✓			**Correct answer = 3 marks** even if no working shown. If answer is incorrect then award 1 mark if; [E] column correct ✓ **AND** Award 1 mark if ; $(O-E)^2$ column correct ✓
		(iv)	there is <1% probability that the differences (between predicted and expected results) are, not significant / due to chance ✓ **OR** there is a >99% probability that the difference is significant / not due to chance. ✓	**1**		**IGNORE** ref to probabilities other than 0.01
		(v)	there is <u>linkage</u> between the two <u>genes</u> (for colour and shape) ✓ the <u>genes</u> (for colour and shape) are on the same chromosome ✓	**2**		**DO NOT ALLOW** alleles for genes **ECF** for 7civ conclusion

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