National
Qualifications
RESOURCE

2021 Biology
Section 2

Higher

Finalised Marking Instructions

These marking instructions have been prepared by examination teams for use by SQA appointed markers when marking external course assessments.

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General marking principles for Higher Biology

Always apply these general principles. Use them in conjunction with the detailed marking instructions, which identify the key features required in candidates' responses.

(a) Always use positive marking. This means candidates accumulate marks for the demonstration of relevant skills, knowledge and understanding; marks are not deducted for errors or omissions.

(b) If a candidate response does not seem to be covered by either the principles or detailed marking instructions, and you are uncertain how to assess it, you must seek guidance from your team leader.

(c) Do not award half marks.

(d) Where a candidate makes an error in the first part of a question, award marks for subsequent answers that are correct with regard to this original error. Do not penalise candidates more than once for the same error.

(e) Unless a numerical question specifically requires evidence of working to be shown, award full marks for a correct final answer (including units, if appropriate) on its own.

(f) Candidates should not use bulleted lists to answer extended-response questions. They must respond to the 'command' word as appropriate and provide extended answers to communicate fully their knowledge and understanding. Candidate responses in the form of bulleted lists may not be able to access the full range of available marks.

(g) In the detailed marking instructions, if a word is **underlined** then it is essential; if a word is **(bracketed)** then it is not essential.

(h) In the detailed marking instructions, words separated by / are **alternatives**.

(i) A correct response can be negated if the candidate includes:
- an extra, incorrect, response
- additional information that contradicts the correct response

(j) Where the candidate is instructed to choose one question to answer but instead answers two questions, mark both responses and award the higher mark.

(k) Unless otherwise required by the question, the use of abbreviations (for example DNA, ATP) or chemical formulae (for example CO2, H20) are acceptable alternatives to naming.

(l) If a numerical answer is required and units are not given in the stem of the question or in the answer space, candidates must supply the units to gain the mark. If units are required on more than one occasion, do not penalise candidates repeatedly.

(m) If incorrect spelling is given, sound out the words.
- If the correct word is recognisable then award the mark.
- If the word can easily be confused with another biological term then **do not** award the mark, for example glucagon and glycogen.

(n) Presentation of data:

- If a candidate provides two graphs, in response to one question, mark both and award the higher mark.
- If a question asks for a particular type of graph/chart and the candidate gives the wrong type, do not award full marks. Candidates cannot achieve the plot mark but **may** be able to achieve the mark for scale and label. If the x and y data are transposed, then do not award the scale and label mark.
- If the graph uses less than 50% of the axes then do not award the scale and label mark.
- If 0 is plotted when no data for this is given, then do not award the plot mark — candidates should only plot the data given.

(o) Only award marks for a valid response to the question asked. For example, in response to questions that ask candidates to:

- **identify, name, give** or **state**, they need only answer or present in brief form
- **describe**, they must provide a statement as opposed to simply one word
- **explain**, they must provide a reason for the information given
- **compare**, they must demonstrate knowledge and understanding of the similarities and/or differences between topics being examined
- **calculate**, they must determine a number from given facts, figures or information
- **predict**, they must indicate what may happen based on available information
- **suggest**, they must apply their knowledge and understanding to a new situation

Marking instructions for each question

Question			Expected response	Max mark	Additional guidance
1.	(a)		Guanine	**1**	Not acceptable: G alone
	(b)	(i)	Primer	**1**	
		(ii)	TATCAG	**1**	Accept GACTAT Accept UAUCAG (as primers are often RNA)
		(iii)	DNA polymerase	**1**	Not acceptable: polymerase alone Not acceptable: Taq polymerase (as replication is occurring in a eukaryotic cell)
	(c)	(i)	**A** – To break the hydrogen bonds/ bonds between the bases/strands (in DNA) **OR** Separates strands **(1)** **B** - Primers bind to DNA/target sequence (on DNA)/ complementary nucleotides **(1)**	**2**	Accept: to denature the DNA. Not acceptable: unzips alone Accept anneal for bind to Not acceptable: primers bind/anneal alone
		(ii)	36	**1**	
	(d)		Solve crimes/forensics/settle paternity suits/diagnose diseases/ diagnose genetic disorders	**1**	
2.	(a)		12·5	**1**	
	(b)		Lizards with larger feet survive (as they can cling on) **(1)** (Reproduce and) pass on these genes/sequences to the next generation **(1)**	**2**	Accept: increase in frequency of these genes/sequences in future generations
	(c)	(i)	Allopatric	**1**	Not acceptable: geographical but this does not negate

Question			Expected response	Max mark	Additional guidance
2.	(c)	(ii)	DNA sequences would be different **OR** One population cannot breed with the other to produce fertile offspring **OR** The populations cannot interbreed to produce fertile offspring.	**1**	Response must include reference to one population/group breeding with the other/interbreeding.
3.	(a)		Stage – electron transport chain **(1)** Exact location – inner mitochondrial membrane **(1)**	**2**	Accept cytochrome system Accept cristae Not acceptable: mitochondrial membrane alone
	(b)		X - ATP synthase Y - Oxygen	**2**	
	(c)		Movement of electrons releases energy to pump/move/transport hydrogen ions across the inner membrane **(1)** (Return) flow of hydrogen (ions) through ATP synthase/enzyme X generates ATP **(1)**	**2**	

Question			Expected response	Max mark	Additional guidance
4.	**A**		1. Glucose broken down to pyruvate in the cytoplasm 2. Glucose/intermediates phosphorylated (by ATP) 3. ATP used in energy investment phase 4. More ATP produced in energy pay off stage/net gain of ATP 5. Dehydrogenase enzymes remove hydrogen ions and electrons 6. Pass them to NAD /NADH produced/formed **Any 4**	**4**	
	B		1. Vector is a DNA molecule used to carry (foreign) DNA into another cell/genome/organism 2. Restriction site where restriction endonuclease cuts/gene inserted 3. Regulatory sequence that controls gene expression 4. Origin of replication allows plasmid to make copies of itself 5. Selectable marker/antibiotic resistance gene allows only bacteria that have taken up plasmid to grow 6. Ligase seals/inserts the gene (into the plasmid) **Any 4** **NB award 1 mark if any 3 from points 2-5 named without descriptions.**	**4**	Accept genetic information/gene Accept: restriction enzyme Not acceptable: endonuclease alone

Question			Expected response	Max mark	Additional guidance
5.	(a)	(i)	0·25	**1**	
		(ii)	The results for volunteers A and B are different/not consistent/ concordant **OR** A decreased more than B	**1**	Not acceptable: only two volunteers were used alone. If figures stated they must be correct
	(b)	(i)	Response – Shivering **(1)** Explanation – muscles contract, generating heat **(1)** **OR** Response - Hair erector muscles contract/hairs raised **(1)** Explanation – traps a layer of warm/insulating air **(1)** **OR** Response – vasoconstriction/blood vessels (in the skin) get narrower **(1)** Explanation – less blood flow to skin so less heat lost **(1)** **OR** Response – Increase in metabolic rate **(1)** Explanation – Produces (more) heat **(1)**	**2**	
		(ii)	(it allows) high/optimal/increased diffusion rates	**1**	
6.	(a)		Lowers heart rate/metabolic rate/ breathing rate/(body) temperature **AND** saves/conserves energy	**1**	
	(b)	(i)	72	**1**	
		(ii)	(As less ice means) less food/prey/seals	**1**	
	(c)		Aestivation/daily torpor	**1**	Not migration Not dormancy

<table>
<tr><th colspan="3">Question</th><th>Expected response</th><th>Max mark</th><th>Additional guidance</th></tr>
<tr><td>7.</td><td>(a)</td><td>(i)</td><td>Water bath/incubator</td><td>1</td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td>Number of cells
OR
Incubation time

OR

Volume/concentration/type/ nutrient composition/pH of media

OR

Volume/concentration/type of solvent</td><td>1</td><td></td></tr>
<tr><td></td><td>(b)</td><td></td><td>Reason – to show it was the drug having the effect.

OR

To show the solvent didn’t affect the results.</td><td>1</td><td></td></tr>
<tr><td></td><td>(c)</td><td></td><td>Axes correctly labelled and scale correct (1)
Points correctly plotted (1)
Lines labelled or key (1)

<table>
<tr><th rowspan="2">Drug concentration (nM)</th><th colspan="2">Protein synthesis (% of control)</th></tr>
<tr><th>Drug Y</th><th>Drug Z</th></tr>
<tr><td>0 (Control)</td><td>100</td><td>100</td></tr>
<tr><td>10</td><td>100</td><td>85</td></tr>
<tr><td>50</td><td>56</td><td>35</td></tr>
<tr><td>75</td><td>32</td><td>14</td></tr>
<tr><td>100</td><td>7</td><td>0</td></tr>
</table></td><td>3</td><td>Any 3 values to establish a linear scale. Zero at the origin is not essential.
Data can be plotted outwith the numbered scale.

Scale breaks are not acceptable.

If the axes are transposed do not award the scale mark.

The line must go through all points.</td></tr>
<tr><td></td><td>(d)</td><td></td><td>Because there are two different types of cells
OR
Drug Y used HeLa and Drug Z used HL-60</td><td>1</td><td></td></tr>
</table>

Question			Expected response	Max mark	Additional guidance
8.	(a)	(i)	3000	**1**	
		(ii)	9 : 2	**1**	
		(iii)	320	**1**	
	(b)	(i)	More cells/*E.coli* **(1)** Cells/*E.coli* produce asparagine **(1)**	**2**	 Not acceptable: asparagine is produced alone
		(ii)	Toxic metabolites are accumulating/ building up **OR** Nutrients/raw materials have been depleted	**1**	Not acceptable: death phase alone Accept examples of nutrients/raw materials Not acceptable: asparagine has been depleted
	(c)	(i)	(Amino acid used) to produce protein	**1**	
		(ii)	Vitamins/fatty acids	**1**	Accept beef extract Not acceptable: glucose
9.	(a)	(i)	6·5	**1**	
		(ii)	Non-competitive **(1)** Inhibition not reversed by increasing substrate concentration. **(1)** **OR** Substrate concentrations above 15 mol l^{-1} /high substrate concentrations have no effect on/do not increase the rate of reaction **(1)** **OR** It still inhibits at high substrate concentrations **(1)**	**2**	Accept nitrous oxide for substrate
	(b)	(i)	End-product reaches a critical/high concentration **(1)** Inhibits an enzyme earlier in the pathway. **(1)**	**2**	
		(ii)	Saves energy/raw materials. **OR** End-product is only produced when it is required.	**1**	

Question			Expected response	Max mark	Additional guidance
10.	(a)		chlorophyll/chlorophyll a/ chlorophyll b	**1**	
	(b)	(i)	Extends the range of wavelengths (of light) absorbed **AND** passes energy on to chlorophyll **OR** Absorbs wavelengths not absorbed by chlorophyll **AND** passes energy on to chlorophyll **OR** Broadens the absorption spectrum **AND** passes energy on to chlorophyll	**1**	Accept colours for wavelengths Accept chlorophyll a or chlorophyll b for chlorophyll
		(ii)	*H. grandifolius* is found at a greater depth/20 – 25 m **(1)** Carotenoids allow absorption of green light. **OR** There is no red light at 20 – 25 m **OR** Only green light reaches 20 - 25 m **(1)**	**2**	Award 1 mark for *H. grandifolius* only receives green light
	(c)		Spectroscope/spectrophotometer/ colorimeter	**1**	

Question			Expected response	Max mark	Additional guidance
11.	(a)	(i)	From 0 - 900 Gy the germination/it decreases from 100 to 42(%)/by 58(%) **(1)** **AND** From 900 - 1000 Gy germination/it stays the same/stays at 42 **(1)** **OR** From 0 - 900 Gy the germination/it decreases from 100 to 42(%)/by 58 (%) then stays the same **(2)**	**2**	Award 1 mark for it decreases up to 900 Gy then stays the same. Award 1 mark for correct description and values with no units. 2 marks can be awarded if Gy is stated only once.
		(ii)	96	**1**	
	(b)	(i)	Crop – Groundnut **(1)** Explanation – smallest (%) decrease in growth/dry mass **(1)**	**2**	
		(ii)	10 800	**1**	
12.	(a)	(i)	High seed output/many seeds	**1**	
		(ii)	Dandelion has broad leaves and grass narrow (to absorb spray/herbicide) **OR** Dandelion has broader leaves/grass has narrower leaves	**1**	Accept broad leaves absorb more spray/herbicide than narrow leaves
	(b)		Improvement – randomised plots **(1)** Justification – reduces/eliminates bias or description **(1)**	**2**	Description of bias could be one side might receive more light/nutrients/ moisture

Question			Expected response	Max mark	Additional guidance
13.	(a)		Lookout/donor is more likely to be harmed/attract predator while the others/recipients benefit/escape	**1**	
	(b)		It increases survival chance of shared genes **OR** Because it is kin selection	**1**	
	(c)		As number of lookouts increase from 1 to 10 predation success rate decreases from 56% to 8 % /by 48% **(1)** **AND** From 10 to 12 lookouts predation success remains constant/stays at 8%. **(1)** **OR** As number of lookouts increase from 1 to 10 predation success rate decreases from 56% to 8% /by 48% and then stays the same **(2)**	**2**	Award 1 mark for it increases up to 10 lookouts then stays the same. Award 1 mark for correct description and values with no units. 2 marks can be awarded if units are only stated once.
	(d)	(i)	Ritualistic/threat displays	**1**	Not examples alone
		(ii)	Reduces conflict **OR** Increases chances of dominant animal's favourable genes being passed on	**1**	

Question			Expected response	Max mark	Additional guidance
14.	(a)		A as there is a greater number of species present **OR** A as it has one more species than B/ A has 5 species compared to 4 in B	**1**	
	(b)	(i)	Parasitism/parasitic	**1**	
		(ii)	Host	**1**	
		(iii)	More mites in Farm B **(1)** Chickens are closer together (as they are farmed intensively) **(1)** **OR** More chickens per m^2 **OR** converse	**2**	Not more chickens alone
	(c)		Apathy	**1**	
	(d)		Low cost/cost effective/ less land use/high profits	**1**	

Question			Expected response	Max mark	Additional guidance
15.	(a)		More/increased competition (between species) for food/habitat **(1)** Some species die out/species richness decreases **OR** Genetic/species diversity decreases **(1)**	**2**	
	(b)	(i)	Inbreeding (depression)/fewer mates **OR** Loss of genetic variation/diversity **OR** Bottleneck effect	**1**	
		(ii)	Habitat corridors	**1**	Not corridors alone
		(iii)	Allow recolonisation (after local extinctions) **OR** Increase access to food/mates (in other fragments)	**1**	
	(c)		Crops produce more food per unit area then animals. **OR** converse **OR** Energy is lost between trophic levels and farming cattle has more trophic levels than crops	**1**	

Question			Expected response	Max mark	Additional guidance
16.	**A**	(i)	1. Stem cells are unspecialised cells (in animals) 2. Stem cells can self-renew/divide **AND** differentiate 3. Embryonic stem cells are pluripotent **OR** Embryonic stem cells can become/differentiate into any type of cell 4. In embryonic stem cells all of their genes can be switched on/expressed 5. Tissue stem cells are multipotent **OR** Tissue stem cells can only differentiate into cells of their tissue **OR** Tissue stem cells can differentiate into a narrow range of cell types 6. In tissue stem cells (genes are switched on/expressed to) produce proteins characteristic of that cell type 7. Tissue stem cells are involved in growth/repair/renewal (of their tissue) **(Max 4 from points 1-7)**	**4**	Points 1-7 may be awarded (Max 4 marks) if correctly given in part (ii) Not acceptable for point 4: all genes are switched on
		(ii)	a. Therapeutic use involves repair of damaged or diseased organs/tissues b. Therapeutic use example – corneal repair/producing skin grafts/bone marrow transplant c. Embryonic stem cells can divide in culture in the lab d. Research use of stem cells - model cells to study how diseases develop **OR** to test drugs e. Provides information on how cells divide/differentiate/genes are regulated f. Ethics of embryonic stem cell use – responsibility to help treat disease/ease suffering **OR** -involves destroying an embryo **(Max 4 from points a - f)**	**4**	Points a-f may be awarded (Max 4 marks) if correctly given in part (i)

Question			Expected response	Max mark	Additional guidance
	B	(i)	1. Insertion is where a base/ nucleotide is added to DNA/gene 2. Deletion is where base is removed from DNA/gene 3. Substitution is where one base is replaced by another in the DNA/ gene 4. All three mutations named but not described 5. Insertion/deletion are frameshift mutations 6. Frameshift/deletion/insertion change all codons after the mutation 7. Nonsense results in a premature stop codon 8. Splice site mutation results in some introns being retained **OR** some exons removed from/not included in the mature transcript **(Max 5 from points 1 - 8)**	**5**	Points 1-8 may be awarded (Max 5 marks) if correctly given in part (ii) Points 1-3 DNA/gene need only be mentioned once in points 1-3. Point 4 may only be awarded if points 1-3 are not awarded.
		(ii)	a. Missense mutation is where one amino acid is changed for another b. Missense mutation has little effect on the protein or can result in a non-functioning protein c. Insertion/deletion/frameshift changes all amino acids after the mutation d. Frameshift/deletion/insertion has a major effect on protein shape/structure/function e. Nonsense mutation results in a shorter protein f. Splice site mutation could result in a longer or shorter protein **(Max 3 from points a - f)**	**3**	Points a-f may be awarded (Max 3 marks) if correctly given in part (i) Both effects are required for point b. Not acceptable for point c: Insertion/deletion/frameshift changes all amino acids alone

[END OF MARKING INSTRUCTIONS]