National Qualifications 2022

2022 Biology

Higher – Paper 2

Finalised marking instructions

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

General marking principles for Higher Biology

Always apply these general principles. Use them in conjunction with the marking instructions for each question, 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:
- 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)	(i)	Any value or any range from 92 to 98 inclusive.	**1**	
		(ii)	Allows DNA polymerase to add nucleotides. **OR** Provides a start point for DNA replication. **OR** Binds to the target sequence.	**1**	
	(b)	(i)	**Name:** (DNA) ligase **(1)** **Suggestion:** Both strands are replicated continuously. **OR** There are no fragments to join. **(1)**	**2**	
		(ii)	It would be denatured. **OR** It is not heat tolerant/resistant. **OR** It would not work at high temperatures.	**1**	
	(c)		Solving crimes/forensics **OR** (Settle) paternity/maternity suits **OR** Diagnose genetic disorder/genetic disease.	**1**	Not - diagnose disease.

Question			Expected response	Max mark	Additional guidance
2.	(a)		Nucleus	**1**	
	(b)	(i)	More than one polypeptide/protein **OR** Two polypeptides/proteins **OR** More than one mature transcript	**1**	Not - two polypeptides from one mature transcript.
		(ii)	Different exons are included/ retained/joined together (in the mature transcript/mRNA).	**1**	Not - any suggestion of changing the order of exons. Not **-** depends what sections are treated as exons and introns.
	(c)		Ribosomes contain (r)RNA which will contain uracil. **OR** mRNA is at the ribosome **and** contains uracil. **OR** tRNA is at the ribosome **and** contains uracil.	**1**	

Question			Expected response	Max mark	Additional guidance
3.	(a)		Prokaryotes carry out horizontal transfer of genes/DNA **OR** Prokaryotes transfer genes/DNA in the same generation.	**1**	Not - horizontal transfer alone
	(b)		MRSA/resistant bacteria survive/have a selective advantage. **OR** MRSA/non-resistant bacteria die/killed by antibiotic. **(1)** Pass on resistance genes/alleles to offspring/to next generation/ vertically/horizontally **(1)**	**2**	The response must clearly reference the bacteria/MRSA and not humans. Not – pass on resistance genes/alleles alone.
	(c)	(i)	MRSA- increased until 2007 then decreased. **(1)** Non-resistant- Remained (fairly) constant. **(1)**	**2**	Not - a description of values for all years. Not - a description of each little change.
		(ii)	2008/2009/2010	**1**	
		(iii)	Personalised medicine. **OR** Pharmacogenetics.	**1**	

Question			Expected response	Max mark	Additional guidance
4.	(a)	(i)	Certain genes are expressed/ switched on. **OR** Genes characteristic of that cell type are expressed/switched on.	**1**	Not - certain genes can be switched on **and** off.
		(ii)	Mitosis/cell division	**1**	
	(b)		Micro-organisms/bacteria/fungi would grow. **(1)** Compete for nutrients/resources/ raw materials. **OR** Micro-organisms/bacteria/fungi cause disease **(1)** **Award 1 mark only for:** There would be competition from micro-organisms/bacteria/fungi	**2**	Not - organisms alone Not - compete for light/space (do not negate otherwise correct answer)
	(c)	(i)	0.2	**1**	
		(ii)	Any value greater than 11 up to and including 12.	**1**	Not - a range of values

Question			Expected response	Max mark	Additional guidance
5.	(a)	(i)	Geographical	**1**	
		(ii)	• It prevents gene flow/breeding between the groups/populations. **(1)** • Different mutations occur in each population. **(1)** • Natural selection occurs. **(1)** **(Any 2)**	**2**	Not - Prevents gene flow/ interbreeding between the two **species.** Not - mutations occur in each population.
		(iii)	Allopatric	**1**	
	(b)		Birds can fly (across the canyon). **OR** Ground animals can't fly.	**1**	
	(c)		A group of organisms/animals/plants that can (inter)breed to produce fertile offspring (and that does not normally breed with other groups).	**1**	

Question			Expected response	Max mark	Additional guidance
6.	(a)		(Central) matrix of mitochondria.	**1**	
	(b)		Oxaloacetate.	**1**	
	(c)		(Succinyl CoA) acts as a competitive inhibitor.	**1**	Accept description of competitive inhibitor.
	(d)		Lactate/ATP/NAD	**1**	Not - NADH
7.	(a)		As the (body) mass increases the metabolic rate decreases. **OR** As the (body) mass decreases the metabolic rate increases.	**1**	Not - as metabolic rate increases body mass decreases. Not - as metabolic rate decreases body mass increases.
	(b)		7.2	**1**	
	(c)		The body masses are different.	**1**	
	(d)		Respirometer/calorimeter/oxygen probe/carbon dioxide probe.	**1**	
	(e)	(i)	2 atria and 2 ventricles.	**1**	Not - 4 chambers alone Mention of single or incomplete double circulatory system would negate otherwise correct answer.
		(ii)	No mixing of oxygenated and de-oxygenated blood. **OR** Blood pumped (out) at higher pressure. **(1)** Efficient oxygen delivery (to cells). **(1)**	**2**	

Question			Expected response	Max mark	Additional guidance
8.	(a)	(i)	September, October, and November **OR** September to November.	**1**	
		(ii)	As air temperature decreases body temperature decreases **OR** As air temperature increases body/ internal/crocodile temperature increases. **OR** Body/internal/crocodile temperature is dependent on/similar to the air temperature.	**1**	Not – as body temperature decreases air temperature decreases. Not - as body temperature increases air temperature increases. Not - body temperature is **the same** as air temperature.
	(b)	(i)	Decreases from 6.5 kg (in August) to 5.6 kg in November **(1)** Then increases to 6.1 kg (in December). **(1)** **Award 1 mark only** for- Decreases to November then increases.	**2**	If additional points are described these must be correct. Units must be mentioned once to achieve full marks.
		(ii)	75%	**1**	
	(c)	(i)	159	**1**	
		(ii)	25.7	**1**	

Question			Expected response	Max mark	Additional guidance
9.	(a)		5	**1**	
	(b)		6:13	**1**	
	(c)		100	**1**	
	(d)	(i)	Antibiotic production **starts** in the stationary phase. **OR** Antibiotic is **only** produced in the stationary phase.	**1**	
		(ii)	Reduces competition for resources/ nutrients/raw materials. **OR** Outcompetes other bacteria/ microorganisms.	**1**	Not - kills other bacteria alone. Not – outcompetes other organisms.
	(e)		Oxygen/pH/temperature/sterility	**1**	

<table>
<tr><th colspan="3">Question</th><th>Expected response</th><th>Max mark</th><th>Additional guidance</th></tr>
<tr><td>10.</td><td>(a)</td><td>(i)</td><td>Light intensity.
OR
Power of bulb/lamp.
OR
Distance between bulb/lamp and tube/filter/algae.
OR
Concentration of algae in beads.
OR
Species/type of algae.
OR
Size of (algal/gel) beads.
OR
Temperature.</td><td>1</td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td>Carry out the investigation in the dark.
OR
Suitable description of removing other light sources.</td><td>1</td><td></td></tr>
<tr><td></td><td>(b)</td><td></td><td>Axes correctly labelled with correct units and scale correct (1)

Points correctly plotted and joined (1)

<table><tr><th>Wavelength of light (nm)</th><th>Colorimeter reading (units)</th></tr><tr><td>400</td><td>0.40</td></tr><tr><td>450</td><td>0.82</td></tr><tr><td>500</td><td>0.24</td></tr><tr><td>550</td><td>0.20</td></tr><tr><td>600</td><td>0.34</td></tr><tr><td>650</td><td>0.96</td></tr><tr><td>700</td><td>0.22</td></tr></table></td><td>2</td><td>Scale:
• Any 3 values to establish a linear scale.
• Data can be plotted out with the numbered scale.
• Scale breaks are not acceptable.
• If the axes are transposed do not award the scale mark.

Plot:
• The line must go through all points.</td></tr>
<tr><td></td><td>(c)</td><td>(i)</td><td>The rate of photosynthesis is greatest/highest at 650 nm.</td><td>1</td><td>Units must be included at least once.</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>Repeat the experiment at each wavelength (of light).</td><td>1</td><td>Not - repeat experiment/ investigation alone</td></tr>
<tr><td></td><td>(d)</td><td></td><td>They have carotenoids (1)

They absorb/use light transmitted/not absorbed by (surface) plants. (1)</td><td>2</td><td></td></tr>
</table>

Question			Expected response	Max mark	Additional guidance
11.	**A**		1. Toxic to non-target species. **(1)** 2. Persistent in the environment/ soil. **(1)** 3. Bioaccumulation is the build-up of pesticide/chemical within an organism. **(1)** 4. Biomagnification is the increasing concentration of a pesticide/ chemical between trophic levels/along food chain. **(1)** 5. Bioaccumulation and biomagnification with no description. **(1)** **Only award point 5 if neither point 3 or point 4 are awarded.** 6. Result in resistant (populations of) pests. **(1)** **(maximum of 3 from 1 – 6)** 7. Biological control introduces a predator/pathogen/parasite of the pest. **OR** Control organism may become an invasive species/parasitise/prey on/be a pathogen of other species. **(1)**	**4**	NOT- toxic to/kills/harmful to animals alone

Question			Expected response	Max mark	Additional guidance
11.	**B**		1. Naming stereotypy and misdirected behaviour. **(1)** 2. Stereotypy is repetitive behaviour (with no obvious purpose). **(1)** 3. Misdirected is (normal) behaviour that is carried out inappropriately towards themselves/others/ surroundings. **(1)** 4. Failure in sexual/parental behaviour. **(1)** 5. Hysteria is (very) high levels of activity. **(1)** 6. Apathy is (very) low levels of activity. **(1)** 7. Altered levels of activity **OR** naming hysteria and apathy with no description. **(1)** **Only award point 7 if neither point 5 or point 6 are awarded.** **Max of 4 marks from points 1-7.**	**4**	**NOT-** high/low levels of energy

Question			Expected response	Max mark	Additional guidance
12.	(a)	(i)	Randomisation of plots/treatments.	**1**	Not - randomisation alone.
		(ii)	500 plants in each plot. **OR** Four plots/replicates of each cultivar.	**1**	Not - 500 plants alone.
	(b)		Q has the longest roots. **(1)** T has the highest mass of grain (produced per plot). **(1)**	**2**	
	(c)		F_2 has too much variation.	**1**	
13.	(a)	(i)	Mutualism/mutualistic	**1**	
		(ii)	**Coral:** Gains oxygen/glucose/sugar. **(1)** **Zooxanthellae:** Receive protection/habitat/ shelter/nutrients **OR** Can use light reflected (from coral) for **photosynthesis.** **(1)**	**2**	Not – gains nutrients/raw materials/ resources. Not - receives more reflected light without reference to photosynthesis.
	(b)		**Percentage:** Any figure/range between 20 and 22 inclusive. **(1)** **Justification:** increase in sea temperature is getting greater. **(1)** **OR** **Percentage:** 21 **(1)** **Justification:** For every 0.1 increase in temperature the coral/percentage covered decreases by 1%. **(1)** **Award 1 mark only for-** Percentage: any value less than 30. **AND** Justification: as temperature increases coral/percentage (coverage) decreases.	**2**	

Question			Expected response	Max mark	Additional guidance
14.	(a)	(i)	Workers	**1**	
		(ii)	**Explanation:** They are related. **(1)** **Advantage:** Increase survival of shared genes/ DNA. **OR** Increases the chance of shared genes/DNA being passed on to the offspring/next generation. **(1)**	**2**	
		(iii)	Defend hive/queen. **OR** Carry out waggle dance to show direction/distance of food. **OR** Build/repair the hive. **OR** Collect pollen/nectar/food.	**1**	
	(b)	(i)	1.75×10^6 **OR** 1 750 000	**1**	
		(ii)	As insecticide/pesticide (use) decreases a lower percentage of/ less colonies are lost. **OR** Loss of colonies decreases as insecticide/pesticide (use) decreases.	**1**	Not - As insecticide/pesticide use increases the loss of colonies increases. (incorrect direction chronologically). Not - As the number of colonies decreases the insecticide/pesticide use decrease.

Question			Expected response	Max mark	Additional guidance
15.	(a)	(i)	Spread rapidly **AND** Outcompete the native species/ tortoises.	**1**	
		(ii)	Prey on native species/tortoises. **OR** Hybridise with them/native species/ tortoises.	**1**	
		(iii)	Reduced/low genetic diversity/ variation. **(1)** Cannot adapt/evolve to cope with environmental change. **OR** Inbreeding leads to lower reproductive rates/success. **(1)**	**2**	
	(b)		Genetic (diversity). **(1)** New/different alleles introduced. **(1)**	**2**	Not - new/different **genes** introduced.

Question			Expected response	Max mark	Additional guidance
16.	**A**	(i)	1. Integrated pathways of reactions **OR** Series of reactions. **(1)** 2. Controlled/catalysed by enzymes. **(1)** 3. Can have reversible and irreversible steps/reactions. **(1)** 4. Can have alternative routes. **(1)** 5. Anabolism is build-up of molecules/synthesis. **(1)** 6. Anabolism requires energy/ATP. **(1)** 7. Catabolism is breakdown of molecules/degradation. **(1)** 8. Catabolism releases energy/ATP. **(maximum 6)**	**6**	Not - metabolic pathways can be reversible and irreversible. **NOT-** catabolism produces energy
		(ii)	a. Pumps actively transport ions/ particles across the membrane. **(1)** b. (Proteins) act as enzymes. **(1)** c. (Proteins) act as pores. **(1)** **(maximum 2)**	**2**	Accept carrier protein for pump. Accept channel protein for pore.

Question			Expected response	Max mark	Additional guidance
16.	**B**	(i)	1. (Regulators) maintain internal environment/temperature regardless of external environment/temperature. **(1)** 2. (Regulators) use metabolism/ metabolic rate to control internal environment/temperature. **(1)** 3. (Regulators) Have a wide range of ecological niches. **(1)** 4. Homeostasis has high metabolic/ energy costs. **(1)** **(maximum 3)**	**3**	
		(ii)	a. Temperature increase/change is detected by the hypothalamus **OR** Hypothalamus monitors/controls/ regulates temperature. **(1)** b. Information sent by (electrical impulses through) nerves to effectors/skin. **(1)** c. Vasodilation/skin blood vessels widen. **(1)** d. Increased blood flow to skin so (more) heat lost. **(1)** e. Sweating occurs. **(1)** f. Heat used to evaporate water/ sweat. **OR** Evaporating sweat cools the skin/ body. **(1)** g. Decreased metabolic rate. **(1)** **(maximum 5)**	**5**	

[END OF MARKING INSTRUCTIONS]

Published: May 2023

Change since last published:

Question 10 (b)
• ½ box tolerance for plotting.
Removed from Additional Guidance column