



2014 Biology

Advanced Higher

Finalised Marking Instructions

© Scottish Qualifications Authority 2014

The information in this publication may be reproduced to support SQA qualifications only on a non-commercial basis. If it is to be used for any other purposes written permission must be obtained from SQA's NQ Assessment team.

Where the publication includes materials from sources other than SQA (secondary copyright), this material should only be reproduced for the purposes of examination or assessment. If it needs to be reproduced for any other purpose it is the centre's responsibility to obtain the necessary copyright clearance. SQA's NQ Assessment team may be able to direct you to the secondary sources.

These Marking Instructions have been prepared by Examination Teams for use by SQA Appointed Markers when marking External Course Assessments. This publication must not be reproduced for commercial or trade purposes.

Part One: General Marking Principles for: Biology Advanced Higher

This information is provided to help you understand the general principles you must apply when marking candidate responses to questions in this Paper. These principles must be read in conjunction with the specific Marking Instructions for each question.

- (a) Marks for each candidate response must always be assigned in line with these general marking principles and the specific Marking Instructions for the relevant question. If a specific 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/Principal Assessor.
- (b) Marking should always be positive ie, marks should be awarded for what is correct and not deducted for errors or omissions.

GENERAL MARKING ADVICE: Biology Advanced Higher

The marking schemes are written to assist in determining the “minimal acceptable answer” rather than listing every possible correct and incorrect answer. The following notes are offered to support Markers in making judgements on candidates’ evidence, and apply to marking both end of unit assessments and course assessments.

1. There are no **half marks**. Where three answers are needed for two marks, normally one or two correct answers gain one mark.
2. In the mark scheme, if a word is **underlined** then it is essential; if a word is **(bracketed)** then it is not essential.
3. In the mark scheme, words separated by/are **alternatives**.
4. If two answers are given which contradict one another the first answer should be taken. However, there are occasions where the second answer negates the first and no marks are given. There is no hard and fast rule here, and professional judgement must be applied. Good marking schemes should cover these eventualities.
5. Where questions in data are in two parts, if the second part of the question is correct in relation to an incorrect answer given in the first part, then the mark can often be given. The general rule is that candidates should not be penalised repeatedly.
6. 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, candidates should not be penalised repeatedly.

7. Clear indication of understanding is what is required, so:
- if a description or explanation is asked for, a one word answer is not acceptable
 - if the question asks for **letters** and the candidate gives words and they are correct, then give the mark
 - if the question asks for a word to be **underlined** and the candidate circles the word, then give the mark
 - if the result of a calculation is in the space provided and not entered into a table and is clearly the answer, then give the mark
 - **chemical formulae** are acceptable eg CO₂, H₂O
 - contractions used in the Arrangements document eg DNA, ATP are acceptable
 - words not required in the syllabus can still be given credit if used appropriately eg metaphase of meiosis
8. Incorrect **spelling** is given. Sound out the word(s),
- if the correct item is recognisable then give the mark
 - if the word can easily be confused with another biological term then **do not** give the mark eg ureter and urethra
 - if the word is a mixture of other biological words then **do not** give the mark, eg mellum, melebrum, amniosynthesis
9. **Presentation of data:**
- if a candidate provides two graphs or bar charts (eg one in the question and another at the end of the booklet), mark both and give the higher score
 - if the question asks for a line graph and a histogram or bar chart is given, then do not give the mark(s). Credit can be given for labelling the axes correctly, plotting the points, joining the points either with straight lines or curves (best fit rarely used)
 - if the x and y data are transposed, then do not give the mark
 - if the graph used less than 50% of the axes, then do not give the mark
 - if 0 is plotted when no data is given, then do not give the mark (ie candidates should only plot the data given)
 - no distinction is made between bar charts and histograms for marking purposes. (For information: bar charts should be used to show discontinuous features, have descriptions on the x-axis and have separate columns; histograms should be used to show continuous features; have ranges of numbers on the x-axis and have contiguous columns)
 - where data is read off a graph it is often good practice to allow for acceptable minor errors. An answer may be given 7.3 ± 0.1
10. **Extended response questions:** if candidates give two answers where this is a choice, mark both and give the higher score.

11. **Annotating scripts:**

- put a 0 in the box if no marks awarded – a mark is required in each box
- indicate on the scripts why marks were given for part of a question worth 3 or 2 marks. A ✓ or x near answers will do

12. **Totalling scripts:** errors in totalling can be more significant than errors in marking:

- enter a correct and carefully checked total for each candidate
- do not use running totals as these have repeatedly been shown to lead to more errors

Part Two: Marking Instructions for each Question

Section A

Question			Expected Answer(s)	Max Mark	Additional Guidance
1			D		
2			C		
3			A		
4			B		
5			B		
6			A		
7			B		
8			C		
9			C		
10			A		
11			D		
12			A		
13			B		
14			D		
15			C		

Question			Expected Answer(s)	Max Mark	Additional Guidance
16			D		
17			B		
18			D		
19			B		
20			B		
21			D		
22			A		
23			C		
24			A		
25			C		

Section B

Question			Expected Answer(s)	Max Mark	Additional Guidance
1.	(a)		<p>(in RM) glucose transport is higher in control / before insulin / after insulin</p> <p>OR</p> <p>(in RM) glucose transport shows greater <i>increase</i> (1)</p> <p>One correct quantification in support, eg 4 – 3 (1)</p>	2	<p>Note comparatives essential, eg. 'In control, transport in red is 4 units whereas in white it is only 3 units.' = 2 marks</p> <p>Control = before Insulin = no insulin</p> <p>Before ~ 4.0RM ~3.0WM After ~ 9.0RM ~6.5WM (+/- 0.2 units)</p>
1	(b)	(i)	(in the two cell types) amounts of GLUT/samples/tissue/fractions can be different	1	Accept mass = amount
1.	(b)	(ii)	Error bars overlap so differences (between GLUT levels) are not significant/(GLUT) levels could be the same	1	The size of the error bar is not relevant, eg 'The error bars are the same in both' is a comment about variance but the result is about the GLUT levels.
1.	(c)	(i)	All in PM/none in IM in both types	1	
1.	(c)	(ii)	<p>(GLUT1 stays in PM, so insulin has) no effect</p> <p>(on location/distribution/fraction in either muscle type)</p>	1	Accept (slight) decrease in amount in PM
1.	(c)	(iii)	(in both muscle types) insulin increases the amount of GLUT4 in PM and decreases it in IM	1	Amount of GLUT4 can be descriptions of the blot – lighter, darker, denser, more intense

Question			Expected Answer(s)	Max Mark	Additional Guidance
1.	(d)		<p>(after insulin both muscle types have) (In Fig 4): similar (relative) increase in PM and (relative) decrease in IM</p> <p>(Fig 3): (comparing overall blot densities) bigger/darker blots in Red Muscle (1–4) than white (5–8)</p>	2	<p>Graph shows percentage changes are matching in both muscle types</p> <p>And blots show magnitude is greater in red</p> <p>eg 2 vs 6</p>
1.	(e)	(i)	<p>(Hydrophilic signals) bind to a membrane receptor/membrane protein (1)</p> <p>Only some/target cells have the receptors/specific proteins (1)</p>	2	<p>Cell surface = membrane</p> <p>Attach OK for “binding”</p>
1.	(e)	(ii)	Signal at the outside/extracellular signal/insulin triggers a response inside the cell.	1	Need to make the generalisation here when talking about the recruitment of GLUT 4 to plasma membrane
1.	(f)	(i)	<p>Energy storage</p> <p>OR</p> <p>storage (of glucose) in form that is insoluble/avoids osmotic effects</p>	1	
1.	(f)	(ii)	<p>Branched/polysaccharide/chains (of glucose molecules)/ polymer</p> <p>AND</p> <p>α 1,4 glycosidic bonds (between glucose molecules)</p> <p>OR</p> <p>α 1,6 glycosidic bonds at branch points</p> <p>OR</p> <p>Annotated diagrams</p>	1	Or description of glycosidic bond
				(14)	

Question			Expected Answer(s)	Max Mark	Additional Guidance
2.			1. Define transgenic as containing DNA from a different species 2. Ti plasmid removed (from the bacterium) 3. Tumour/gall causing “gene” removed/disabled 4. desired gene extracted from source 5. endonuclease/restriction enzyme cuts plasmid OR source 6. ligase splices gene into plasmid 7. incorporation of marker genes/antibiotic resistance genes/kanamycin resistance genes 8. (modified) plasmid returned to <i>Agrobacterium</i> 9. (<i>Agro</i>) <i>bacterium</i> incubated with protoplasts in selective medium <p style="text-align: right;">(Any 4)</p>	4	Seal/join for splice OK
				(4)	
3.	(a)		Prosthetic (group)	1	Correct spelling
3.	(b)	(i)	(origin) MTOC/centriole/centrosome and centromere/kinetochore	1	
3.	(b)	(ii)	to pull chromatids/chromosomes/centromeres apart	1	
3.	(c)	(i)	Both points will fail to align chromosomes on the equator/ metaphase plate because microtubules do not grow (enough to form spindle fibres) OR microtubule growth is blocked	1	Microtubules = spindle fibres
3.	(c)	(ii)	Will affect all cells that are dividing	1	All = normal/healthy/not in tumours etc
				(5)	

Question			Expected Answer(s)	Max Mark	Additional Guidance
4.	(a)		covalent modification/proteolytic cleavage	1	
4.	(b)		Hydrolysis	1	
4.	(c)		prevents digestion of the pancreas/proteins in the pancreas prevents digestion of other enzymes in pancreatic juice	1	Not about the protease inhibitor Not damage to pancreas
4.	(d)		trypsin can attack (the trypsinogen) at lysine and make more trypsin that will do the same OR new trypsin can join in activation and speed up the conversion of trypsinogen	1	Not 'Autocatalytic cascade' on its own
				(4)	
5.	(a)	(i)	(requires) <u>energy</u>	1	
5.	(a)	(ii)	Extended/wide range of habitats /environments Extends the range of temperatures inhabited	1	Not 'places', 'locations', 'niche'
5.	(b)		Osmoconformers	1	
				(3)	

Question			Expected Answer(s)	Max Mark	Additional Guidance
6.	(a)		to kill pests/reduce pest population and increase yield/ reduce loss/reduce damage/that eat the crop	1	Allow herbicides, fungicides etc
6	(b)		specific/biodegradable/not persistent	1	
6	(c)	(i)	200%	1	
6.	(c)	(ii)	(pairs of sentences with suggestion and corresponding reason) eg smaller fields (1) because bumblebees will get food within range of their nests/ bumblebees can then forage beyond the monoculture (1) OR Increase diversity of flowering plants available (1) because bumblebees do not store much food (1) bees won't live long after the crop is harvested bees have longer to feed	2	Not answers about avoiding pesticides Not 'put crop nearer to the nest' 2 issues of behaviour: limited distance for foraging (less than 100m) and don't store food Solutions: <i>reduce distances</i> between suitable forage OR <i>Extend the species</i> available to feed on More hedges More (unplanted) area left round fields Set aside etc.
				(5)	
7.	(a)		mutualistic relationship between coral (polyps) and algae/zooxanthellae (1) algae expelled from/leave coral (and coral 'bleaches'/dies as temperature rises) (1)	2	Symbiotic is OK Description of mutual benefits is OK instead of term mutualism
7.	(b)	(i)	increases from about 24°C to 27°C around week 10 then decreases	1	
7.	(b)	(ii)	(the spike caused a) Decrease in the floating canopy (seaweed) and increased the turf-forming/sea-bed cover	1	
7.	(c)		<u>allogenic succession</u>	1	
				(5)	

Question			Expected Answer(s)	Max Mark	Additional Guidance
8.	A	(i)	<p>EITHER</p> <ol style="list-style-type: none"> ecosystems depend on energy from the sun autotrophs convert simple/inorganic molecules into (complex) organic molecules (photo)autotrophs/producers convert light to chemical energy by photosynthesis only a proportion of light energy available is fixed productivity is rate of accumulation of biomass/organic matter GPP = total energy fixed OR total yield of organic matter/biomass (by photosynthesis) NPP = energy remaining after respiratory losses <p>OR $NPP = GPP - R$</p> <ol style="list-style-type: none"> NPP determines energy available for animals/heterotrophs/next trophic level chemoautotrophs description should include idea of obtaining energy from inorganic molecules to make organic <p style="text-align: right;">(Maximum 6 marks)</p>	6	<p>Rate equivalent to productivity units</p> <p>One mark penalty for NPP/GPP confusion</p> <p>Energy = organic matter, biomass</p>

Question			Expected Answer(s)	Max Mark	Additional Guidance
8.	A	(ii)	<p>10. autotrophs/producers are first trophic level</p> <p>11. (second trophic level) primary consumers/herbivores + eat producers/plants</p> <p>12. (third trophic level) secondary consumers/carnivores + eat animals</p> <p>13. energy transferred through trophic levels is by feeding</p> <p>14. energy losses occur at a trophic level/at transfers</p> <p>15. one example of loss from: excreted/egested/uneaten material/dead organism</p> <p>16. (losses) result in energy flow to decomposers/detritivores/saprotrophs</p> <p>17. ultimate energy loss as heat OR reference to thermodynamics</p> <p>18. ecological efficiency is the percentage/proportion of energy transferred to next level</p> <p>19. (percentage) transfer/ecological efficiency is low/'10% rule'</p> <p>20. energy flow represented by pyramid of energy/productivity</p> <p>21. energy losses restrict number of trophic levels</p> <p style="text-align: right;">(Maximum 9 marks)</p>	9	<p>Consume = eat</p> <p>Egested = undigested</p> <p>Diagrams must be correctly labelled</p>
				(15)	

Question			Expected Answer(s)	Max Mark	Additional Guidance
8.	B	(i)	<p>OR</p> <ol style="list-style-type: none"> 1. fossil fuels are burned to release energy 2. (burning fossil fuels) releases gases 3. example of (gas released from burning): sulphur dioxide/nitrogen oxides/carbon dioxide 4. these (dissolve in atmospheric water to) form acid rain 5. acid rain lowers pH of water (in freshwater ecosystem) 6. (acid rain) dissolves minerals out of the soil/rocks which pollute fresh water 7. carbon dioxide from burning fossil fuels enhances greenhouse effect/causes global warming 8. pH drop OR temperature increase (may) reduce species diversity/affect species distribution <p style="text-align: right;">(Any 5)</p>	5	<p>Stress fresh water ecosystems</p> <p>Chemical symbols are OK</p> <p>Negates: if CFC or methane in a list with correct gases</p> <p>Need idea of adding to GH effect</p> <p>Not eg. 'kills fish'</p>
8.	B	(ii)	<ol style="list-style-type: none"> 9. toxic pollutants are substances that cause harm to organisms (in their ecosystem) 10. heavy metals OR an example are toxic pollutants 11. DDT is a (toxic) insecticide/pesticide 12. describe source of toxic pollutant 13. persistent/non-biodegradable/not broken down 14. toxicity arising from biotransformation 15. bioaccumulation + build up in one organism/trophic level 16. biological magnification + build up in successive trophic levels <p style="text-align: right;">(Any 5)</p>	5	<p>Hg, Pb, Cd, Cr</p> <p>eg. application of pesticide in agriculture eg. discharge of industrial waste</p> <p>can be described</p> <p>15 and 16 terms + definition</p>

Question			Expected Answer(s)	Max Mark	Additional Guidance
8.	B	(iii)	<p>17. example of biodegradable organic pollutant (eg plant waste/paper waste/farmyard manure/sewage)</p> <p>18. ...results in high biochemical oxygen demand/BOD</p> <p>19. BOD as measure of oxygen required (by decomposers)</p> <p>20. (pollutant/organic material) stimulates growth/ increases population of bacteria ...</p> <p>21. ... decrease in concentration of dissolved oxygen</p> <p>22. species which require high oxygen levels are susceptible/die out</p> <p>23. species which can cope with low oxygen levels are favoured/increase (in population)</p> <p>24. relative abundance of such species used to indicate/ monitor quality (of freshwater ecosystem)</p> <p style="text-align: right;">(Any 5)</p>	5	NB fresh water
				(15)	

Section C

Biotechnology

Question			Expected Answer(s)	Max Mark	Additional Guidance
1.	(a)		dilution plating/colorimeter (turbidity)/haemocytometer	1	
1.	(b)		diauxic growth	1	
1.	(c)	(i)	(protein) not bound to operator OR (protein) bound to inducer/lactose AND transcription of structural gene occurs OR structural gene switched on	1	
1.	(c)	(ii)	(protein) (bound to cAMP) binds (promoter of the) <i>lac</i> gene and stimulates transcription of structural gene	1	
1.	(d)		lag phase for <i>lac</i> operon/takes time for the production of beta galactosidase	1	
				(5)	
2.			<ol style="list-style-type: none"> 1. chymosin used in cheese production/to change milk to curds and whey 2. produced as an alternative to traditional rennet 3. recombinant plasmid containing (calf) chymosin gene 4. introduced into suitable species of micro-organism/<i>E.coli</i>/yeast/<i>K. lactis</i>/<i>Aspergillus niger</i> 5. fermentation/culturing of the modified micro-organisms 6. requires sterile conditions 7. need to control nutrients/oxygen/pH/temperature/ anti-foaming agents/time 8. recombinant enzymes / chymosin produced as secondary metabolite 	5	
				(5)	

Question			Expected Answer(s)	Max Mark	Additional Guidance
3.	(a)	(i)	myeloma (cells) (1) (make) hybridomas immortal/can divide indefinitely (1)	2	
3.	(a)	(ii)	using selective media	1	
3	(b)		monoclonal antibody binds to tumour (1) radioactive component destroys/damages cells (1)	2	
				(5)	
4.	(a)		ranges overlap if data for 35°C and 50°C if the same times are compared	1	35°C/15 hours and 50°C/15 hours – ranges overlap 35°C/30 hours and 50°C/30 hours – ranges overlap
4.	(b)	(i)	some autolysates don't contain detectable RNA (suggesting it has all been broken down)	1	
4.	(b)	(ii)	50°C for 30 hours (1) autolysate contains the most partially degraded RNA (for GMP/IMP production) (1)	2	
4.	(c)		type of yeast/age of culture/growth stage of culture/pH/salt treatment	1	
				(5)	

Section C (continued)

Animal Behaviour

Question			Expected Answer(s)	Max Mark	Additional Guidance
1.	(a)	(i)	Petrels choose/prefer odours of non-kin/unrelated birds.	1	Refer back to Aim
1.	(a)	(ii)	16	1	
1.	(b)		Maze thoroughly washed Maze covered/avoid observer effects Odour stimuli alternated between arms (eliminate bias) Wear disposable gloves/eliminate human odour etc. (Any one)	1	Experimental variables to be kept constant are OK, eg. swab birds for same length of time Gender/age is not an issue
1.	(c)		Inbreeding increases expression of disadvantageous/lethal recessive alleles Results in lower fitness/reduced breeding success Natural selection favours behaviours with greater reproductive success (Any 2)	2	Not genes
1.	(d)		(Natal) males disperse	1	
				(6)	
2.			Any three from 1–5 1. Human activity results in rapid environmental change 2. Example – destruction of habitat/house building 3. (Adaptable species) may change diet 4. (Adaptable species may change) foraging behaviour 5. (Adaptable species may change) habitat preference Any two correct examples such as 6. exploitation of rubbish dumps by (herring) gulls/ 7. urban foraging by foxes 8. urban nesting in (herring) gulls 9. species other than fox or gull	5	Scavenging behaviour can be in different locations
				(5)	

Question			Expected Answer(s)	Max Mark	Additional Guidance
3.	(a)		Immediate/physiological/environmental factor trigger stimulus/sign stimulus	1	
3.	(b)		Time from event/stimulus to response/behaviour	1	
3.	(c)		Different individuals carrying out different tasks etc.	1	Not just sharing the same task – need allocation of roles
				(3)	
4.	(a)	(i)	Learning is a change of behaviour based on experience that must be remembered OR converse	1	
4.	(a)	(ii)	Irreversible/difficult to reverse Critical time period Object of attachment followed to exclusion of others Occurs rapidly (Any one)	1	
4.	(a)	(iii)	Object of attachment/followed is usually parent AND Provides food/shelter/protection from predators etc	1	
4.	(b)	(i)	Error bar overlaps zero line	1	
4.	(b)	(ii)	They prefer mates of the same species as the foster father	1	
4.	(b)	(iii)	Zig-zag dance, swimming into nest, swollen belly, nudging tail etc.	1	
				(6)	

Section B

Physiology, Health and Exercise

Question			Expected Answer(s)	Max Mark	Additional Guidance
1.			(exercise) 1. reduces BP/hypertension 2. reduces risk of MI/stroke 3. improves (blood) lipid profile/increase HDL:LDL 4. reduces fat/cholesterol in arteries and the risk of atherosclerosis 5. reduces body fat/obesity which is a risk factor 6. decreases (resting) heart rate 7. improves myocardial circulation/blood flow to heart and link to angina/oxygen supply/oxygen deficiency	5	Penalise "prevent" only once Ratio can be put as HDL up and LDL down Capillary network OK if in heart
				(5)	
2.	(a)	(i)	percentage body fat	1	Proportion idea needed
2.	(a)	(ii)	depends on hydration level (of the body) overestimates (fat) in lean people underestimates (fat) in obese people	1	
2.	(b)	(i)	Bone is more porous/bigger pore size and trabeculae thinner	1	both comparative; must refer to trabeculae
2.	(b)	(ii)	do weight bearing exercise OR increase bone density when young/under 30	1	Bone mass = bone density
2.	(b)	(iii)	menopause (in women) speeds up loss of bone density decreasing oestrogen at menopause females have lower bone density to begin with	1	Not stops
				(5)	

Question			Expected Answer(s)	Max Mark	Additional Guidance
3.	(a)		Physical activity and BMR	1	Not exercise
3.	(b)	(i)	Volume of air breathed (in known time) and change in O ₂ content of breathed air	1	OK to explain how percentage O is obtained
3.	(b)	(ii)	does not measure heat derived from oxygen consumed (rather than measured in calorimeter) uses correlation/relationship between O ₂ consumption and energy use (Any one)	1	
3.	(c)	(i)	400 kJ/d (accept %)	1	ΔEE increases from 100 to 500 Units needed
3.	(c)	(ii)	bias removed allows placebo effect to be measured psychological influences on outcome are avoided (Any one)	1	
				(5)	
4.	(a)	(i)	not to exhaustion/used to derive VO _{2max}	1	
4.	(a)	(ii)	oxygen uptake/used and body mass/weight	1	
4.	(b)	(i)	A: Time to exhaustion is greater than control pre-training (1) B: no (significant) change in time to exhaustion following training (1) OR for HIT group: error bar for pre-training overlaps error bar post-training	2	White v white HIT white v grey
4.	(b)	(ii)	HIT group showed significantly shorter <i>trial time after training</i>	1	
				(5)	

[END OF MARKING INSTRUCTIONS]