National
Qualifications
2016

2016 Biology

Higher

Finalised Marking Instructions

General Marking Principles for Higher Biology

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 detailed marking instructions, which identify the key features required in candidate responses.

(a) Marks for each candidate response must always be assigned in line with these General Marking Principles and the Detailed Marking Instructions for this assessment.

(b) Marking should always be positive, ie marks should be awarded for what is correct and not deducted for errors or omissions.

(c) 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.

(d) There are no half marks awarded.

(e) Where a candidate makes an error at an early stage in a multi stage calculation, credit should normally be given for correct follow on working subsequent stages, unless the error significantly reduces the complexity of the remaining stages. The same principle should be applied in questions which require several stages of non-mathematical reasoning.

(f) Unless a numerical question specifically requires evidence of working to be shown, full marks should be awarded for a correct final answer (including units) on its own.

(g) Bulleted lists should not be used for extended response questions. Candidates must respond to the "command" word as appropriate and write extended answers in order 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.

(h) In the mark scheme, if a word is **underlined** then it is essential; if a word is **(bracketed)** then it is not essential.

(i) In the mark scheme, words separated by / are **alternatives**.

(j) If two answers are given that 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.

(k) 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 CO_2, H_2O
- contractions used in the Course Support Notes eg DNA, ATP are acceptable
- words not required in the syllabus can still be given credit if used appropriately eg metaphase of meiosis.

(l) Incorrect **spelling** is used:

- if the term is recognisable then give the mark
- if the term can easily be confused with another biological term then **do not** give the mark eg ureter and urethra
- if the term is a mixture of other biological terms then **do not** give the mark, eg mellum, melebrum, amniosynthesis

(m) Presentation of data:

- if a candidate provides two graphs or bar charts, in response to one question (eg one in the question and another at the end of the booklet), mark both and give the higher score
- if a question asks for a particular type of graph/chart and the wrong type is given, then do not give the mark(s). Credit can be given for eg correctly labelling the axes, plotting the points, joining the points wither with straight lines or curves (best fit rarely used), constructing the height of the bars
- 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 discrete features, have descriptions of 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 continguous columns)
- where data is read off a graph it is often good practice to allow for acceptable minor error. An answer may be 7·3 ± 0·3.

(n) Marks are awarded only for a valid response to the question asked. For example, in response to questions that ask candidate to:

- **identify**, **name**, **give** or **state**, they need only name or present in brief form;
- **describe**, they must provide a statement or structure of characteristics and/or features;
- **explain**, they must relate cause and effect and/or make relationships between things clear;
- **compare**, they must demonstrate knowledge and understanding of the similarities and/or differences between things;
- **calculate**, they must determine a number from given facts, figures or information;
- **predict**, they must suggest what may happen based on available information;
- **evaluate**, they must make a judgement based on criteria;
- **suggest**, they must apply their knowledge and understanding of biology to a new situation. Marks will be awarded for any suggestions that are supported by knowledge and understanding of biology.

Marking Instructions for each question

Section 1

Question	Answer	Mark
1.	B	**1**
2.	A	**1**
3.	C	**1**
4.	B	**1**
5.	C	**1**
6.	B	**1**
7.	A	**1**
8.	A	**1**
9.	C	**1**
10.	C	**1**
11.	A	**1**
12.	D	**1**
13.	A	**1**
14.	D	**1**
15.	D	**1**
16.	B	**1**
17.	D	**1**
18.	C	**1**
19.	B	**1**
20.	D	**1**

Section 2

Question			Expected Answer(s)	Max Mark	Additional Guidance
1.	(a)		Amino acid	**1**	
	(b)		Protein **OR** Enzymes	**1**	
	(c)		Cut/cleave **AND** combine polypeptide chains **OR** add phosphate/carbohydrate	**1**	NOT – *post translational modification* NOT – *cleave/cut* alone
	(d)		Name: **Alternative** (RNA) splicing **(1)** Description: Different (combinations of/variety of) **exons** are included/ spliced together (in the mature transcript/ RNA) **(1)**	**2**	NOT – a description suggesting the order of exons is changed NOT – depends what sections are treated as exons and introns
2.	(a)	(i)	Prokaryotic has circular (chromosome) **AND** eukaryotic has linear (chromosomes)	**1**	NOT – eukaryote has linear chromosome and prokaryote has not NOT – prokaryotic has plasmid alone.
		(ii)	Proteins/Histone	**1**	
	(b)		Mitochondrion **OR** Chloroplast **OR** plasmid in yeast	**1**	

Question			Expected Answer(s)	Max Mark	Additional Guidance
	(c)	(i)	Nucleotides added to 3′ end **OR** Polymerase (only) adds to 3′ end **OR** Polymerase works from 5′ to 3′ **OR** DNA/it is replicated from 5′ to 3′	**1**	
		(ii)	(DNA) Nucleotides/primer	**1**	NOT − bases/helicase/ligase/polymerase
	(d)		So that … an exact copy/complete set of… genetic material /genetic instructions /genetic information/genes/DNA/ chromosomes **AND** is passed to (each)… new cell/daughter cell/the next generation **OR** during mitosis/cell division **OR** So new cells have the same…. genetic material/genetic instructions /genetic information/genes/DNA/ chromosomes… as the original cell **OR** To maintain the… number of chromosomes/chromosome complement… in new/daughter cells	**1**	NOT − cell replication NOT − so daughter cells can carry out their normal function alone.

Question			Expected Answer(s)	Max Mark	Additional Guidance
3.	(a)		It differentiates into/specialises into/ becomes… many/lots of/all/wide range of cell types/tissue types **OR** It is pluripotent/totipotent	**1**	 NOT − multipotent
	(b)		Different proteins will be produced/ synthesised/made (resulting in different cell types) **OR** Only proteins characteristic of that cell type are produced/synthesised/ made	**1**	 **NB** : Protein coded for ≠ synthesised
	(c)		Repair of damaged/diseased… organs/cells/tissues **OR** Production of tissues for grafting/ transplant **OR** Correct examples eg bone marrow transplants/(make) skin grafts/ to treat a named disease/treat burns	**1**	NOT − cure/treat diseases alone NOT − research diseases
	(d)		Embryo/it/baby/foetus/a potential life… is… destroyed/killed/not allowed to develop **OR** Embryos which would have been destroyed are being put to good use **OR** Use of stem cells for drug testing rather than animals **OR** Diseases could be cured	**1**	 NOT − religious reasons alone

Question			Expected Answer(s)	Max Mark	Additional Guidance
4.	(a)	(i)	From…. start/0 – 5 weeks/over first 5 weeks it increased from **0** – 9·2 **(1)** From 5 (– 7) weeks it remained constant/levelled off **(1)** **Correct values for 2 statements but no units (weeks) = 1 mark**	**2**	
		(ii)	200	**1**	
		(iii)	B	**1**	
	(b)		**B** It/number of shoots is highest/ greatest (at 7 weeks) **(1)** **and** this is (still) increasing **(1)** **OR** **C** It/number of shoots… is increasing more/most rapidly **(1)** **and** B is slowing down/levelling off **(1)**	**2**	
	(c)		Greatest (average) **root** length/ Longer **roots** **(1)** More water absorbed for photolysis/photosynthesis **OR** More nutrients absorbed for named process eg protein synthesis/ATP production etc. **(1)**	**2**	

Question			Expected Answer(s)	Max Mark	Additional Guidance
5.	(a)	(i)	Sympatric	**1**	
		(ii)	Prevents/interrupts/stops/blocks… gene flow/gene exchange/breeding/ mating… between populations **OR** Prevents interbreeding	**1**	NOT – stops populations from mating/ breeding alone
		(iii)	(DNA) sequence data/genome analysis would be similar **OR** They/the two populations… can **inter**breed/breed together… to produce fertile offspring (or converse statement)	**1**	NOT – they can **breed** to produce fertile offspring NOT – answers referring to 2 species instead of 2 populations
	(b)	(i)	(At least one) extra set of chromosomes **OR** More than 2 (complete) sets of chromosomes. **OR** 2n becomes 3n/4n etc. **OR** genome duplication/multiple sets of genome	**1**	NOT – more than 1 set of chromosomes NOT – 3n/4n/5n alone NOT – sets of DNA/genes/genetic material in place of chromosomes
		(ii)	Provides additional material upon which natural selection can work on **OR** Additional sets of chromosomes can mask harmful mutations **OR** Allows (advantageous) mutations to occur in extra chromosomes **OR** Can produce fertile/stable hybrids **OR** They are more vigorous/disease resistant/grow faster	**1**	NOT – increased yield/size/seedless varieties NOT – Polyploidy provides/creates new variation for natural selection NOT – hybrid vigour

Question			Expected Answer(s)	Max Mark	Additional Guidance
6.	(a)		Name: Lag phase **(1)** Explanation: (time required for) DNA replication/enzyme induction/enzyme production **OR** Cells can't divide until DNA replicates /enzymes induced **(1)** **NB**: Correct explanation for lag phase with wrong name **= 1 mark**	**2**	NOT – l**og** (check handwriting) NOT – lagg**ing** NOT – enzymes are starting to work NOT – enzymes are being switched on NOT – cells are getting used to the environment/acclimatising **NB :** Incorrectly named phase with matching explanation **= 0 marks**
	(b)	(i)	Stationary	**1**	NOT – 'C' alone
		(ii)	Kills/inhibits/toxic to/prevents growth of…. other bacteria **AND** reduces/eliminates competition from other bacteria **OR** allows it to **outcompete** other bacteria **OR** Eliminates interspecific competition	**1**	NOT – kills other bacteria alone
	(c)		Cell number decreases/line goes down… during/in …. death phase/phase D/at the end/ eventually	**1**	

Question			Expected Answer(s)	Max Mark	Additional Guidance
7.	**A**		1. Anabolism is a synthesis/build up reaction **OR** Anabolism is build-up of molecules/ substances **OR** Anabolism is where simple molecules are built up into more complex/large molecules	**1**	**NB**: For full marks to be awarded candidates must have provided at least 1 correct point for anabolism **AND** at least 1 point for catabolism
			2. Anabolism requires the input/ take up… of energy/ATP	**1**	
			3. Catabolism is breakdown/ degradation ….. of….. molecules/substances **OR** Catabolism is a….. break down/degradation……. reaction **OR** Catabolism is where complex/large molecules are changed into more simple molecules	**1**	
			4. Energy/ATP is released/given off in catabolism	**1**	NOT – *catabolism does not require energy*
			5. Both can have reversible and irreversible steps	**1**	
			6. Both can have alternative routes	**1**	
				(Max 4)	

Question			Expected Answer(s)	Max Mark	Additional Guidance
7.	**B**		1. Conformers' metabolism/ metabolic rate/internal environment is… dependent on/affected by….. surroundings/external environment/ external factors/external variables	**1**	**NB**: For full marks to be awarded candidates must give at least 1 correct point for conformers **AND** regulators.
			2. Conformers use behaviour to maintain optimum **metabolic** rate	**1**	
			3. Regulators can maintain/control/ regulate… their … metabolism/metabolic rate/internal environment/… regardless of external conditions	**1**	
			4. Regulators requires energy for homeostasis/negative feedback	**1**	
			5. Conformers have **narrower** (ecological) niches (or converse)	**1**	
			6. Conformers have low**er** metabolic costs/rates of metabolism (or converse)	**1**	
				(Max 4)	

Question			Expected Answer(s)	Max Mark	Additional Guidance
8.	(a)		990	**1**	
	(b)		As temperature increases population decreases **OR** The higher the temperature the lower the population **NB:** If values included (21 to 72)/(123 to 0·1) they must be correct, units not necessary **NB**: Any description extended beyond the first 4 days negates	**1**	NOT – **As** the population decreases the temperature increases (Dependent variable controlling the independent is wrong)
	(c)	(i)	Species: B **(1)** Justification: high population/ population thrived at… 72°C/highest temperature **OR** higher population than A or C at…72°C/highest temperature **(1)**	**2**	NOT – As the temperature increased the population increased NOT – its optimum temperature is 72°C/ highest temperature NOT – can withstand a wider range of temperatures
		(ii)	Contain enzymes/proteins which are… tolerant of/don't denature at/are resistant to/optimum at/working at… high temperatures	**1**	NOT – they are heat tolerant NOT – extreme temperatures
		(iii)	hot springs/geysers/volcanoes/seabed vents	**1**	

Question			Expected Answer(s)	Max Mark	Additional Guidance
9.	(a)		Name: restriction endonuclease **(1)** Function: Cuts DNA/ genes out **OR** Cuts plasmid **(1)** **OR** Name: Ligase **(1)** Function: Joins/seals/inserts gene **into** plasmid **OR** Joins/seals/ sticky ends of plasmid and gene **(1)**	**2**	NOT – cuts gene from plasmid NOT – to plasmid NOT – joins sticky ends alone NOT – joins together gene and plasmid
	(b)	(i)	Grow/culture with ampicillin/ antibiotic **(1)** Only cells containing the plasmid/that gene/transformed cells/modified cells can grow/survive **(1)**	**2**	NOT – only plasmids with gene survive NOT – only resistant cells survive
		(ii)	DNA/gene/plasmid/genetic info. passed from/between/to … cell/bacterium/bacteria … in same generation/without reproduction/in same population/ neighbouring bacteria **OR** DNA/gene/plasmid/genetic information/vector passed by… conjugation/transduction/ transformation (or description) **OR** DNA/gene/plasmid/genetic info. passed from prokaryote to eukaryote	**1**	NOT – DNA/gene/plasmid/genetic info. passed from one bacterium to another alone NOT – term *conjugation* alone
9.	(c)		Eliminates/kills… other/contaminating/unwanted... microorganisms/bacteria **OR** Eliminates competition from… other/unwanted... microorganisms/bacteria **OR** So **only** insulin-producing bacteria can grow	**1**	NOT – contamination alone NOT – answers relating to idea of patient safety **NB**: germs ≠ microorganisms NOT – **Reduces** contamination by other Microorganisms

Question			Expected Answer(s)	Max Mark	Additional Guidance
10.	(a)	(i)	To allow (time) for... respiration/metabolic rate… to be affected by… temperature/conditions/change **OR** To allow crickets (time) to… acclimatise/adjust/respond to/get used to… temperature/condition/change **OR** To allow flask/equipment/crickets (time) to reach the temperature	**1**	Environment / surroundings / situation ≠ flask / conditions NOT – to allow crickets time to adapt NOT – to allow time for (steady rate of) respiration NOT – to acclimatise alone NOT – To allow **it** to adjust to the conditions NOT – to allow environment to reach the temperature
		(ii)	Description: (exactly) the same… set up/experiment… **OR** full description(same size/volume of flask, in water bath and CO_2 sensor) **AND** (With) no crickets/dead crickets/ glass beads **(1)** Explanation: To show it was the crickets that respired/metabolised/ produced the CO_2 **OR** No… CO_2 production/respiration/ metabolism… without live crickets/ with dead crickets/with no crickets/with control **(1)**	**2**	NOT – a flask with no crickets NOT – allow comparison alone NOT – to prove the independent variable is causing the result
	(b)		Axes labelled correctly and scales to fill at least half the grid **(1)** Points plotted correctly and joined with a ruler **(1)**	**2**	Common zero is acceptable 5 boxes = 200 or 5 boxes = 250 are both acceptable scales. Y axis does not have to start at 0 Mark not awarded if line extended to zero from 5°C If axes wrong way around but points plotted correctly, award 1 mark
	(c)		As the temperature increased, the (rate of) metabolism increased	**1**	NOT - rate of… CO_2 production/ respiration alone NOT – As metabolism increases temperature decreases

Question			Expected Answer(s)	Max Mark	Additional Guidance
11.	(a)	(i)	Colchicine concentration	**1**	NOT – colchicine alone NOT – concentration alone
		(ii)	50 plants/seeds **at each concentration**	**1**	NOT – many plants at each concentration NOT – repeated and average calculated NOT – 50 plants used alone NOT – 50 plants and average collected
	(b)	(i)	8	**1**	
		(ii)	3 : 7	**1**	
	(c)		More photosynthesis **(1)** More energy for growth/seed production **(1)**	**2**	
12.	(a)	(i)	(female) mosquito	**1**	NOT – mosquito saliva NOT – male mosquito
		(ii)	Females/they need the **blood** for egg **production** **OR** males don't produce eggs so don't need **blood**	**1**	NOT – females need blood for eggs alone NOT – females need blood to carry eggs
	(b)		(The host is harmed) by losing energy/ nutrients/food **OR** (Host harmed as)parasite feeds off it/ gains nutrients from it	**1**	NOT – host loses resources NOT – destroys liver/red blood cells
	(c)		Method 1: Mosquito… discouraged/stopped from… biting/feeding/fewer people bitten **AND** it cannot spread parasite/disease/ virus/bacteria **OR** Method 2: There are …no/fewer…(parasites to transmit to the human/mosquito **(1)**	**1**	

Question			Expected Answer(s)	Max Mark	Additional Guidance
13	(a)	(i)	110	**1**	
		(ii)	3100	**1**	
		(iii)	325	**1**	
	(b)		Zebra mussel population increased and unionid decreased	**1**	one species must be named order not important NOT − description of 2003 numbers alone
	(c)		Unionid/native population drops (from 140) to zero/killed off/ eliminated	**1**	NOT − Unionid decreases
	(d)		New environment may be free from/ have less/have no… predators **OR** parasite/disease **OR** pathogens **OR** competitors (which would limit its population in its native habitat)	**1**	
	(e)		Number/abundance **AND** frequency of alleles in a population/ gene pool/species	**1**	NOT − ecosystem/community

Question			Expected Answer(s)	Max Mark	Additional Guidance
14.	A	(i)	**Weeds :** 1. Weeds compete with/inhibit (crop) plants **AND** reduce productivity/growth/yield	**1**	**NB:** For full marks to be awarded, candidates must give at least 1 correct point for weeds **AND** at least 1 correct point for pests **AND** at least 1 correct point for diseases.
			2. Annual weeds have... rapid growth/short life cycles/ complete life cycle within a year/ produce many seeds/ produce seeds with long term viability **OR** Perennial weeds have storage organs/vegetative reproduction	**1**	
			Pests : 3. Pests eat/damage… crops/plants/plant parts **AND** reduce productivity/growth/yield	**1**	
			4. Any 2 from nematodes/insects/molluscs	**1**	Not examples eg aphid
			Diseases : 5. Diseases are caused by bacteria/fungi/viruses	**1**	
			6. Diseases are often spread by invertebrates/pests	**1**	
				(Max 4)	

Question			Expected Answer(s)	Max Mark	Additional Guidance
14.	**A**	(ii)	a. Weeds/pests/diseases can be controlled by <u>cultural</u> means **AND** example (ploughing/weeding/ roguing/crop rotation/time of sowing)	**1**	
			b. Selective weed killer/selective herbicide… only kills/affects… certain plant species/broad leaved weed	**1**	NOT – descriptions of herbicides mimicking plant hormones etc.
			c. Systemic weed killer… spreads through(vascular system)/ enters plant **AND** kills (whole) plant/stops regrowth/ regeneration **OR** Systemic pesticide/insecticide… spreads through/enters plant/ in the phloem **AND** kills pest feeding on plant	**1**	systematic negates correct description
			d. Applications of fungicide based on disease forecasts are more effective than treating diseased crop	**1**	
			e. Compensatory mark to be awarded if none of points b /c /d awarded but fungicide, pesticide/ insecticide and herbicide are all named	**1**	
			f. Biological control is use of predator/parasite of pest	**1**	
			g. example of a problem with chemical/biological control ANY **one** from : • toxicity to non pest/target species • persistence in the environment • accumulation/magnification in food chains/food webs • production of resistant populations • predator/parasite/control organism/disease organism becomes… invasive/outcompetes/ preys on/parasitizes other species	**1**	
			h. Integrated pest management combines biological and chemical control **OR** chemical and cultural control **OR** biological and cultural control **OR** biological, cultural and chemical control	**1** **(Max 4)**	NOT – IPM as abbreviation

Question			Expected Answer(s)	Max Mark	Additional Guidance
14.	**B**	(i)	1. Social hierarchy is a rank order/pecking order in a group of animals **OR** dominant/alpha **AND** subordinates/lower rank	**1**	NOT – most important/ strongest
			2. aggression/fighting/conflict/violence reduced	**1**	NOT – **prevents** conflict/aggression/conflict/ violence
			3. ritualistic display/appeasement/ threat/submissive… behaviour **OR** alliances formed to increase social status **OR** descriptive examples	**1**	
			4. ensures… best/successful… genes/characteristics are passed on **OR** guarantees experienced leadership **Max 3 marks from points 1 to 4**	**1**	NOT – ensures genes from dominant are passed on
			5. cooperative hunting is where animals hunt in a group/together **AND one** from increases hunting success **OR** allows larger prey to brought down **OR** more successful than hunting individually	**1**	NOT – being in a larger group means they get more food NOT allows larger prey to be hunted/targeted – must be successful
			6. (subordinate) animals all get **more** food/energy… than **hunting alone**	**1**	
			7. less energy used/lost per individual	**1**	
				(Max 4)	

Question			Expected Answer(s)	Max Mark	Additional Guidance
14.	**B**	(ii)	a. Any 2 examples – bees, wasps, ants, termites	**1**	
			b. Only some members of colony (hive reproduce / are fertile) **OR** Queen **AND** males/drones mate/ reproduce **OR** only queen lays eggs **OR** some/most members of colony are sterile/infertile/do not reproduce **OR** some/most of colony are workers who are sterile	**1**	NOT – some members of colony produce children NOT – only queen reproduces alone NOT – queen gives birth
			c. examples of worker roles ANY **one** from : • raise relatives • defend the hive • collect pollen/nectar/food • waggle dance to show direction of food etc.	**1**	NOT – waggle dance alone
			d. social insects show……. kin selection/altruism between related individuals	**1**	
			e. increases/helps survival of shared genes **OR** so shared genes are passed on to next generation		
			f. Some are **keystone species** which are crucial for (stability of) the ecosystem/ food web/pollination/soil fertility **OR** The removal of **keystone species** can… disrupt/collapse… the ecosystem/food web	**1** **(Max 4)**	NOT – some are keystone species which are crucial for the environment

[END OF MARKING INSTRUCTIONS]