

Markscheme

Specimen paper

Biology

Higher level

Paper 2

20 pages

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The following are the annotations available to use when marking responses.

Annotation	Explanation	Shortcut
	Correct point (automatically awards 1 mark when stamped)	
 	These are annotations which can be used to show which marking point was used to award a mark. It is easier to use these than to pick up the tick stamp and then the text box (they each automatically award 1 mark when stamped)	
	Quality marks awarded for clarity and structure (these each automatically award 1 mark when stamped)	
	Pointer (use when you want to delete an annotation or change colour)	
	Benefit of the doubt	
	Error carried forward	
	Irrelevant, a significant amount of material that does not answer the question	
	Contradiction	
	Omission/incomplete	
	Too vague	
	No working shown	
	Unclear	

Annotation	Explanation	Shortcut
	This is a dynamic annotation; it can be used to surround work	
	This is a dynamic, vertical wavy line that can be expanded (for instance, to highlight a section of irrelevant work)	
	This is a dynamic, horizontal wavy line that can be expanded (for instance, to highlight a section of irrelevant work)	
	Valid part (to be used when more than one element is required to gain the mark eg: drawings)	
	Same as	
	Or words to that effect	
	Advantage / pro (to identify elements in an unclear discussion when pairs are required)	
	Disadvantage / con (to identify elements in an unclear discussion when pairs are required)	
	Difference (to identify elements in an unclear comparison)	
	Similarity (to identify elements in an unclear comparison)	
	Highlight, stamp and drag out to highlight an area of the script	
	Text box used for additional marking comments. It can be linked to a specific tick if that is appropriate	
	Seen; to be stamped on parts of a question or option which have been left blank	
	Zero; to be used when a question part is not worthy of credit. Awards zero for the question part	

You **must** make sure you have looked at all pages. Please put the  annotation on any blank page, to indicate that you have seen it.

General Marking Instructions

Assistant Examiners (AEs) will be contacted by their team leader (TL) through RM™ Assessor, by e-mail or telephone – if through RM™ Assessor or by e-mail, please reply to confirm that you have downloaded the markscheme from IBIS. The purpose of this initial contact is to allow AEs to raise any queries they have regarding the markscheme and its interpretation. AEs should contact their team leader through RM™ Assessor or by e-mail at any time if they have any problems/queries regarding marking. For any queries regarding the use of RM™ Assessor, please contact emarking@ibo.org.

1. Follow the markscheme provided, award only whole marks and mark only in **RED**.
2. Make sure that the question you are about to mark is highlighted in the mark panel on the right-hand side of the screen.
3. Where a mark is awarded, a tick/check (✓) **must** be placed in the text at the **precise point** where it becomes clear that the candidate deserves the mark. **One tick to be shown for each mark awarded.**
4. Sometimes, careful consideration is required to decide whether or not to award a mark. In these cases use RM™ Assessor annotations to support your decision. You are encouraged to write comments where it helps clarity, especially for re-marking purposes. Use a text box for these additional comments. It should be remembered that the script may be returned to the candidate.
5. Personal codes/notations are unacceptable.
6. Where an answer to a part question is worth no marks but the candidate has attempted the part question, use the “ZERO” annotation to award zero marks. Where a candidate has not attempted the part question, use the “SEEN” annotation to show you have looked at the question. RM™ Assessor will apply “NR” once you click complete.
7. If a candidate has attempted more than the required number of questions within a paper or section of a paper, mark all the answers. RM™ Assessor will only award the highest mark or marks in line with the rubric.
8. Ensure that you have viewed **every** page including any additional sheets. Please ensure that you stamp “SEEN” on any additional pages that are blank or where the candidate has crossed out his/her work.
9. Mark positively. Give candidates credit for what they have achieved and for what they have got correct, rather than penalizing them for what they have got wrong. However, a mark should not be awarded where there is contradiction within an answer. Make a comment to this effect using a text box or the “CON” stamp.

Subject Details: Biology HL Paper 2 Markscheme

Candidates are required to answer **all** questions in Section A and **two** out of **three** questions in Section B. Maximum total = **80 marks**.

1. Each row in the “Question” column relates to the smallest subpart of the question.
2. The maximum mark for each question subpart is indicated in the “Total” column.
3. Each marking point in the “Answers” column is shown by means of a semicolon (;) at the end of the marking point.
4. A question subpart may have more marking points than the total allows. This will be indicated by “**max**” written after the mark in the “Total” column. The related rubric, if necessary, will be outlined in the “Notes” column.
5. An alternative word is indicated in the “Answers” column by a slash (/). Either word can be accepted.
6. An alternative answer is indicated in the “Answers” column by “**OR**”. Either answer can be accepted.
7. An alternative markscheme is indicated in the “Answers” column under heading **ALTERNATIVE 1** *etc.* Either alternative can be accepted.
8. Words inside brackets () in the “Answers” column are not necessary to gain the mark.
9. Words that are underlined are essential for the mark.
10. The order of marking points does not have to be as in the “Answers” column, unless stated otherwise in the “Notes” column.
11. If the candidate’s answer has the same “meaning” or can be clearly interpreted as being of equivalent significance, detail and validity as that in the “Answers” column then award the mark. Where this point is considered to be particularly relevant in a question it is emphasized by **OWTTE** (or words to that effect) in the “Notes” column.
12. Remember that many candidates are writing in a second language. Effective communication is more important than grammatical accuracy.
13. Occasionally, a part of a question may require an answer that is required for subsequent marking points. If an error is made in the first marking point then it should be penalized. However, if the incorrect answer is used correctly in subsequent marking points then **follow through** marks should be awarded. When marking, indicate this by adding **ECF** (error carried forward) on the script.
14. Do **not** penalize candidates for errors in units or significant figures, **unless** it is specifically referred to in the “Notes” column.

Section B

Extended response questions – quality mark

- ♦ Extended response questions for HLP2 each carry a mark total of **[16]**. Of these marks, **[15]** are awarded for content and **[1]** for the quality of the answer.
- ♦ **[1]** for quality is to be awarded when:
 - ♦ the candidate's answers are clear enough to be understood without re-reading.
 - ♦ the candidate has answered the question succinctly with little or no repetition or irrelevant material.
- It is important to judge this on the overall answer, taking into account the answers to all parts of the question. Although, the part with the largest number of marks is likely to provide the most evidence.
- ♦ Candidates that score very highly on the content marks need not necessarily automatically gain **[1]** for quality (and *vice versa*).

Section A

Question			Answers	Notes	Total
1.	a		80s	<i>Units required. Accept value in the range 75s – 85s</i>	1
1.	b		a. snakes spend some time/very short time studying the controls/filter paper OR fewer tongue flicks at the controls/filter paper; b. filter paper itself is not a factor in the experimental results;		2
1.	c		so that the snakes were choosing according to scent and not learning by position / OWTTE		1
1.	d		masks the scent of the squirrel / suggests presence of rival snake / OWTTE		1
1.	e		a. both have a high probability of a strike at shorter distances (from each other); b. at greater distances (from each other) low chance of strike on tail flaggers but high on non-tail flaggers;		2

(continued...)

(Question 1 continued)

Question			Answers	Notes	Total
1.	f		14 (cm) Key: ▲ Tail-flagging ♦ Non tail-flagging Probability of strike Distance / cm	Accept range 12 to 16 cm	1
1.	g		a. squirrel is alert, so strike is likely to miss; b. resources/energy wasted so snakes do not strike;		1
1.	h		with chatter AND 3 minutes after hearing hawk sounds		1

(continued...)

(Question 1 continued)

Question			Answers	Notes	Total
1.	i		a. there is no significant difference in the two; b. bars nearly the same height / large overlap of error bars; c. do not know sample size so conclusions may not be reliable (if sample size is small) OR need to perform a suitable statistical test;		2
1.	j		a. the data supports the suggestion that squirrels listen to bird chatter OR reassuring to hear bird chatter because it indicates no imminent threat/hawk has gone away; b. with no chatter the squirrels looked up more often (than with chatter) OR with chatter the squirrels looked up less often (than with no chatter); c. with no chatter the squirrels were more vigilant (than with chatter) OR with chatter the squirrels were less vigilant (than with no chatter); d. the data shows no significance in the response without chatter OR the data only shows a significant difference in the response with chatter OR large error bars mean conclusions may be unreliable;		3

Question			Answers	Notes	Total
2.	a		a. nucleus; b. mitochondria; c. Golgi apparatus; d. ER/rough ER; e. smooth ER; f. vacuole/vesicle;		2
2.	b	i	a. chloroplasts; b. large/central vacuole;		1
2.	b	ii	a. plasma membrane; b. ribosomes;		1
3.	a	i	arrow pointing from inside the cell to the right outside (accept arrow with its entirety in the cell/below the cell)		1
3.	a	ii	gravity/light		1
3.	b	i	the cells would be larger/longer with auxin		1
3.	b	ii	cytokinin		1

Question			Answers	Notes	Total
4.	a		a. concentration in blood is lower than air / blood arriving at alveoli is oxygen poor/deoxygenated; b. oxygen moves into blood by diffusion; c. oxygen concentration in alveolar air lower than in atmospheric air; d. ventilation occurs OR alveolar air replaced by (oxygen rich) atmospheric air; e. flow of blood in capillaries maintains concentration gradient;	Allow converse for CO ₂ for MP a, b and c	3
4.	b		a. rich capillary supply; b. epithelium is one cell thick; c. moist surface; d. large surface area / high surface area to volume ratio;		2
4.	c		a. plasma membrane has microvilli / is highly folded; b. large numbers of mitochondria (to supply energy for active transport); c. many vesicles formed by endocytosis;		2

Question			Answers	Notes	Total
5.	a		ensures a habitat is sustainable for the prey/limits damage to the ecosystem (as a result of overpopulation)/removes genetically weaker individuals/prevents overgrazing/prevents overpopulation		1
5.	b		a. the size of the predator population (influences the prey population); b. resources/food may be limiting; c. transfer of pathogens/pests/disease (influences the prey population);		2
5.	c	i	a. sample captured, marked and released; b. ratio of marked individuals in a second sample determined; c. equals ratio of marked sample to entire population/use Lincoln index;		2
5.	c	ii	a. low levels of immigration/emigration between sampling events; b. distribution/mortality/survival not affected by capture/markings; c. trap avoidance minimal; d. reproduction patterns/rates not affected;		1

Question			Answers	Notes	Total
6.	a		a. pair of sex chromosomes / X and Y chromosomes; b. X and Y sperm produced in equal numbers; c. egg is X and if fertilized by X sperm leads to a female child; d. egg is X and if fertilized by Y sperm leads to a male child;		2
6.	b		a. sex cell normally contains one copy (of chromosome 21); b. (because of nondisjunction) fail to separate properly; c. in first or second meiotic division; d. sex cell contains two copies (of chromosome 21); e. this sex cell (with two copies) fertilizes normal sex cell (with one copy); f. non-disjunction (of chromosome 21) more frequent in females/increases with age;		3
6.	c		a. mostly males affected; b. sons of affected father are unaffected; c. sons of affected mother are affected;		2

Question			Answers	Notes	Total
7.	a		brown body vestigial wings AND black body, normal wings		1
7.	b		a. independent assortment predicts 1:1:1:1 OR this (mendelian) ratio not seen / recombinants less frequent/parental types more frequent; b. suggests linkage OR small numbers so could be a result of differential survival;		2
7.	c		a. calculate expected numbers; b. assume no selective advantage to any of the genotypes; c. calculate chi square value; d. (if tabulated value is exceeded then) significant difference/reject null hypothesis/alleles do not sort independently/alleles linked;		2

Section B

Question			Answers	Notes	Total
8.	a		a. vaccinations are specific to a specific disease; b. vaccines contain non-self antigens/antigens from pathogens; c. can be live relative/attenuated version of the virus; d. trigger a primary immune response (without causing the disease); e. lymphocytes with specific receptors (are activated and) produce memory cells; f. (memory cells) cause a faster production of antibodies on a second exposure/exposure to the disease; g. (memory cells) provide long term immunity;		7
8.	b		a. (during depolarization) Na^+ channels open; b. allowing Na^+ to flow into the axon; c. (during repolarization) K^+ channels open; d. allowing K^+ to flow out of the axon; e. the Na^+/K^+ pump returns the (axon) membrane to the resting potential; f. by moving 3Na^+ out and 2K^+ in;		4

(continued...)

(Question 8 continued)

Question			Answers	Notes	Total
8.	c		a. courtship behaviour is often complex and unique to a species; b. (at several stages in courtship ritual) rejection occurs if characteristic behaviour not exhibited; c. species-specific egg fertilization; d. compatibility of acrosome with vitelline layer; e. inability of successfully attached wrong species sperm to develop continuity with egg membrane; f. sterility of interspecific hybrids; g. due to differences in chromosome number;		4

Question			Answers	Notes	Total																						
9.	a		a. some toxins/DDT are persistent/degrade slowly (once released into the environment); b. (some toxins/DDT) enter the food chain through producers/lower trophic levels; c. (some toxins/DDT) are passed on to higher trophic levels in the food chain; d. (they are) difficult to excrete / are not excreted; e. (they) accumulate in fatty tissues of animals; f. higher trophic levels/top consumers have higher/the highest concentration of pesticides in their bodies; g. they bioaccumulate/biomagnify;		4																						
9.	b		<table><tr><td>Competitive inhibition</td><td>Non-competitive inhibition</td></tr><tr><td colspan="2">Similarities:</td></tr><tr><td colspan="2">slow down enzyme activity;</td></tr><tr><td colspan="2">interact with R chains of amino acids at the surface of enzyme molecule;</td></tr><tr><td colspan="2">Differences:</td></tr><tr><td>inhibitor binds to active site</td><td>does not bind to active site</td></tr><tr><td>inhibitor does not bind to allosteric site;</td><td>inhibitor binds to allosteric site;</td></tr><tr><td>substrate cannot bind due to blockage of active site</td><td>substrate cannot bind due to disruption/change in shape of active site;</td></tr><tr><td>inhibition is reversible</td><td>inhibition is (usually) permanent;</td></tr><tr><td>inhibitor has similar shape to substrate</td><td>inhibitor does not have similar shape to substrate;</td></tr><tr><td>can be reversed by increasing substrate concentration</td><td>adding substrate does not reduce inhibition;</td></tr></table> a valid example of each;	Competitive inhibition	Non-competitive inhibition	Similarities:		slow down enzyme activity;		interact with R chains of amino acids at the surface of enzyme molecule;		Differences:		inhibitor binds to active site	does not bind to active site	inhibitor does not bind to allosteric site;	inhibitor binds to allosteric site;	substrate cannot bind due to blockage of active site	substrate cannot bind due to disruption/change in shape of active site;	inhibition is reversible	inhibition is (usually) permanent;	inhibitor has similar shape to substrate	inhibitor does not have similar shape to substrate;	can be reversed by increasing substrate concentration	adding substrate does not reduce inhibition;	Answers must have at least one similarity for 7 max.	7 max
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(continued...)

(Question 9 continued)

Question			Answers	Notes	Total
9.	c		a. lower rate of <u>aerobic</u> respiration / inhibits <u>aerobic</u> respiration; b. reduced NAD (not oxidised) accumulates; c. fewer/no electrons (from reduced NAD and FADH) to be transported by carriers; d. less/no energy to transfer protons (from matrix to intermembrane space); e. proton gradient cannot be maintained; f. less/no diffusion of protons through ATP synthase; g. ADP is not phosphorylated / less ATP produced / no energy to produce ATP; h. oxygen not binding to protons / accepting electrons / no water formed;		4

Question			Answers	Notes	Total
10.	a		a. affects/damages/causes change in oncogenes/errors in DNA repair; b. UV radiation might alter complementary base pairing/break hydrogen bonds/fuse bases; c. double helix may uncoil; d. strands may separate/break; e. DNA sequence may be altered/DNA bases may re-connect to different bases after separating; f. DNA strand may break into pieces / fragments of DNA may be lost;		4
10.	b		a. DNA base sequence provides information; b. gene expression / genes provides a template for the construction of a protein; c. transcription occurs / mRNA is built using DNA as a template; d. DNA nucleotide structure described/sugar and phosphate and base; e. polymer of nucleotides makes a DNA strand; f. DNA has two anti-parallel strands; g. complementary base pairs/A pairs with T and C with G; h. strands linked by hydrogen bonding between bases; i. double helix shape / helix held by hydrogen bonds;	Accept points in clearly labelled diagram	7
10.	c		a. gene knockout technology is a genetic engineering technique/intentional alteration in the sequence of a gene; b. making a gene inactive; c. using site specific nucleases / CRISPR; d. researcher observes changes in phenotype of organism; e. allows researcher to determine function of the gene; f. entire library of knockout organisms exists; g. made available to researchers;		4