

Markscheme

May 2022

Biology

Standard level

Paper 2

© International Baccalaureate Organization 2022

All rights reserved. No part of this product may be reproduced in any form or by any electronic or mechanical means, including information storage and retrieval systems, without the prior written permission from the IB. Additionally, the license tied with this product prohibits use of any selected files or extracts from this product. Use by third parties, including but not limited to publishers, private teachers, tutoring or study services, preparatory schools, vendors operating curriculum mapping services or teacher resource digital platforms and app developers, whether fee-covered or not, is prohibited and is a criminal offense.

More information on how to request written permission in the form of a license can be obtained from <https://ibo.org/become-an-ib-school/ib-publishing/licensing/applying-for-a-license/>.

© Organisation du Baccalauréat International 2022

Tous droits réservés. Aucune partie de ce produit ne peut être reproduite sous quelque forme ni par quelque moyen que ce soit, électronique ou mécanique, y compris des systèmes de stockage et de récupération d'informations, sans l'autorisation écrite préalable de l'IB. De plus, la licence associée à ce produit interdit toute utilisation de tout fichier ou extrait sélectionné dans ce produit. L'utilisation par des tiers, y compris, sans toutefois s'y limiter, des éditeurs, des professeurs particuliers, des services de tutorat ou d'aide aux études, des établissements de préparation à l'enseignement supérieur, des fournisseurs de services de planification des programmes d'études, des gestionnaires de plateformes pédagogiques en ligne, et des développeurs d'applications, moyennant paiement ou non, est interdite et constitue une infraction pénale.

Pour plus d'informations sur la procédure à suivre pour obtenir une autorisation écrite sous la forme d'une licence, rendez-vous à l'adresse <https://ibo.org/become-an-ib-school/ib-publishing/licensing/applying-for-a-license/>.

© Organización del Bachillerato Internacional, 2022

Todos los derechos reservados. No se podrá reproducir ninguna parte de este producto de ninguna forma ni por ningún medio electrónico o mecánico, incluidos los sistemas de almacenamiento y recuperación de información, sin la previa autorización por escrito del IB. Además, la licencia vinculada a este producto prohíbe el uso de todo archivo o fragmento seleccionado de este producto. El uso por parte de terceros —lo que incluye, a título enunciativo, editoriales, profesores particulares, servicios de apoyo académico o ayuda para el estudio, colegios preparatorios, desarrolladores de aplicaciones y entidades que presten servicios de planificación curricular u ofrezcan recursos para docentes mediante plataformas digitales—, ya sea incluido en tasas o no, está prohibido y constituye un delito.

En este enlace encontrará más información sobre cómo solicitar una autorización por escrito en forma de licencia: <https://ibo.org/become-an-ib-school/ib-publishing/licensing/applying-for-a-license/>.

Subject Details: Biology SL Paper 2 Markscheme

Candidates are required to answer **all** questions in Section A and **one** out of **two** questions in Section B. Maximum total = **50 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.

Section B

Extended response questions - quality of construction

- ♦ Extended response questions for SLP2 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.

Section A

Question			Answers	Notes	Total
1.	a	i	a. blocks synaptic transmission at (cholinergic synapses); b. binds to (acetylcholine) receptors;		1 max
1.	a	ii	230 g;	<i>accept range of 215 – 265. This takes into account the beginning and end of week 7. Unit required</i>	1
1.	a	iii	a. all increased in (cumulative) mass gain up to 5–6 weeks OR all decreased (in cumulative mass gain) after 6 weeks; b. both with neonicotinoids have significantly lower (cumulative) mass than the control colonies (at all periods) OR colonies exposed to high concentration always had the lowest (cumulative) mass gain;	<i>Accept vice versa</i>	2
1.	a	iv	a. less production of honey/wax; b. fewer bees/dispersal of bees/queens; c. bad weather/environmental change/predators/disease/pests;		1 max
1.	b		a. number of populations may/will decrease; b. both treatments decreased very significantly the number of queens; c. low treatment had (almost) the same effect as the high OR even low levels have as toxic/lethal effects as high levels; d. without new queens, new colonies cannot be founded; e. no/less/little reproduction (as only queens lay eggs); f. new colonies are essential to maintain bumblebee populations;		3 max

(continued...)

(Question 1 continued)

Question			Answers	Notes	Total
1.	c	i	<i>B. lucorum</i> ;		1
1.	c	ii	a. low doses caused (slight) decrease in (average) egg lengths in 3 species/most species OR low doses caused a slight increase in 1 species/ <i>B. pascuorum</i> ; b. high doses caused (slightly) lower (average) results in all 4 species (compared to control); c. in only one species/ <i>B. pratorum</i> , the high doses caused larger lengths than the low doses;	<i>Accept any other valid comparison</i>	2 max
1.	d		a. yes, as even low/both doses (of first neonicotinoid) affect the (overall) development of colonies negatively; (<i>From Graph 1</i>) b. yes, as decreased numbers of queens (likely) affect reproductive capabilities; (<i>From Graph 2</i>) c. the second neonicotinoid (likely) had less/little/no effect on the bees as it had little effect on egg size; (<i>From Graph 3</i>)	<i>OWTTE</i>	1 max

Question		Answers	Notes	Total
2.	a	undifferentiated/pluripotent/ability to divide/differentiate into any types of cells/differentiate along different pathways;		1
2.	b	a. correct formula: 1.1cm = 500 μm, 2.7cm = length, $\frac{2.7 \times 500}{1.1} = X\mu\text{m}$; b. correct answer <u>with unit</u> : 1227μm;	<i>Allow answer in range of 1150 μm to 1350 μm.</i>	1 max
2.	c	treatment of Stargardt's disease/leukemia/diabetes/heart disease/Parkinson's disease;	<i>Any other verifiable condition</i>	1
2.	d	a. could improve quality/length of life of the treated person; b. disease could still be passed on to progeny if defective gene/allele in gametes is not replaced/changed;		2

Question			Answers	Notes	Total
3.	a		a. (in both) anaerobic respiration gives a small amount of ATP/2 ATP/energy from glucose; b. anaerobic respiration occurs when there is no oxygen; c. anaerobic respiration in <u>yeast</u> produces ethanol and carbon dioxide/alcoholic fermentation; d. anaerobic respiration in <u>humans</u> (in muscle) produces lactate/lactic acid/lactic acid fermentation; e. both undergo glycolysis;	<i>Do not accept mpd if CO₂ also included</i>	3 max
3.	b	i	a. water has higher boiling/melting point; b. water has a higher specific heat capacity; c. water has a higher latent heat of vaporization; d. differences due to water having many H-bonds/polarity between the molecules while methane has no H-bonds/polarity;		2 max
3.	b	ii	a. methane is a greenhouse gas OR methane causes an increase in temperature of the atmosphere; b. methane is one of the most powerful greenhouse gases / more powerful than CO ₂ ; c. methane has a relatively short lifespan compared to CO ₂ /decomposes to CO ₂ ;	<i>Other verifiable sources</i>	2 max

Question			Answers	Notes	Total
4.	a	i	pineal gland;	"Brain" not sufficient	1
4.	a	ii	lower in night workers OR later increase/phase difference/shift in night workers;	OWTTE	1
4.	a	iii	<i>Time of day:</i> around 18:00 (locally); OR time that is in the range of local standard bed time; <i>Reason:</i> need to re-establish the increase that occurs after 18:00 hours / reestablish circadian rhythm / OWTTE;	OWTTE	1
4.	b		a. the black lines represent proteins; b. forms a 'sandwich'/2 layers; c. there is a clear layer in the centre; d. (the clear layer) is composed of phospholipids; e. reference to both membranes being similar;		3 max

Question		Answers	Notes	Total
5.	a	<p>a. as temperature rises/is higher (than optimal temperature), the enzyme is denatured; b. as the temperature drops the enzyme molecules have less kinetic energy</p> <p>OR</p> <p>fewer successful collisions;</p>	<p><i>OWTTE</i></p> <p><i>OWTTE</i></p>	2
5.	b	<p>a. restriction enzymes/(restriction) endonucleases cut the gene and the bacterial/plasmid/vector DNA in the same/specific restriction sites</p> <p>OR</p> <p>(restriction) endonucleases work by targeting a specific sequence of base pairs in DNA causing both strands of the DNA to break apart;</p> <p>b. (DNA) ligase attaches/inserts the gene to the bacterial/plasmid/vector DNA</p> <p>OR</p> <p>(DNA) ligase joins the vector and gene by fusing their sugar-phosphate backbones together (with a covalent phosphodiester bond);</p> <p>c. correct reference to reverse transcriptase;</p>	<p><i>Accept correct mention of reverse transcriptase</i></p>	2

Section B

Clarity of communication: [1]

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.

Question		Answers	Notes	Total
6.	a	a. translation occurs on ribosomes when proteins/polypeptides are synthesized; b. amino acid sequence of a protein is determined by the mRNA; c. mRNA is determined by the order of bases of DNA/order of bases sequence in a gene; d. codons (of 3 bases) on mRNA correspond to one amino acid in a polypeptide; e. codons are on mRNA and anticodons on tRNA; f. mRNA binds to ribosome/(during initiation) small ribosomal subunit binds to the start of the mRNA sequence; g. tRNA transfers an amino acid to large ribosomal subunit/to the ribosome; h. reference to start or stop codon; i. tRNA moves to the next mRNA codon to continue the process, creating an amino acid chain; j. peptide bond formed between amino acids k. translation/order of amino acids depends on complementary base pairing between codons and anticodons;		5 max

(continued...)

(Question 6 continued)

Question		Answers	Notes	Total															
6.	b	<p>a. alleles clearly labelled for both parents (in a Punnett square or other format);</p> <p>b. correct genotypes for all four possibilities for children;</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td></td> <td></td> <td colspan="2" style="text-align: center;">father</td> </tr> <tr> <td></td> <td></td> <td style="text-align: center;">X^H</td> <td style="text-align: center;">Y</td> </tr> <tr> <td rowspan="2" style="text-align: center;">mother</td> <td style="text-align: center;">X^h</td> <td style="text-align: center;">$X^H X^h$</td> <td style="text-align: center;">$X^h Y$</td> </tr> <tr> <td style="text-align: center;">X^H</td> <td style="text-align: center;">$X^H X^H$</td> <td style="text-align: center;">$X^H Y$</td> </tr> </table> <p>c. phenotypes of the children: the sons would have a 50 % chance of having hemophilia and the daughters would have 0 % chance of having hemophilia/50 % chance of being a carrier;</p>			father				X^H	Y	mother	X^h	$X^H X^h$	$X^h Y$	X^H	$X^H X^H$	$X^H Y$	<p><i>Sex needs to be mentioned for mpc but info can be taken from the Punnett square</i></p>	3
		father																	
		X^H	Y																
mother	X^h	$X^H X^h$	$X^h Y$																
	X^H	$X^H X^H$	$X^H Y$																
6.	c	<p><i>Clotting process:</i></p> <p>a. blood clotting seals cuts in the skin;</p> <p>b. clotting factors are released (from platelets);</p> <p>c. thrombin is activated;</p> <p>d. a cascade reaction occurs (with thrombin);</p> <p>e. (thrombin causes) fibrinogen is converted to fibrin;</p> <p>f. fibrin forms a clot/blocks the cut/prevents blood from being lost;</p> <p><i>Consequences of hemophilia:</i></p> <p>g. if a person does not have enough clotting factors/hemophilia, the clot will not form;</p> <p>h. pathogens can enter the body more easily;</p> <p>i. (in hemophiliacs) blood will be lost from a cut which affects blood pressure/bleeding to death;</p> <p>j. loss of blood affects amount of hemoglobin/O_2 carried around the body;</p> <p>k. reference to lifestyle / menstrual/birth problems</p>	<p><i>e.g surgery, contact sports</i></p>	7 max															

Question		Answers	Notes	Total
7.	a	<p>a. communities are made up of populations of different species;</p> <p>b. plants receive energy from the sun/light;</p> <p>c. convert it to chemical energy through <u>photosynthesis</u>;</p> <p>d. chemical energy is stored in organic/C-compounds;</p> <p>e. the energy is passed to other organisms through feeding / reference to food chain</p> <p>f. respiration (of plants and animals) converts the chemical energy (of C-compounds) to other useful forms of energy;</p> <p>g. eventually the chemical energy is lost as heat energy;</p> <p>h. energy is non-recyclable/lost from a community/ecosystem;</p> <p>i. energy losses between trophic levels limit food chains/mass of top trophic levels/only about 10% of energy is transferred;</p>		5 max
7.	b	<p>a. (natural selection occurs if) there is variation in degree of drought resistance among members of a population/same species;</p> <p>b. variation is caused by mutations (when changes occur in the DNA/nucleic bases/chromosomes);</p> <p>c. variation during meiosis occurs (with separation of chromosomes);</p> <p>d. variation occurs during sexual reproduction (as different alleles combine);</p> <p>e. some variations make some plants more drought-resistant;</p> <p>f. example of variations: deeper roots/more storage tissue for water/thicker cuticles/less opening of stomata/other verifiable variations;</p> <p>g. these variations let some survive and reproduce better/have more offspring</p> <p>OR</p> <p>(these variations) confer selective advantage;</p> <p>h. these variations/characteristics are passed onto offspring which survive better;</p> <p>i. natural selection increases the frequency of these characteristics;</p> <p>j. eventually leads to changes/evolution in the species / more drought-resistant plants;</p>		7 max

(continued...)

(Question 7 continued)

Question		Answers	Notes	Total
7.	c	<p><i>Benefits:</i></p> <ul style="list-style-type: none"> a. increase crop growth/food productivity; b. with limited water/ less water is used; c. increase amount of land available for food production in dry areas; <p><i>Risks:</i></p> <ul style="list-style-type: none"> d. these plants may out-compete other species in the community/may cause extinction of some species/affect the food chains in the community; e. the modified gene/recombinant DNA may pass to other organisms; f. more grain requires more nutrients from the soil so its quality may diminish/monoculture issues; g. GMO may have health effects in consumers / OWTTE; 	<p><i>Must include at least one benefit and one risk for [3 max]</i></p>	<p>3 max</p>
