



Markscheme

November 2022

Biology

Higher level

Paper 2

17 pages

© 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 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 = **72 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	positive correlation/the greater the BCH the greater the brain mass;	<i>No mark for 'positive relationship' or for directly proportional</i>	1
	b	a. high BCH but brain mass is low/lower than expected/lower than others with similar BCH; b. (fairly) low brain mass but BCH is high/higher than expected/higher than others with similar brain mass;		1 max
	c	easier to measure/doesn't require dissection/non-invasive / shrew not harmed/killed/more ethical;	<i>The mark can awarded for one of these reasons even if it not the first reason given in the answer.</i>	1
	d	Summer;		1

Question		Answers	Notes	Total
1.	e	<p><i>Compare part of answer = similarity:</i> a. both have low BCH (compared with summer);</p> <p><i>Contrast part of answer:</i> b. greater body mass in spring than winter; OR overall/mean/average BCH higher in spring than in winter; OR more variation <u>in body mass</u> in spring than winter;</p>	<p><i>For the second alternative in mpb, the answer must not state simply that BCH is higher in spring as there is much overlap. Do not accept quoted figures without the similarity or difference being stated.</i></p>	2
	f	<p>a. large brain (indicated by large BCH) requires/uses much energy; b. shrews need/use much energy in winter (other than for the brain); c. much energy used in winter for keeping warm/searching for food; d. food/energy more abundant in summer/less abundant in winter; e. growth between winter and summer (so BCH larger in summer);</p>	<p><i>Do not accept hibernation/lower metabolic rate/lower body temperature/lower activity levels/less food eaten in winter. Do not accept answers about body mass.</i></p>	1 max
	g	<p><u>resting in spring;</u></p>		1
	h	<p>a. more food/energy eaten/required in winter/cold; b. food needed to maintain temperature/stay warm/generate heat; c. more loss of body heat in cold conditions; d. more energy used hunting for food; e. food less available in winter/harder to find enough food;</p>		2 max

Question			Answers	Notes	Total
1.	i		4(%)		1
	j		compensates for the different distances between entrances and food/OWTTE; OR to enable (fair/valid) comparison/OWTTE;	<i>Do not accept unspecific answers such as 'to be consistent'</i>	1
	k		<p><i>Similarity between 2 and 9:</i> a. winter path length longer (than spring and summer) in both (trials 2 and 9/from entrances B and C);</p> <p><i>Contrast between 2 and 9:</i> b. path length longer in trial 2 than 9/from entrance B than entrance C (in all seasons);</p> <p>OR error/bar/standard deviation/variation in data greater in trial 2 than 9/from entrance B than entrance C (in all seasons);</p>		2

1.	I	a. in winter shrews have smaller brains/smaller BCH / converse for summer; b. lower/poorer memory/thinking/cognitive skills/learning/intelligence/senses/sense of smell/ability to find food in winter/ converse for summer;		2
----	---	--	--	---

Question		Answers	Notes	Total
2.	a	prophase <u>1</u> / first prophase;		1
	b	a. gene linkage/genes located on the same chromosome; b. independent assortment does not occur; c. no recombination unless there is crossing over (between the genes);	<i>Reject sex-linkage</i>	2 max

Question		Answers	Notes	Total
3.	a	<i>(Evidence does not support this argument because:)</i> a. overall increase in surface temperature but no overall increase/slight decrease in solar irradiance; b. peaks and troughs in solar irradiance do not correspond with fluctuations in surface temperature;	<i>Do not award marks for claims that the evidence supports the argument, for example claims that the fluctuations coincide</i>	2
	b	a. carbon dioxide absorbs/traps long wavelength/infra-red radiation; b. <u>more heat</u> trapped in/ <u>less heat</u> escapes from atmosphere with more carbon dioxide; c. short wave/UV radiation from the sun passes through the atmosphere/reaches the Earth's surface; d. radiation from the sun/sunlight warms the (surface of the) Earth; e. long wavelength/infra-red radiated from the (warmed) Earth's surface;	<i>Do not accept answers relating to ozone in the atmosphere because the question refers to carbon dioxide. For mpa do not accept heat instead of LW/IR radiation.</i>	3 max
	c	methane/nitrous oxide/water vapour/ozone/CFCs/other halogenated gases;		1

Question		Answers	Notes	Total
4.	a	histone;		1
	b	a. (nucleosomes can) promote AND inhibit transcription of genes/expression of genes; b. (nucleosomes can) prevent transcription by (tight) condensation/supercoiling/packing of DNA; c. (nucleosomes can) allow/prevent binding of RNA polymerase/transcription factors; d. tagging/acetylation/methylation of nucleosomes/histones can promote/inhibit transcription; e. movement of histones/nucleosomes (along DNA) can affect which genes are transcribed;	<i>'Affects transcription' is in the question – no mark</i>	1 max
	c	i	<u>RNA polymerase</u> ;	1
	c	ii	promoter;	1
	d	a. lactose binds to <u>repressor</u> protein; b. repressor protein (with lactose bound) cannot block/bind to the <u>promoter</u> / <u>Y</u> ; c. <u>RNA polymerase</u> / <u>X</u> binds to the promotor/transcribes the gene; d. <u>lactase</u> produced (if lactose present)/ <u>lactase</u> production inhibited if lactose absent;	<i>Accept the converse of mpa to mpd with lactose absent</i>	3 max
	e	(different) environment/illness/disease/diet;	<i>Not mutation</i>	1

Question			Answers	Notes	Total
5.	a	i	<u>proximal</u> convoluted tubule/PCT;		1
	a	ii	glomerulus/Bowman's capsule;		1
	b		medulla;		1
	c		a. ADH secreted if blood is hypertonic/solute concentration too high/water content too low/dehydrated; b. aquaporins open/more aquaporins in (plasma membranes of cells in DCT/collecting duct) with ADH; c. DCT/collecting duct becomes more permeable to water/reabsorbs more water (from filtrate);		2 max
	d		<i>Mark the first two answers only</i> (thick) wax layer/cuticle; hairs on leaves/rolled leaves; sunken stomata/stomata in pits/stomata opening at night/CAM physiology; (leaves reduced to) spines/needles/no/few/small leaves/low surface area (to volume ratio) of leaves; thick stems/water storage tissue/vertical stems (to avoid most intense sunlight);		2 max

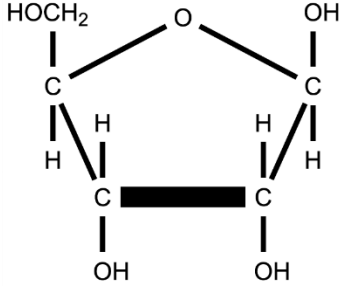
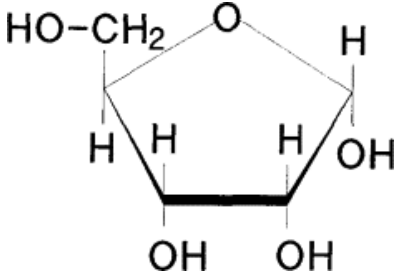
Section B

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. growth/increase in cell size; b. division of mitochondria/chloroplasts/production of more organelles/number of organelles doubled; c. replication of DNA/amount of DNA is doubled; d. transcription of genes/production of mRNA; e. protein synthesis; f. cell respiration/production of ATP;	<i>Allow organelles 'replicated' for mpb</i>	4 max
	b	a. sodium <u>ions/Na⁺</u> enter/diffuse in; b. depolarization/membrane potential/voltage changes from negative to positive; c. potassium channels open AND potassium ions/K ⁺ exit/diffuse out; d. repolarization/membrane potential/voltage changes back from positive to negative; e. local current due to diffusion of sodium ions along the neuron; f. (local currents) cause next sodium channels to open/next part of axon to depolarize; g. opening of sodium channels triggered when threshold potential/-50mV reached;	<i>Do not award mpa for sodium being pumped in (rather than diffusing). Allow mpc with ECF if direction of both sodium and potassium is wrong, or if both movements are described as pumping.</i>	4 max

Question		Answers	Notes	Total
6.	c	<p>a. (specific immune response is) production of antibodies in response to a particular pathogen;</p> <p>b. antibody is specific to/binds to a specific <u>antigen</u>;</p> <p>c. macrophages/phagocytes engulf/present antigens from pathogens/viruses/bacteria;</p> <p>d. T lymphocytes activated by antigens/antigen presentation/antigens presented by macrophage;</p> <p>e. (activated) T lymphocytes activate B lymphocytes;</p> <p>f. only B lymphocytes that produce antibodies against the antigen/pathogen are activated;</p> <p>g. (activated) B lymphocytes clone/divide by mitosis to form <u>plasma cells</u>;</p> <p>h. plasma cells then secrete (large quantity) of an antibody/secrete antibodies of same type;</p> <p>i. some B lymphocytes/plasma cells form memory cells;</p> <p>j. memory cells give long lasting immunity/faster response to a disease/pathogen;</p>	<p><i>Accept B and T cells instead of B and T lymphocytes</i></p>	<p>7 max</p>

Question	Answers	Notes	Total
<p>7. a</p>	<p>a. ring with four carbons and one oxygen atom; b. CH₂OH attached to C4; c. OH and H attached by single bonds to C1, C2 and C3 with OH facing downwards on C2 and C3;</p> <div style="display: flex; justify-content: space-around; align-items: center;">   </div>	<p><i>Numbering of carbons not required for mpa.</i></p> <p><i>Carbons in the ring can be shown as a junction of single bonds without the letter C, but oxygen must be shown as O.</i></p> <p><i>For mpc OH can face up or down.</i></p>	<p>3</p>
<p>b</p>	<p>a. light (energy) absorbed by pigments/chlorophyll/photosystems; b. excited electrons passed to electron carriers/electron transport chain; c. protons/hydrogen ions pumped into thylakoid (space); d. proton gradient/high proton concentration generated; e. protons pass via ATP synthase to the stroma; f. ATP synthase phosphorylates ADP/ATP synthase converts ADP to ATP; g. photophosphorylation/chemiosmosis; h. ATP synthase/electron carriers/proton pumps/photosystems/pigment are in the thylakoid membrane;</p>		<p>5 max</p>

Question		Answers	Notes	Total
7.	c	a. translocation/movement by mass flow; b. in <u>phloem sieve tubes</u> ; c. sieve plates/pores in end walls/lack of organelles allows flow (of sap); d. carbohydrates (principally) transported as sucrose; e. (sucrose/glucose/sugar/carbohydrate) loaded (into phloem) by active transport; f. loading/pumping in (of sugars) by companion cells; g. high solute concentration generated (at the source); h. water enters by osmosis (due to the high solute concentration); i. hydrostatic pressure increased/high hydrostatic pressure generated; j. pressure gradient causes flow (from source to sink); k. leaves are a source because carbohydrates are made there; l. transport to the sink where carbohydrates are used/stored;		7 max

Question		Answers	Notes	Total
8.	a	<p>a. diversification/ different species produced from a common/shared ancestor;</p> <p>b. homologous features have similarities of structure</p> <p>c. despite different functions;</p> <p>d. (different) adaptation to different environments/different selective pressures;</p> <p>e. pentadactyl limbs/Darwin's finches/other example of adaptive radiation described correctly;</p>	<p><i>Allow any of the marking points with reference to a named example e.g. Darwin's finches or pentadactyl limb</i></p>	3 max
	b	<p>a. polyploidy is having more than two (complete) sets of chromosomes/3n/4n/other specific example of polyploidy;</p> <p>b. can be due to errors in meiosis/production of diploid gametes;</p> <p>c. can be due to DNA replication without mitosis/cytokinesis;</p> <p>d. polyploidy causes reproductive isolation;</p> <p>e. diploids crossed with tetraploids produce infertile (triploid) offspring / triploid offspring are infertile;</p> <p>f. tetraploids are therefore a new species/failure to interbreed/reproductive isolation leads to speciation;</p> <p>g. (many) examples in the onion family/<i>Allium</i>/other valid example of speciation by polyploidy;</p> <p>h. infertile interspecific hybrids can become fertile by becoming polyploid;</p>	<p><i>Reject non-disjunction as a cause of polyploidy as it usually applies to a single bivalent</i></p>	5 max

Question		Answers	Notes	Total
8.	c	<p>Naming:</p> <p>a. binomial nomenclature/(plant is) given a binomial/double name;</p> <p>b. first name is the genus and second name is the species/genus initial upper case and species lower case;</p> <p>c. names (of plant species) are international/are universally understood/are published in journals;</p> <p>Classification:</p> <p>d. study the characteristics/structure/reproduction/chemical properties/DNA (of the plant);</p> <p>e. put/classify (the plant) in a group/genus with other similar species;</p> <p>f. natural classification corresponds with evolution/natural classification is based on many features</p> <p>g. analogous features/features due to convergent evolution should not be used;</p> <p>h. hierarchy of groups/taxa (in traditional classification/3 or more taxa in correct sequence (kingdom-phylum-class);</p> <p>i. two or more of bryophyta, filicinophyta, coniferophyta and angiospermophyta named;</p> <p>j. a clade is a group of organisms evolved from a common ancestor;</p> <p>k. base sequences/amino acid sequences used to group organisms into clades/deduce evolutionary relationships;</p> <p>l. cladograms show the relationships between clades/likely evolutionary divergence of clades;</p> <p>m. each branch point/node represents where species are formed via divergent evolution;</p> <p>n. species are now classified into a sequence of clades (rather than a rigid hierarchy of taxa);</p>	<p><i>For mpi, common names such as 'mosses' are acceptable.</i></p>	<p>7 max</p>