M11/4/BIOLO/HP3/ENG/TZ1/XX/M

International Baccalaureate®
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MARKSCHEME

May 2011

BIOLOGY

Higher Level

Paper 3

12 pages

General Marking Instructions

Subject Details: Biology HL Paper 3 Markscheme

Mark Allocation

Candidates are required to answer questions from **TWO** of the Options **[2 × 20 marks]**.
Maximum total = **[40 marks]**

1. A markscheme often has more marking points than the total allows. This is intentional. Do **not** award more than the maximum marks allowed for part of a question.

2. Each marking point has a separate line and the end is signified by means of a semicolon (;).

3. An alternative answer or wording is indicated in the markscheme by a slash (/). Either wording can be accepted.

4. Words in brackets ( ) in the markscheme are not necessary to gain the mark.

5. Words that are underlined are essential for the mark.

6. The order of marking points does not have to be as in the markscheme, unless stated otherwise.

7. 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 markscheme then award the mark. Where this point is considered to be particularly relevant in a question it is emphasized by writing ***OWTTE*** (or words to that effect).

8. 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.

9. Only consider units at the end of a calculation.

Option D — Evolution

D1. (a) *Highest probability*: 0.58 *(Allow answers from 0.57–0.59)*
Lowest probability: 0.25 *(Allow answers from 0.24–0.26)* ***[1]***
Both required for the mark.

(b) different varieties from same lake / I ***[1]***

(c) individuals are more likely to breed if they are the same variety / individuals of different varieties have a low probability of breeding;
the probability of breeding between individuals of the same variety shows a large range of values / narrow range if of different variety;
the probability of breeding between any two individuals is always less than 0.6/correct numerical value; ***[2 max]***

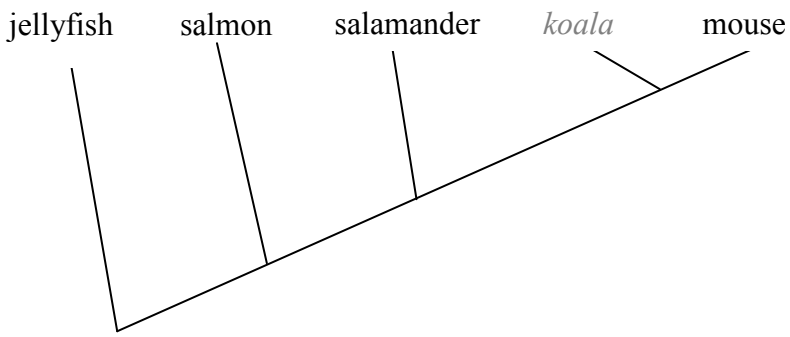
(d) data provides (strong) evidence for reproductive isolation between the varieties in each lake;
different sizes/feeding habits/habitat (shore versus open water) seem to contribute (strongly) to low breeding probability;
this could lead to speciation/formation of separate species in each lake;
same varieties from different lakes do not show strong reproductive isolation / geographical isolation is a weak factor in speciation / no evidence of allopatric speciation;
sympatric speciation seems to be taking place because different varieties from the same lake have a low probability of breeding; ***[3 max]***

D2. (a) a group of related organisms sharing a common ancestor / a group of organisms containing an ancestor and all of its descendants / *OWTTE* ***[1]***

(b) homologous structures evolved from a common ancestor while analogous structures did not;
example of homologous and example of analogous; *(both needed)* ***[2]***

e.g. an example of homologous is pentadactyl limb in mammals and birds / mouth parts in house fly and mosquito/other valid example and an example of analogous is eye in vertebrates and squid/octopus / wings of insect and bat / jointed legs of vertebrates and insects/other valid example

(c) *Two correct labels for* ***[1]****.*



[2 max]

(d) opposable thumbs (enable grabbing);
flat fingernails (instead of claws/for scratching);
forward-facing eyes for stereoscopic vision;
rotatable shoulder joints (for tree-climbing adaptation);
skull modified for upright posture;
large brain to body/skull ratio enables higher levels of thinking; ***[2 max]***

D3. eukaryotes evolved from prokaryotes;
mitochondria/chloroplasts evolved from (independent) prokaryotic cells;
taken in by larger (heterotrophic) cell by endocytosis;
theory supported by characteristics of chloroplasts/mitochondria;

[2 max] *for mitochondria/chloroplast characteristics:*
mitochondria/chloroplasts have naked DNA;
mitochondria/chloroplasts divide/carry out fission;
mitochondria/chloroplasts have 70S ribosomes / synthezise own proteins;
mitochondria/chloroplasts have double membranes;
cristae similar to mesosomes / thylakoid have similar structures in prokaryotes;

but theory cannot be falsified as it predicts something occurring in the past;
theory does not explain the origins of cilia/flagella/linear chromosomes/meiosis;
weaker evidence that cilia/flagella evolved from attached bacteria/spirochetes; ***[6 max]***

Option E — Neurobiology and behaviour

E1. (a) in flight ***[1]***

(b) $\frac{1}{4} \times \frac{1}{6} \times 100$;
4.2 (%); *(Allow answers from 4% to 4.2%)* ***[1 max]***

(c) (alloparenting is) an altruistic behaviour;
which gives chicks greater chances of survival;
other birds look after chicks while parents resting/feeding/looking for food; ***[2 max]***

(d) birds need to rest/sleep to recover energy/digest food / are inactive at night;
moulting makes them flightless;
defending territory / protection of young / other example of social behaviour; ***[1 max]***

(e) innate behaviour develops independently of the environmental context/ genetically determined, while learned behaviour develops as a result of experience ***[1]***

E2. (a) stimulus is a change in the (internal/external) environment that can be detected ***[1]***

(b) (i) *medulla oblongata*: controls autonomic functions of the body such as heart rate/blood pressure/ventilation/swallowing/vomiting/digestion/cranial reflexes ***[1]***

(ii) *hypothalamus*: links nervous and endocrine systems / produces hormones secreted by posterior pituitary / controls hormonal secretion by pituitary / maintains homeostasis such as control of body temperature/hunger/thirst/fatigue/circadian cycles ***[1]***

(c) psychoactive drugs may increase or decrease transmission (to the post-synaptic membrane);
may increase the release/delay the breakdown/interfere with storage/uptake/reabsorption of neurotransmitters;
may mimic the action of neurotransmitters;
inhibitory drugs may reduce the effect of excitatory neurotransmitters / increase the effect/release of inhibitory neurotransmitters;
inhibitory drugs can hyperpolarize the post-synaptic neuron; ***[3 max]***

(d) endorphins released by pituitary gland (during stress, injury or exercise);
endorphins block transmission of impulses at synapses involved in pain perception;
bind to receptors in the membrane neurons (involved in) sending pain signal;
block release of neurotransmitters; ***[2 max]***

E3. eardrum moved by sound waves;
eardrum/tympanic membrane causes movement of the malleus/bones of the middle ear/ossicles;
bones of the middle ear/malleus, incus and stapes/hammer, anvil and stirrup amplify/magnify movement;
bones of the middle ear/stapes push on the oval window;
causing movement of fluid/vibration within the cochlea/inner ear;
hair cells are mechanoreceptors;
which release a chemical neurotransmitter when stimulated;
sounds/vibrations are transformed into nerve impulses/action potentials;
carried by auditory nerve to brain;
round window releases pressure so fluid in cochlea can vibrate; ***[6 max]***

Option F — Microbes and biotechnology

F1. (a) 97 (%) *(Allow values from 96.8% to 97%)* ***[1]***

(b) *Aspergillus flavus* has less protease activity;
A. flavus produces more tyrosine equivalents;
A. flavus produces more nitrogen;
A. flavus produces higher glucose concentration; ***[2 max]***
Accept the converse of any of the above points.

(c) will have a sweeter taste (than soy produced with *A. oryzae*) because it has more glucose;
has an acceptable taste;
no toxicity important otherwise not sold;
locally occurring fungus may have ecological/economical advantage over imported soy sauce;
more dissolved nitrogen might be dangerous/long-term effects not known;
aged will be a little less sweet / have more protease activity than the filtered; ***[3 max]***

F2. (a) can be Gram-positive or Gram-negative;
Gram-negative have a thinner wall/less peptidoglycan/*converse*;
Gram-negative have an outer layer of lipopolysaccharide and protein; ***[2 max]***

(b) *Rhizobium*: converts atmospheric nitrogen to ammonia / nitrogen fixation;
Nitrobacter: oxidizes nitrite into nitrate / nitrification; ***[2]***

(c) obtains energy from chemical reactions/by oxidizing inorganic chemicals (to generate ATP);
produces organic compounds from inorganic compounds/carbon dioxide; ***[2]***

(d) bacteria remove contaminants from the environment;
by using them as energy sources;
(or) by converting them to a soluble/ harmless form;
example of bioremediation (*e.g. Pseudomonas* is used to clean up oil spills); ***[2 max]***

F3. prions are infective agents / theoretical unit of infection;
a form of protein;
is responsible for neurodegeneration/degeneration of the brain structure;
believed to cause BSE/mad cow disease/Creutzfeldt-Jakob disease/CJD/scrapie/kuru;
transmission did not fit any conventional theory;
(normal) proteins /PrP^{C} refold abnormally;
refolded proteins/PrP^{Sc}/prion proteins cause other (normal) proteins to refold abnormally;
an exponential rise in number of cases is not occurring (for most of these diseases) / sporadic outbreaks not explained / similar idea;
BSE/bovine spongiform encephalopathy used as an excuse for protectionism; ***[6 max]***

Option G — Ecology and conservation

G1. (a) 166 mg m^{-2} *(Allow answers in the range of 162–168 mg m^{-2})* ***[1]***

(b) rapid rise and fall between April and August;
peak in May/June;
fluctuates between August/September and December;
low December/January until February/March;
cyclical; ***[2 max]***

(c) negative relationship / during period of defoliation, biomass/amount (of terrestrial invertebrates) is at its lowest;
less leaves means less food/habitats / easier for predators to see invertebrates;
defoliation occurs in winter/autumn and the cold may kill invertebrates; ***[2 max]***

(d) (aquatic invertebrate flux) decreases because movement to the forest has occurred (by adult forms) / fewer aquatic invertebrates left in the stream so fewer are moving;
fluctuation due to movement of different species/different life cycles/second generation;
decreases because invertebrates left at the beginning of winter/cold season;
(adult forms) move to utilize (changes in) food supply in forest; ***[2 max]***

(e) increased/alternative food source for (forest) organisms/forest birds;
decreased food supply for aquatic organisms;
can cause changes in the food webs/pyramids of energy; ***[1 max]***

G2. (a) (i) tundra ***[1]***

(ii) absence of tall trees/tall plants;
lichens/mosses/sedges/small grasses/annuals;
short growing/flowering season; ***[1 max]***

(b) edge effect is the contrast between different environments/from central area of reserve;
small reserves have more edge effect;
as fragmentation increases so does edge (effect);
example of edge effect (*e.g.* cowbirds that lay eggs in edge will increase); ***[2 max]***

(c) example of invasive species;
example of biological control; ***[2]***

e.g.
to control the cottony cushion scale (*Icerya purchasi*) (a pest that was devastating the California citrus industry in the late 1800s);
the vedalia beetle/a predatory insect (*Rodolia cardinalis)* was introduced (from Australia);

G3. r-strategy occurs in unstable environment/ where there are ecological disruptions;
resources used to maximize reproducing (once);
for example in coastal rock pools / other example;
pathogens/pest species have r-strategies / other example of r-strategy organism;
in stable/predictable environments K-strategy predominates;
more resources are invested for long-term survival;
for example in forests / other example;
trees / humans / whales / other example of K-strategy organism;
difficult to determine strategy / r- and K-strategies represent two extremes in a range of strategies; ***[6 max]***

Option H — Further human physiology

H1. (a) $0.13\,(\text{pH}\,\text{min}^{-1})$ *(Allow values between 0.125 and 0.135)* ***[1]***

(b) (DIDS) reduces the rate of decrease of (extracellular) pH;
rate of decrease reduced less than control cells / some SCL26A9 are not inhibited;
[1 max]

(c) (hypothesis supported as) SCL26A9 in excess means more transport of ions;
(hypothesis supported as) when inhibited there is less transport of ions (needed to maintain neutral pH); ***[2]***

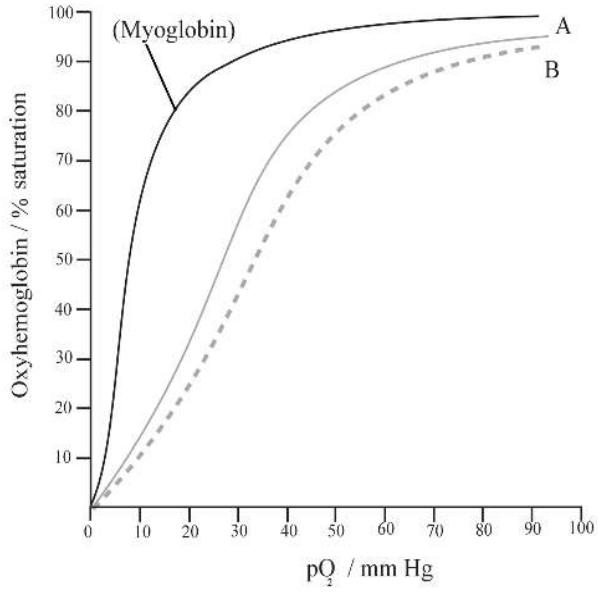
(d) host cells increase transcription/ protein synthesis to make more carriers ***[1]***

(e) pH will fall;
SLC26A9 transports less chloride/hydrogen carbonate ions; ***[2]***

H2. (a) atheroma/fatty deposits in arteries;
hardening of arteries/atherosclerosis/arteriosclerosis;
rough surface causes rupture of platelets;
clots form in coronary artery; ***[2 max]***

(b) (i) increase in CO_2 concentration;
decrease in pH; ***[1 max]***

(ii) graph drawn to left of A;
curve not sigmoid; ***[2]***
As shown below.



(c) hemoglobin absorbed by phagocytes/Kupffer cells;
split into heme and globins;
globin hydrolysed/broken down to amino acids;
iron removed from heme group / heme broken down to form bilirubin/bile pigment; ***[2 max]***

H3. ADH secreted by hypothalamus;
by neurosecretory cells;
transport of ADH to posterior pituitary for storage;
through axon;
osmoreceptor cells monitor concentration of blood plasma;
if blood plasma too concentrated, ADH released;
kidney produces a small volume of hypertonic urine / reabsorption of water in collecting ducts;
if plasma too dilute, ADH level of blood drops;
kidney produces a large volume of hypotonic urine / little water reabsorbed from collecting ducts;
controlled by negative feedback; ***[6 max]***