M12/4/BIOLO/HP3/ENG/TZ1/XX/M

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MARKSCHEME

May 2012

BIOLOGY

Higher Level

Paper 3

16 pages

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General Marking Instructions

Assistant Examiners (AEs) will be contacted by their team leader (TL) through Scoris™, by e-mail or telephone – if through Scoris™ 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 Scoris™ or by e-mail at any time if they have any problems/queries regarding marking. For any queries regarding the use of Scoris™, please contact emarking@ibo.org.

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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 Scoris™ 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, enter a zero in the mark panel on the right-hand side of the screen. Where an answer to a part question is worth no marks because the candidate has not attempted the part question, enter an "NR" in the mark panel on the right-hand side of the screen.

7. If a candidate has attempted more than the required number of options within a paper or section of a paper, mark all the answers. Scoris™ 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 sheet that contains no other annotation.

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 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.

2. Each marking point has a separate line and the end is shown 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 ***OWTTE*** (or words to that effect).

8. Remember that many candidates are writing in a second language. Effective communication is more important than grammatical accuracy.

9. 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.

10. Do **not** penalize candidates for errors in units or significant figures, **unless** it is specifically referred to in the markscheme.

Option D — Evolution

D1. (a) 1972 ***[1]***

(b) 32 *(units not required) (Allow answers in the range 31–33)* ***[1]***

(c) (i) *Award **[2 max]** if at least 1 similarity and 1 difference not given.*

Similarities:
a. in all species, melanics show a decline / non-melanics an increase in frequency;
b. up to 1987 percentage of melanics stable/slight decline for all three species;

*Differences: Both parts of comparision required for **[1]**.*
c. after 1987 percentage of *B. betularia* melanics declines sharply whereas percentage for the other species declines slowly;
d. at start of investigation/1969/up to 1987 (very) few (less than 10 %) non-melanic forms of *B. betularia* whereas the percentage much higher (more than 20 %) for the other two species / converse;
e. melanic forms of *B. betularia* and *O. bidentata* drop below 50% (by 1996) but *A. crenata* does not; ***[3 max]***

(ii) a. change from polluted (industrial) environment to clean (post-industrial);
b. change in tree species allowing different habitats for resting moths;
c. change in predators as climate/habitats change;
d. changing selection pressures/mutation/migration/genetic drift;
e. grass grows quickly/colour not influenced by pollution so least change in/less selection pressure on *A. crenata*; ***[2 max]***

D2. (a) a. (the first) self-replicating material/genetic material;
b. (the first) catalyst/enzyme; ***[1 max]***

(b) (i) a. correct working (evidence of using $p^2+2pq+q^2=1$);
b. frequency of dominant phenotype / phenotype A is 99 %/0.99;
c. frequency of recessive phenotype / phenotype a is 1 %/0.01; ***[3]***
Do not award marking points b and c if only genotypes (AA, Aa and aa) are given. Answer must refer to phenotypes.

(ii) a. no natural selection / no allele specific mortality;
b. random mating;
c. large population;
d. no mutation;
e. no immigration/emigration/migration;
f. constant allele frequency over time; ***[1 max]***

(c)

	Analogous structures	***Homologous structures***
a.	same function	(same or) different function;
b.	differ in (fundamental) structure	similar in (fundamental) structure;
c.	not common ancestry/convergent evolution	common ancestry/divergent evolution;

[2 max]

D3. a. both genetic and cultural evolution allow humans to adapt to environmental change;
b. cultural evolution more rapid than genetic evolution;
c. cultural evolution can pass between non-related individuals but genetic evolution is only passed through inheritance;
d. genetic evolution involves changes in gene frequencies;
e. cultural evolution involves learning/ largely acquired/not innate/not instinct;
f. unit of cultural evolution is word / gesture / image / language / tool / meme;
g. genetic evolution is subject to natural selection;
h. example of cultural evolution (*e.g.* agriculture/language/ customs/art /technology other);
i. example of genetic evolution still occurring (through changes in allele frequency) *e.g.* sickle-cell anemia / resistance to malaria / HIV resistance / other example;
j. cultural evolution hastened by modern technology / modern biotechnology has potential to hasten genetic evolution; ***[6 max]***

Option E — Neurobiology and behaviour

E1. (a) 31 cm *(units required) (Allow answers in the range 30.8 cm –31.2 cm)* ***[1]***

(b) direct/positive correlation / higher birth weight babies have larger head circumference ***[1]***
Do not accept directly proportional.

(c) a. head circumference decreases in babies exposed to high levels of cocaine;
b. low cocaine exposure has slightly/consistently lower head circumference than no cocaine at all birth weights;
c. effect of cocaine exposure on head circumference decreases as the birth weight increases (or converse);
d. smallest head circumference from high cocaine group / largest head circumference from no cocaine group; ***[2 max]***

(d) a. causes smaller head circumference;
b. at both low and high level of use / high cocaine has a greater effect/converse;
c. there is no proof that there is a cause and effect, just a correlation/there might be other variables influencing this relationship; ***[2 max]***

E2. (a) innate behaviour is independent of experience/environmental conditions/inherited while learned behaviour is influenced by experience/environment / *OWTTE* ***[1]***

(b) cerebellum ***[1]***

(c) I eardrum / tympanic membrane
II cochlea
III auditory/vestibulocochlear nerve
IV semicircular canals ***[2 max]***
*Award **[1]** for every two correct.*

(d)

	sympathetic	***parasympathetic***
a.	both are divisions of the autonomic nervous system (ANS) (regulating internal environment);	
b.	have antagonistic effects;	
c.	secretes (nor)adrenaline/(nor)epinephrine	secretes acetylcholine;
d.	accelerates heart rate	slows down heart rate;
e.	causes widening (dilation) of the pupils	causes narrowing of pupils (constriction);
f.	in gut/stomach/pancreas/intestines/ salivary glands inhibits activity / constricts blood flow (to arterioles)	(in gut/stomach/pancreas/intestines/ salivary glands) stimulates activity / maintains normal blood flow (to arterioles);
g.	relaxes/opens/dilates bronchi	constricts bronchi;
h.	inhibits emptying of bladder	promotes emptying of bladder;

[4 max]

E3. a. bees live/interact together in a group/community (consists of 20 000–80 000 individuals);
b. bees are organized in a caste system / division of labour *(do not accept hierarchy)*;
c. queen, drone and worker;
d. queen/fertile female lays eggs/reproduces;
e. chemical communication/pheromones produced by queen;
f. few larvae are fed on royal jelly and develop into new queens;
g. drones/fertile males can mate with queens (to provide genetic variety);
h. workers/infertile females gather food/clean the colony/defend the colony/feed larvae/secrete wax to build the hive;
i. workers cooperate to regulate the internal temperature of the hive;
j. workers share information about food/waggle dance;
k. changing duties for the workers as they age/about half life span spent on indoor duties, then rest of time outside foraging; ***[6 max]***

Option F — Microbes and biotechnology

F1. (a) coliphages/viruses ***[1]***

(b)
a. number of both types (bacteria and viruses) is reduced;
b. the reduction of bacteria was greater than for viruses;
c. in the first 10 minutes reduction of bacteria is large whereas reduction of viruses is gradual;
d. after 30 minutes less than 0.0001 % of bacteria remain while about 10 % of viruses remain; *Accept any other reasonable comparison.* ***[2 max]***

(c)
a. not necessary for bacteria as nearly all have been killed;
b. necessary for coliphages as they take longer to denature/destroy/are still present;
c. depends whether pathogens in sewage are heat tolerant;
d. depends on the cost of the treatment;
e. depends whether presence of a few microbes in treated sewage is harmful; ***[2 max]***

(d)
a. anaerobic conditions / increases BOD (biological oxygen demand) / eutrophication;
b. low dissolved oxygen may kill (aerobic) organisms;
c. pathogens/cause health hazards (bathing or drinking water);
d. algal blooms;
e. diversity falls/favours organisms able to survive low oxygen levels; ***[2 max]***

F2. (a) the study of the occurrence / distribution / transmission / control of diseases ***[1]***
*Award **[1 max]** for **two** correct factors.*

(b) I (is Gram-positive) because it has thick/outer layer of peptidoglycan/does not have outer layer (of lipids) external to peptidoglycan layer ***[1]***

(c)
a. producers / food source in aquatic environments;
b. nitrogen fixers / denitrifiers;
c. decomposers;
d. methane producers; ***[2 max]***

(d)
a. both use light as source of energy/to generate ATP;
b. cyanobacterium example of photoautotroph and *Rhodospirillum* example of photoheterotroph / other examples;
c. photoautotrophs are mainly aerobic but photoheterotrophs are mainly anaerobic;
d. organic compounds made from inorganic substances in photoautotrophs and obtained from other organisms in photoheterotrophs; ***[3 max]***

F3. a. caused by protozoan *Plasmodium*;
b. transmitted (to human) by (female) mosquito/*Anopheles*;
c. mosquito ingests blood with parasites when bites infected person;
d. parasite reproduces/grows/matures in the mosquito's gut / migrates to mosquito's salivary glands;
e. next time mosquito feeds on blood, injects the parasite (into human);
f. parasites travel to the liver;
g. (after days or years) parasites leave the liver cells and enter red blood cells;
h. infected red blood cells rupture, freeing the parasites (to enter other red blood cells);
i. symptoms of malaria are fever/chills/headache/stomach upset/flu-like symptoms;
j. symptoms are cyclic due to parasite life cycle / *Plasmodium* may remain dormant in liver for long periods;
k. frequent rupture of red blood cells/blocked capillaries can lead to anaemia;
l. different types of malaria / some fatal / economic consequences; ***[6 max]***

Accept above points in an annotated diagram.

Option G — Ecology and conservation

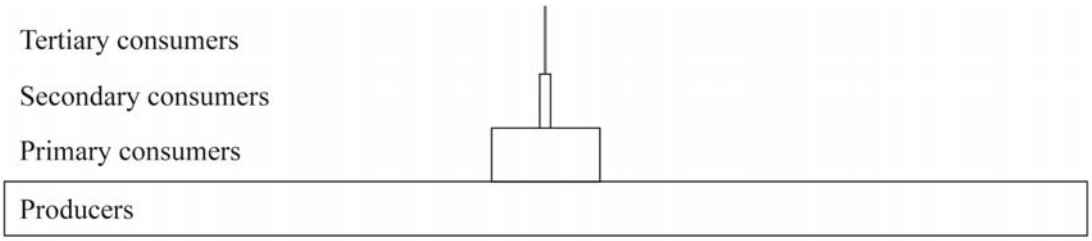
G1. (a) (i) (tank) 6 ***[1]***

(ii) (tank) 4 ***[1]***

(b) a. increasing phosphorus decreases mercury accumulation by *Daphnia*;
b. increasing concentration of phosphorus above tank 4 has little effect;
c. highest levels of mercury accumulation recorded at low phosphorus concentrations; ***[2 max]***

(c) a. increased phosphorus concentrations produce algal blooms/increased algae;
b. larger populations of algae result in smaller concentrations of mercury in the (individual) algae;
c. less mercury taken in/accumulated by *Daphnia* from their food; ***[2 max]***

G2. (a)



Values: primary consumers: 10 000 kJ m^{-2} yr^{-},^{1} secondary consumers: 1000 kJ m^{-2} yr^{-1} and tertiary consumers: 100 kJ m^{-2} yr^{-1}

a. correct values; *(allow 20 % error)*
b. correct trophic level labels; (*do not accept trophic level 1, trophic level 2 etc.)*
c. drawing showing proper proportions; *(height of each step the same, each bar no more than one quarter of the one below)* ***[3]***

(b) the dry mass / organic material (of a group) of organisms in a given area/habitat ***[1]***

(c)

	r-strategies	K-strategies	
a.	suit an unstable environment/pioneer species	suit a stable environment/ occur in climax community	;
b.	short life span/ mature early	long life span/ mature late	;
c.	small body size that can quickly be reached	larger body size that gives competitive advantage	;
d.	energy and resources devoted to reproduce once	may reproduce several times	;
e.	many small offspring produced (as most do not survive)	few (relatively large) offspring (need to compete to reach adulthood)	;
f.	no parental care	much parental care	; ***[2 max]***

(d) a. name of two organisms;
b. how each benefits;
Accept one verified, valid example. Examples are given below.

a. name of two organisms *(both for **[1]**)*	***b. how each benefits*** *(both for **[1]**)*
e.g. bacteria and/or fungi that live in the rumen of ruminant mammals;	*e.g.* the ruminant is dependent on digestion of cellulose by microorganisms in order to gain nutritional benefit from its diet / for the microorganisms, the rumen is their habitat;
e.g. lichens consist of fungus and an alga;	*e.g.* alga makes food by photosynthesis for both and fungus absorbs mineral ions/gives shape and structure/suitable environment for growth;
e.g. bacteria in root nodules of legumes;	*e.g.* bacteria fix nitrogen which is used by plants which house and provide organic compounds for bacteria;
e.g. fungus and gardening/leaf cutter ants;	*e.g.* ants bring leaves which are food for fungi and fungi convert plant material to form insects can digest;
e.g. ants and acacia trees;	*e.g.* hollow thorns in tree house stinging ants which attack anything that touches tree; tree provides sugar and proteins for ants;
e.g. flashlight fish (*Photoblepharon*) and bacteria;	*e.g.* bacteria are bioluminescent, live in organ below fish's eye; light attracts prey and signals to mates; bacteria receive nutrients from fish;

[2 max]

G3. a. *in situ* conservation is carried out in nature reserves/natural habitats;
b. named example of a species that is being conserved *in situ*;
c. *in situ* conservation reduces possibility that habitat disappears and the whole community is lost / may prevent the total number of species that become endangered from increasing;
d. allows species to live in an environment for which they are adapted / they are able to fit into their normal food chains;
e. threatened species in a reserve may be monitored for further deterioration in numbers / remedial steps can be taken;
f. offspring acquire skills from parents/peers around them / offspring acquire natural behaviour;
g. reserves and protected areas in various parts of the world can share experience on how to manage them successfully;
h. nature reserves are popular sites for the public to visit maintaining awareness/education/scientific study;
i. reserves are places to return endangered individuals from breeding programmes as they provide realistic conditions for re-adaptation / *OWTTE*; ***[6 max]***

Option H — Further human physiology

H1. (a) 8 (min) *(Allow 6 to 9 mins)* ***[1]***

(b)
a. exercise-induced dilation of the femoral artery for both groups;
b. increase in artery diameter greater in non-smokers (converse);
c. artery diameter at start comparable between both groups / non-smoker slightly higher;
d. initial increase in diameter is (almost) immediate for both groups;
e. increase in workload (after 20 minutes) causes increased artery dilation for both groups; ***[3 max]***

(c)
a. increase in artery diameter increases blood flow in response to exercise;
b. arteries from non-smokers are more flexible/elastic;
c. smokers give less blood to their muscles during exercise;
d. increased blood pressure in smokers;
e. smaller increase in diameter of arteries of smokers due to atherosclerosis/plaque build up / *OWTTE*; ***[2 max]***

H2. (a)
a. changing pressure of blood in heart automatically opens and closes the valves / the closing of valves generates the heart sounds;
b. first heart sound (S_1) is produced by the closing of the AV valves/mitral and tricuspid valves;
c. second heart sound (S_2) produced by the closing of semilunar valves/aortic and pulmonary valves; ***[2 max]***

(b)
a. iron;
b. bile pigments/bilirubin;
c. globin/amino acids; ***[2 max]***

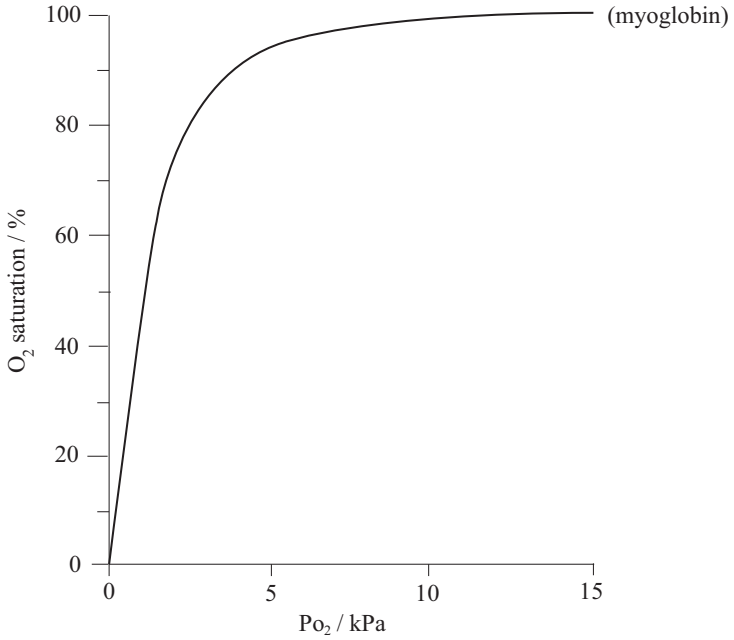
(c)

		Gastric juice	***Pancreatic juice***
a.	***Acidity or alkalinity***	1–2/acidic/hydrochloric acid	7–8/<u>slightly</u> alkaline/ HCO_3^-/hydrogen carbonate;
b.	***Enzymes***	pepsin(ogen) / rennin	mixture of (many) enzymes/amylase / lipase / carboxypeptidase / trypsin(ogen); *Do not award mark if incorrect enzyme listed for either.*
c.	***Site of action***	stomach	<u>small</u> intestine / duodenum; ***[3]***

*Award **[1]** for each correct row.*

(d) cellulose / lignin / bile pigments / intestinal cells / bacteria ***[1]***

H3. a. myoglobin is specialized for oxygen storage;
b. myoglobin has a single heme/globin unit/polypeptide chain;
c. found in muscle;
d. myoglobin has a higher affinity for oxygen than haemoglobin; (*allow this point if haemoglobin dissociation curve correctly drawn to right of myoglobin curve and labelled)*
e. in normal conditions/at rest myoglobin is saturated with oxygen;
f. used during intense muscle contraction when the oxygen supply is insufficient/when muscle is very active its oxygen concentration may fall (below 0.5 kPa);
g. when this happens myoglobin releases oxygen;



h. steep rise below 5 kPa with no lag/not sigmoid;
i. slower rise approaching 100 % above 5 kPa; ***[6 max]***