N11/4/BIOLO/HP3/ENG/TZ0/XX/M

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MARKSCHEME

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BIOLOGY

Higher Level

Paper 3

16 pages

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 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 <u>underlined</u> 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) 1977 / 1978 ***[1]***
__N.B.__ Some responses are interpreting this as a change between years.

(b) both species increased (relative) beak size at the beginning of the study/ between the years 1973/1974 to 1977/1978;
no similarity in trend for both species after 1977/1978/1979 / no relationship between the two species in the years of increase and decrease;
more occurrence of decrease in (relative) beak size in *G. fortis* whereas *G. scandens* showed more increases in (relative) beak size;
G. fortis shows wider fluctuation in (relative) beak size than *G. scandens*; ***[3 max]***
Do not accept year by year comparisons.

(c) changes in environment/rainfall/ocean currents/migration / drought;
change in food supply;
hybridization/crossbreeding between species;
natural selection / selection pressure; ***[2 max]***

D2. (a) (i) hydrogen (H_2) / methane (CH_4) / ammonia (NH_3) ***[1]***
Award __[1]__ for any __two__ of the above.
Do not accept incorrect formulas.

(ii) organic molecules/amino acids/nucleotide bases formed ***[1]***

(b) brain size increased during hominid evolution;
increased consumption of meat/protein/change from vegetable to meat diet correlates with increased brain size;
change in teeth over same time period shows change in diet from plant to meat;
example of change in brain capacity; *(e.g. Australopithecus had cranial capacity of 400 cm^3 to 500 cm^3 compared with human cranial capacity of 1400 cm^3)* ***[3 max]***
greater mental ability/brain size needed for predators than grazers;

(c)

convergent evolution	***divergent evolution***
explain relationships between organisms with structures with similar form/function;	
no common ancestor/unrelated;	organisms share common ancestor
structures are analogous;	structures are homologous
organisms (with separate ancestries) adapt in similar ways;	basic structure in ancestor modified in different ways
adaptation to similar environments/ niches;	adaptation to different environments/ niches
similar form and same function;	similar form but different function
e.g. bird wing and insect wing; *(accept other correct examples)*	*e.g.* pentadactyl limb / bat wing and horse forelimb

[3 max]

To award __[3 max]__ responses need to be comparisons.
Responses do not need to be shown in a table format.

D3. classification traditionally based on morphology;
cladistics (strength) based on molecular differences/base sequences/amino acid sequences;
cladistics (weakness) is based on probability but improbable events do occur, so relationships can be wrong;
clade includes ancestral species/descendants from that species;
members of clade share set of features not found in more distant relatives;
cladogram is a tree-like diagram where nodes/branches represent the splitting of (two) new groups from a common ancestor;
different cladograms can represent same relationships in a group;
cladogram timescale not necessary;
classification based on cladograms is often same as traditional classification;
in some groups cladograms have led to revised classification; ***[6 max]***
Accept any of the above points shown in a clearly annotated diagram.

Option E — Neurobiology and behaviour

E1. (a) 12 cm s^{-1} *(units required)* ***[1]***

(b) 32 (%) ***[1]***

(c) at all velocities (of water flow) larvae swim both with and against current;
maximum (swimming) velocity is same (12 cm s^{-1}) at all velocities (of water flow)/going with or against current;
velocity (of water flow) increases fewer larvae swim against current; *(accept correct numerical comparisons)*
at higher velocity (of water flow)/6.3 cm s^{-1} more larvae swim at faster net speeds; ***[2 max]***

(d) (data supports hypothesis as) some larvae able to swim against current at all (water flow) velocities;
(data supports hypothesis) since few larvae have net velocity of 0 cm s^{-1} most of them are actively swimming /not just moving with the current;
(data inconclusive) as more larvae swim along with the current at both velocities; ***[2 max]***

E2. (a) (i) I: ganglion cell
II: bipolar cell/neuron
(both needed) ***[1]***

(ii)

rods	***cones***
used in dim light	used in bright light;
black and white vision / one type sensitive to all wavelengths of light	colour vision / three types sensitive to red, blue and green light;
passage from group of rod cells to single bipolar neuron/nerve fibre in optic nerve	passage of impulse from single cone cell to a single bipolar neuron/ nerve fibre;
detect shape and movement	perception of fine detail;
found all along the retina	found in fovea / concentrated in one region;

[2 max]

To award ***[2 max]*** *responses need to be compared.*
Responses do not need to be shown in a table format.

(b) rapid unconscious response to change in light intensity / controls amount of light entering eye to prevent damage to retina/to see in darkness;
in bright light circular muscles in iris contract causing pupil to constrict / in dim light longitudinal/radial muscles in iris contract causing pupil dilation;
constriction by parasympathetic NS / dilation by action of sympathetic NS; ***[2 max]***

(c) pupil reflex is a brain stem reflex / shows activity in the medulla oblongata;
pupil reflex must be absent in brain death;
pupil reflex is possible in coma victims where motor function is absent;
pupil reflex alone not enough to diagnose brain death;
other criteria include coma/absence of response to pain in all extremities/ absence of brain stem reflexes/lack of respiratory movements;
some cases of coma irreversible / some cases may recover;
doctors need to diagnose damage to decide treatment/long-term life support /organ donation; ***[3 max]***

E3. organism expends time/energy in caring for other (unrelated) members of the same species;
put themselves at risk or disadvantage for the good of other members of the species / actions that increase another individual's number of offspring at cost to one's own reproduction;
valid example; *(e.g. primates / vampire bats / male turkeys or other birds such as Florida jays / mole rats)* *Do not accept parental care.*
description of altruistic behaviour of the example given;
might expect natural selection to be against behaviour that reduces chances of survival and reproduction;
close kin share alleles;
(adaptive significance is to) increase frequency of alleles shared in common;
(provides genetic advantages in kin by) promoting survival and reproduction within species;
altruistic behaviour towards non-relatives may allow selection of alleles responsible for the behaviour to be perpetuated;
some argue no true altruism as organism benefits either directly or indirectly in the future; ***[6 max]***
*Award **[5 max]** if no valid non-human example given.*

Option F — Microbes and biotechnology

F1. (a) rapid initial uptake (to approximately 75 % uptake);
rate of uptake slows and plateaus (at approximately 85 % uptake after 90 minutes);
only 90 % of cadmium ions absorbed (however long the contact time) / reaches maximum at 120 min; ***[2 max]***

(b) 64 (%) *(allow responses in the range of 62 to 66 %)* ***[1]***

(c) can remove almost 100 %/98 % cadmium ions at pH 5 therefore very efficient;
A. fumigatus able to remove cadmium ions at pH values tested;
removal of cadmium ions more efficient at higher pH/weak acid;
strongly acidic/very low pH may inhibit/reduce uptake of cadmium ions by *A. fumigatus*;
pollution causing acidification of water may make removal more difficult;
A. fumigatus common therefore may be convenient/easy to use / *OWTTE*;
cadmium is not actually removed as it may pass along food chains / be released when *A. fumigatus* dies / unknown impact on environment; ***[2 max]***

(d) easier to store/collect/transport dead/dried material;
prevents overgrowth of *A. fumigatus*;
reduce BOD and allow other organisms to use more resources/live in water; ***[1 max]***

F2. (a) (i) *similarities*:
both have walls made of murein net;
both have polysaccharide chains cross-linked by short peptide chains/ peptidoglycan;

differences:
Gram-positive have thicker/more rigid walls while Gram-negative walls are thinner;
Gram-positive walls contain other components/polysaccharides and proteins while Gram negative do not;
Gram-negative walls coated on outside with lipid-rich layer while Gram-positive are not; ***[2 max]***
*To award **[2 max]** responses need to address a similarity and a difference.*

(ii) organism which uses chemical source of energy <u>and</u> organic compounds as source of carbon *(both needed)* ***[1]***

(b) bacteria cause decay by feeding on dead/decaying organic matter (in sewage);
nitrifying bacteria convert ammonia to nitrates /nitrites;
plant/reed roots absorb nitrates;
denitrifying bacteria convert nitrates to nitrogen; ***[2 max]***

(c)

Chlamydia	***Streptococcus***
intracellular (infection)	extracellular (infection);
sexually transmitted disease / infectious conjunctivitis	respiratory infection / pneumonia / skin infections;
reproduces in host cell / cannot survive long in extracellular environment	live outside host cell / in intercellular spaces;
(usually) long-term infection	(usually) short-term infection;

[3 max]

F3. viral vector used to replace defective gene in somatic cell;
virus genetically engineered to carry normal copy of gene;
valid example; *(e.g. SCID (severe combined immunodeficiency))*
cause of disease; *(e.g. lack of enzyme/adenosine deaminase/ADA in bone marrow cells)*
technical issues need to be solved / ensure correct amount of gene product/at the right time/in the right place;
need to be sure insertion of therapeutic gene does not harm other necessary cell functions;
viral vectors may infect healthy cells;
causing illness/disease/cancer;
virus may revert to original form and cause disease;
newly introduced DNA may affect reproductive cells causing genetic changes;
immune system may attack newly introduced viruses causing inflammation/toxicity/ organ failure; ***[6 max]***

Option G — Ecology and conservation

G1. (a) (i) 14 ***[1]***

(ii) trend is similar but differences/values at Konza are always higher;
both show greater increase in non-grass abundance than grass abundance when single (large) herbivore species/buffalo/bison present;
both have lower abundance when no (large) herbivore species/buffalo/ bison present than when single (large) herbivore species/buffalo/bison present; ***[1 max]***

(iii) grasses eaten by herbivore so increase less than non-grass abundance;
herbivores spread seeds of different species between locations;
herbivores change the habitat (*e.g.* by trampling/manure);
herbivores prevent woody plants from growing and maintain grassland; ***[1 max]***

(b) Konza always has higher species diversity than Kruger;
both increase in species diversity when a single (large) herbivore species/ buffalo/bison is present;
Konza has greater increases than Kruger when a single (large) herbivore species/ buffalo/bison is present; ***[2 max]***
Accept specific correct numerical comparison.

(c) single (large) herbivore species/buffalo/bison appears to be better for plant community due to higher abundance and diversity;
although multiple herbivore species/buffalo/bison result in less non-grass abundance than single species, it is higher than when no herbivore species are present;
the numbers of single and multiple herbivore species/buffalo/bison are not given (so not enough information);
no multiple herbivore species/buffalo/bison in Konza/only Kruger (so not enough information); ***[2 max]***

G2. (a) secondary succession as some plants/organic components were present before fire ***[1]***

(b) moderate rainfall, hot/warm summers and cold/cool winters and trees drop their leaves ***[1]***
*To award **[1]** all three aspects are needed.*

(c) describe method for ensuring random placement of quadrats in a grid; *(do not accept transect)*

different species present in quadrat identified and counted;
used to estimate species density/frequency/abundance/cover; ***[2 max]***

(d) *size*:
large nature reserves usually promote conservation better than small ones;
large areas needed for far-ranging animals (*e.g.* grizzly bear);
larger areas have proportionally smaller perimeters/less affected by edges;

edge effect:
ecology of edges of ecosystems is different from central areas due to edge effects;
fragmentation (of forests) leads to increase in edges which will favour some species over others;

habitat corridor:
habitat/movement/wildlife corridors allow organisms to move between different parts of fragmented habitat; ***[3 max]***

*To award **[3]** responses must refer to size, edge effect and habitat corridor.*

G3. large areas of ocean under no government control therefore need for international agreement/legislation;
fish stocks are a renewable resource if managed properly/should not be overexploited;
total allowable catches/quotas to limit maximum catch;
regulation of mesh sizes/selective fishing gear/limit size of fish caught/ban drift nets;
limit fishing effort by reducing the number of fishing days at sea of fishing vessels;
fix the number and type of fishing vessels authorized to fish;
cooperation may be difficult as most laws made at national level;
closed areas/total ban on fishing in threatened areas;
closed seasons banning fishing during breeding season;
use of fish farms; ***[6 max]***

Option H — Further human physiology

H1. (a) inversely proportional / as Sa_{O_2} increases P_{PA} decreases / negative correlation *[1]*

(b) 14 % *(allow responses in the range of 12 % to 16 %)* *[1]*
Accept negative value.

(c) healthy highlanders have much lower P_{PA} than highlanders with chronic mountain sickness (CMS);

correct numerical comparison of mean; *(e.g. healthy highlanders have a mean of 23 mm Hg (allow a range of 21 to 25) while CMS of 46 mm Hg (allow a range of 44 to 48))*

healthy highlanders show smaller range of P_{PA} than highlanders with CMS / *vice versa*;

correct numerical comparison of range; *(e.g. healthy highlanders from 15 to 30 mm Hg while CMS from 30 to 85 mm Hg)*

highest P_{PA} of healthy highlanders is similar to lowest P_{PA} of CMS; ***[3 max]***

(d) high blood pressure due to high P_{PA} ;
lower saturation (Sa_{O_2}) of blood with oxygen results in shortness of breath/ fatigue/nausea;
headaches due to high blood pressure (P_{PA}) ; ***[1 max]***

H2. (a) (i) I: lacteal
II: longitudinal/smooth muscles / muscularis mucosa *(both needed)* ***[1]***

(ii) microvilli/brush border to increase surface area;
enzymes (peptidases and disaccharase) bound to membranes (of microvilli) to complete hydrolysis/digestion;
tight junctions separate fluid of intestinal lumen from intercellular fluid/ impermeable barrier;
large number of mitochondria as high energy demand for active transport;
pinocytotic vesicles formed by endocytosis/uptake of fluid with products of digestion; ***[2 max]***

(b) bile contains bile salts (and pigments);
bile salt molecules have both a hydrophilic and hydrophobic end;
reduces size of fat/lipid globules / emulsifies fats;
causes increase in total surface area so acted on more effectively by enzyme (lipase); ***[2 max]***

(c) trypsin is protein-digesting enzyme/protease;
trypsinogen is inactive form produced by pancreas;
produced in inactive form to prevent it digesting cells of pancreas;
converted to active form trypsin in small intestine by enterokinase/ enteropeptidase;
enterokinase/enteropeptidase secreted by intestinal mucosa/wall of small intestine; ***[3 max]***

H3. receptors in hypothalamus detect decrease in blood solute potential/increase in blood concentration;
occurs when excessive sweating/too little water intake/excessive salt intake;
nerve impulses pass to posterior pituitary gland where ADH is released;
ADH secreted by neurosecretory cells;
ADH makes epithelium of convoluted tubule /collecting duct more permeable to water;
water reabsorption results in more concentrated urine;
when high intake of water/solute potential of blood increases/blood more dilute ADH release is inhibited;
walls of convoluted tubule and collecting duct become less permeable to water;
less water is reabsorbed creating dilute urine;
is example of negative feedback; ***[6 max]***