N08/4/BIOLO/HP3/ENG/TZ0/XX/M+

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# MARKSCHEME

## November 2008

## BIOLOGY

## Higher Level

## Paper 3

10 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. However, if the incorrect answer is used correctly in subsequent marking points then **follow through** marks should be awarded.

**10.** Only consider units at the end of a calculation. Unless directed otherwise in the markscheme, unit errors should only be penalized once in the paper.

**Option D — Evolution**

**D1.** (a) $0.19 - 0.11 = 0.08$ ***or*** $\frac{0.08}{0.11} \times 100$;
73%; ***[2]***
*Accept answers with decimal places e.g 72.7%.*

(b) less agile / escape less easily / jump less / noisier movement;
slower;
owls look out for them / owls (learn to) select asymmetric woodmice / easily recognized; ***[2 max]***

(c) owls caught (more) mice that were more asymmetric;
selection pressure against asymmetric mice;
scientists caught more mice that were less asymmetric than owls did, so less asymmetric mice survive better;
asymmetric mice may have some other survival advantage *e.g.* higher reproductive rate;
asymmetric mice are more likely to die out / asymmetric mice still in population;
the study period is short so it is difficult to predict the outcome; ***[3 max]***

**D2.** (a) the amount of time taken for a radioactive isotope to decay to half its original level / the time taken for half the nuclei of an isotope to decay ***[1]***

(b) $^{40}K$ decays to $^{40}Ar$;
proportion of each isotope is measured;
half-life deduced from decay curve;
half-life of $^{40}K$ is greater than 1000 000 000 years/billon;
used to date rocks and fossils over 10 000 years old; ***[2 max]***

**D3.** (a) limb is an homologous structure / limb has same type and number of bones;
evolved from a common ancestor;
present in nearly all vertebrate (classes);
shows changes over time / different limb has different uses; ***[3 max]***

(b) recombination / crossing over / chiasmata;
during meiosis in prophase I;
so new variations in the gametes;
random orientation / independent assortment;
during metaphase I;
mutations arise to gene / mutations arise to chromosome;
random mating;
random fertilization of gametes;
most mutated organisms die / some mutated organisms survive;
alters alleles in gene pool; ***[7 max]***

**Option E — Neurobiology and Behaviour**

**E1.** (a) January ***[1]***

(b) protection from predators;
shelter from weather/rain/wind/cold / climatic conditions/heat;
breeding site;
access to water/nutrients/minerals; ***[1 max]***

(c) most use in the winter months / less use in summer;
more variable use over the years / greater difference between summer and winter use over the years;
highest use in winter of 2003/in July 2003 / lowest use in summer of 2000/2001/June 2001; ***[2 max]***
*Accept other correct answers.*

(d) in 2000 cave systems were not used at all;
in 2001 the cave systems were used in January but not the other two months;
in 2001 and 2002 they were used in January;
highest usage in January 2002;
never used in March; ***[3 max]***

**E2.** (a) sensory neuron, from sense receptor;
association/relay/intermediary neuron, in spinal cord;
motor neuron, to effector; ***[2 max]***

(b) parasympathetic system contracts circular muscles / pupil constricts;
sympathetic system contracts radial muscles / pupil dilates; ***[2]***

**E3.** (a)

| | *type of stimulus* | *example of stimulus* |
|---|---|---|
| *Mechanoreceptor*: | movement/touch/ vibration/sound/ stretch | sound waves / pressure / gravity / other examples of movement; |
| *Thermoreceptor*: | temperature | hot/cold; |
| *Chemoreceptor*: | chemical substance | smell/taste/pH/ $CO_2$; |

***[2]***

*Award **[2]** for three correct rows, **[1]** for two correct and **[0]** for only one correct.*

(b) *Award **[3 max]** for the general statements below.*
psychoactive drugs affect the mind/brain and personality;
some psychoactive drugs act like neurotransmitters;
(some psychoactive drugs act like neurotransmitters) but are not broken down (at receptors);
some psychoactive drugs interfere with the breaking down of the neurotransmitters;
affect the transmission of optic signal in the thalamus/optical cortex;

*Award **[2 max]** for each of the two examples given. Accept only effects on the synaptic transmission.*

cocaine/crack;
stimulates synaptic transmission of adrenergic synapses / inhibits dopamine re-uptake;

nicotine;
stimulates synaptic transmission of cholinergic synapses / increases activity of acetylcholine synapses;

amphetamines / ecstasy;
stimulates synaptic transmission of adrenergic synapses / inhibits dopamine re-uptake;
longer lasting effect / 2 to 4 hours;

caffine;
acts on adenosine receptors as an antagonist;

alcohol;
binds to GABA / enhances effects of GABA / binds to NMDA receptors / decreases activity of glutamate (an exitatory neurotransmitter);

THC / cannabis;
binds to cannabinoid receptor (blocking synaptic transmission);

benzodiazepines;
binds to GABA / prolongs inhibitory effects of GABA / acts at benzodiazepine site;

opium / morphine / heroin;
acts on opoid receptors / at synapses of the nucleus accubens; ***[7 max]***

## Option F — Applied Plant and Animal Science

**F1.** (a) (i) third instar ***[1]***

(ii) *Humulus lupulus* ***[1]***

(b) *Salvia* has a lower efficiency / imidacloprid has higher efficiency in all stages;
effectiveness of *Salvia* is constant for every stage / imidacloprid has lower efficiency in the fourth stage;
efficiency against the fourth instar is similar for both;
in both, efficiency is similar/constant for the first three instars; ***[2 max]***

(c) not good when compared to imidacloprid insecticide;
*Humulus lupulus* is the most effective against fourth instar;
some other plant extracts as effective as imidacloprid against fourth instar;
all have an effect better than control;
possible combination may work; ***[3 max]***

**F2.** (a) increase in plant biomass per leaf area per unit of time ***[1]***

(b) (pruning) removes apical meristem;
removes the source of auxin;
allowing lateral buds to grow; ***[2 max]***

**F3.** (a) small leaf-like structures/bracts attached to stem;
<u>anthers</u> – shown large and protruding from flower with elongated filaments;
<u>stigmas</u> – shown as feathery and protruding from the flower; ***[3]***

(b) some flowering plants are short day/some are long day plants;
important variable is length of darkness/photoperiod;
phytochromes exist in two interconvertible forms/ $P_r$ and $P_{fr}$;
$P_r$ aborbs red light/660 nm light;
changes its structure to $P_{fr}$;
$P_{fr}$ absorbs far red light/730 nm light;
convert back to $P_r$ in darkness/low light intensity;
(daylight has mostly) red light / little far red light;
long days/short nights raise $P_{fr}$ levels;
balance between two phytochromes allows plants to measure day length;
$P_{fr}$ is active form/ $P_r$ is inactive form;
$P_{fr}$ level controls flowering;
by switching on appropriate genes / activating hormone/florigen;
short day plants have flowering inhibited by $P_{fr}$ / long day plants have flowering promoted by $P_{fr}$; ***[7 max]***

**Option G — Ecology and Conservation**

**G1.** (a) 5% ***[1]***

(b) more than 35% young/0–4.9 year old animals / most elephants are in the 0–4.9 age bracket;
decline in numbers as age increases;
the percentage of 30+ age group increases; ***[2 max]***

(c) more young have died / selection against young / fewer young born;
younger elephants of 1970 are now older elephants in 2000;
elephants have left the area; ***[2 max]***

(d) special measures to ensure elephants have enough food sources;
predators removed;
exploitation/poaching by humans controlled;
*ex-situ* conservation/zoos to encourage breeding / artificial insemination / bring in more females; ***[1 max]***

**G2.** (a) $28\,400\,\text{kJ}\,\text{m}^{-2}\,\text{year}^{-1}$ *(units required)* ***[1]***

(b) lichens/plant roots can help erosion of rock;
death and decay by bacteria/fungi/decomposers can increase soil <u>mineral</u> content;
organic materials lead to increase in humus;
plant roots promote retention of water / roots of plants result in reduced erosion of soil;
worms increase aeration of soils / worms/other animals mix soil; ***[3 max]***

**G3.** (a) *Award **[0]** if any reference to greenhouse effect.*
ozone absorbs UV radiation;
less penetrates to surface of the Earth;
less mutation/damage to living organisms;
example of damage *e.g.* less coral bleaching / reduced risk of skin cancer / less UV damage to crops; ***[3 max]***
*Accept converse statements where relevant.*

(b) methane produced by anaerobic bacteria;
sewage or manure most widely used;
several groups of bacteria involved;
one type converts material to organic acids/alcohols;
one type converts organic acids/alcohol to acetate/carbon dioxide and hydrogen;
methanogenic bacteria produce methane;
$CO_2$ and $H_2$ react to form $CH_4$ (and water) / $CO_2 + 4H_2 \rightarrow CH_4 + 2H_2O$ /
acetate $\rightarrow CH_4 + CO_2$;
*e.g. Methanobacterium*/*methanococcus*;
produces about $40\%$ to $70\%$ methane;
remains used as organic fertilizer; ***[7 max]***

**Option H — Further Human Physiology**

**H1.** (a) $100-55=45$ ***or*** $\frac{45}{55}\times 100\%$;
$82\%$; ***[2]***
*Accept answers with decimal places e.g 81.8%.*

(b) calcium reduces the uptake of cadmium;
zinc increases uptake of cadmium;
both metals together reduce the cadmium uptake the most; ***[2 max]***

(c) zinc assists/enhances/increases uptake of cadmium;
in presence of calcium the cadmium uptake is less than the control;
in presence of calcium and zinc the cadmium uptake reduces further;
so results suggest that cadmium is taken up by zinc protein channels;
the experiment is undertaken in artificial conditions; ***[3 max]***

**H2.** (a) pressure exerted by a given gas in a mixture ***[1]***

(b) causes change in the (conformational) structure of hemoglobin;
$O_2$ given up more readily by hemoglobin / so less able to hold $O_2$ / less saturated with $O_2$;
moves hemoglobin $O_2$ dissociation curve right (and downwards); ***[2 max]***

**H3.** (a) transport of lipid from gut/intestine;
drains/recovers body/tissue fluid;
back to vein/blood system;
white cells/pathogens/viruses/cancer cells also transported;
returns proteins/nutrients to the blood; ***[3 max]***

(b) atrial systole / atria contract;
blood flows to ventricle;
ventricular systole / ventricles contract;
when ventricular pressure rise above atrial pressure;
atrio-ventricular/(bi/tri) cuspid valves shut/prevent backflow;
as ventricular pressure rises above arterial pressure;
semi-lunar valves/arterial valves open;
blood pumped into circulatory system/arteries;
as ventricles contract/systole atria relax/diastole;
as ventricles relax/diastole;
ventricular pressure falls / pressure in artery exceeds pressure in ventricle;
semi lunar/arterial valves shut; ***[7 max]***
*Award **[5 max]** if no reference to pressure is made when explaining the events of the cardiac cycle.*