



MARKSCHEME

May 2011

BIOLOGY

Higher Level

Paper 3

10 pages

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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) (i) 0.26 (arbitrary units) (*units not required*) [1]
- (ii) 123 km (*accept answers in the range of 122 km and 124 km*) [1]
- (b) none / low correlation / non-significant / *OWTTE*;
less data/fewer results/less variation at 60/70 km distance; [1 max]
- (c) both show genetic differences (between all pairs of colonies);
both have (highly) variable/wide range of genetic distance;
similar mean/average genetic distance;
V. maculifrons has a greater range than *V. squamosa*; (*vice versa*) [2 max]
- (d) no/little evolution / not evolving;
allele frequencies remaining the same;
no natural selection;
uncertain because limited number of colonies/alleles/time; [2 max]
- D2.** (a) (i) transient when one allele gradually replaces another / directional selection;
balanced when allele frequencies do not change / no/stabilizing selection; [2]
- (ii) *e.g.* gradual increase in darker peppered moths due to environmental change/
industrial melanism [1]
Accept any other valid example.
- (b) name of type of barrier;
description; [2]
e.g. behavioural isolation;
different courtship behaviour so no mating between two populations;
Accept only the first type of barrier in the answer. Accept geographical separation, hybrid infertility, difference in chromosome number or breeding time.
- (c) variation due to random mutations / count numbers of difference in base sequence;
can be used as evolutionary clock / estimate time since divergence/separation;
amount of variation indicates how closely species are related/linked;
differences can indicate ancestry/sequence in which groups diverged; [2 max]
- D3.** few hominid fossils have been found/not often found/are very rare;
most hominids/organisms not preserved/decompose;
only teeth and bones remain / soft tissues do not fossilize;
require certain conditions for preservation/dry/anaerobic/quickly covered/frozen;
earlier cultures did not bury the dead / remains were scavenged/dispersed;
acids break down/dissolve teeth/bones;
many missing links/fossils of intermediate stages;
difficult to get conclusive evidence / difficult to falsify theories;
theories change radically with one/few discoveries; [6 max]

Option E — Neurobiology and behaviour

- E1.** (a) 15 days **[1]**
- (b) $13 - 9 = 4(\text{days})$ *or* $\frac{4(\text{days})}{13(\text{days})} \times 100$ *or* $100 - 69.2$;
 31% *or* 30.8% *or* 30.77%; **[2]**
- (c) both types of sound decreased mean time to egg laying;
 extra-colony sound decreased time more than intra-colony;
 both types of sound increased (mean) number of eggs laid;
 same (increase in) egg number with intra- and extra-colony sound;
 no information on sample sizes/number of pairs/egg size;
 competition (implied/perceived) leads to earlier egg laying; **[3 max]**
Answers must evaluate the effect of the sounds, not merely compare the results.
- E2.** (a) I. cerebral hemisphere / cerebrum;
 II. hypothalamus;
 III. cerebellum;
 IV. medulla oblongata; **[2 max]**
Award [1] for any two of the above.
- (b) heart can contract without nervous stimulation/myogenic contractions;
 SA node is pacemaker/generates heart beat/initiates each cardiac cycle;
 epinephrine/adrenalin speeds up the heart rate;
 autonomic/sympathetic and parasympathetic nervous system control;
 sympathetic speeds up heart rate;
 parasympathetic/vagus nerve slows heart rate (back to normal/resting rate); **[3 max]**
- (c) edge enhancement is greater perception at edges of light/dark areas;
 caused by processing in two types of ganglion cell in retina;
 contralateral is processing left field of view in right side of brain / *vice versa*;
 cross over between left and right sides in the optic chiasma;
 convergence is combining impulses from groups of (rod/cone) cells;
 done by bipolar cells in retina; **[3 max]**
- E3.** excitatory (psychoactive) drug;
 cocaine attaches to dopamine pumps/transporters (on presynaptic membrane);
 blocks uptake/recycling / causes dopamine to persist in the synaptic cleft;
 amplifies synaptic transmission / causes constant stimulation of postsynaptic neuron;
 causes euphoria/feelings of happiness/pleasurable effects;
 causes feelings of great energy/alertness/talkativeness;
 addictive / causes addiction;
 changes in personality / problems with family/friends/work;
crimes to pay for cost of drug/crime associated with the production/distribution; **[6 max]**

Option F — Microbes and biotechnology

- F1.** (a) (i) 1.6 (units) cm^{-3} (accept answers in range of 1.5 units cm^{-3} and 1.7 units cm^{-3}) [1]
- (ii) 8.3 (units) cm^{-3} (accept answers in range of 8.2 units cm^{-3} and 8.4 units cm^{-3}) [1]
- (b) as fermentation time increases laccase production rises then falls;
 as veratryl alcohol concentration increases laccase production rises then falls;
 optimum fermentation time is 4.75/5.0/5.25 days;
 most laccase overall with low veratryl alcohol concentration and long fermentation; (accept converse)
 optimum veratryl alcohol concentration is 33/34/35 mmol dm^{-3} ;
 fermentation time has greater effect than veratryl alcohol concentration; [3 max]
- (c) temperature;
 pH;
 oxygen concentration;
 carbon dioxide concentration;
 build up of waste/toxic products of metabolism;
 amount of contamination;
 light;
 supply of raw materials/nutrients/sugar;
 concentration of fungi;
 presence of other fungi/bacteria; [2 max]
- F2.** (a) cell wall structure/composition / whether the cell wall contains peptidoglycan;
 size of / 70S or 80S ribosomes;
 (base sequence in) ribosomal RNA/rRNA;
 whether there are introns;
 whether there are histone proteins;
 membrane structure / ether or ester bonds (in membrane lipids); [2 max]
- (b) chemoautotrophs use inorganic substances/carbon dioxide;
 chemoheterotrophs use organic compounds/other organisms; [2]
- (c) name of microorganism / specific name of type of food poisoning;
 method of transmission;
 treatment; [3]
- e.g. Salmonella*;
 spread when contaminated food is undercooked/stored at too high a temperature;
 antibiotics / oral rehydration fluids / eating culture of *Lactobacillus*;
- e.g. ciguatera* (fish poisoning);
 toxins from algae/dinoflagellates/protists accumulate in fish which are then eaten;
 no effective treatment;
 Award [0] for cholera, yeast or other invalid examples.

F3. a pandemic is an outbreak of a disease over large geographical area/many countries;

example of pandemic disease:

avian flu/bird flu;

name of causative agent:

H5N1 virus/new strain of flu virus;

occurrence/when and how it occurred:

in the late 20th century originally in birds/domestic poultry, infections spread to humans;

location/geographical distribution:

started in Asia and stayed mainly there, some spread to other parts of world;

mode of transmission:

exposure to infected birds/feces;

methods of control:

global records of occurrence / killing of infected birds / protection of workers from infected animals / containment strategies of infected areas;

any two problems with control:

migrating wild birds may carry the virus to domestic ones / ethical issues/equitable access to care / possibility of spread through contaminated water/sewage / high costs of research and development / vaccine availability / problems coordinating international communities / worldwide travel / contact between humans and infected animals;

[6 max]

Award [4 max] if problems of control are not discussed.

Also accept SARS (2003), any of the cholera pandemics, Spanish flu (1918), Influenza A (H1N1)/swine flu (2009 to 2010) or any other flu pandemic, AIDS from the 1980s onwards, and any other pandemics as verified on the WHO website, for example.

Do not accept malaria, but if this or another example is rejected for marking point b, up to [5 max] can still be awarded for the other marking points.

Option G — Ecology and conservation

- G1.** (a) 260 pmol mg^{-1} (accept answers in the range of 255 pmol mg^{-1} to 265 pmol mg^{-1}) [1]
- (b) *Neobisium muscorum*;
level of cadmium remains high / does not decrease (when cadmium is removed); [2]
- (c) (i) *Notiophilus biguttatus* [1]
- (ii) can excrete/remove/eliminate cadmium (from its tissues);
faster reduction/removal / drops to lowest level after cadmium exposure;
cadmium levels stop rising sooner/rise slowing by day ten;
is less tolerant/dies when cadmium reaches a certain concentration;
exposed to cadmium for a shorter time/period; [2 max]
- (d) cadmium accumulates along food chain / biomagnification / bioaccumulation;
heavy metals cause abnormal growth/behaviour/death/failure to reproduce;
Notiophilus biguttatus has less effect on the food chain (as it accumulates less);
cadmium harmful/lethal to organisms at/near the end of the food chain;
(death of arthropods) may change soil quality; [2 max]
- G2.** (a) tropical rainforest;
because the climate is warm/hot all year;
because of the high level of rainfall/precipitation all year; [3]
- (b) species sensitive to certain environmental conditions / species used to monitor
environmental change / species used to determine environmental conditions [1]
- (c) name of species to be controlled;
method of biological control with species name of predator/parasite/pathogen; [2]
- e.g. rabbits (introduced into Australia);
controlled by release of myxoma virus / myxomatosis (from South America);
Allow any other verifiable example. Reject cane toads as a biological control agent
and other unsuccessful cases.*

G3. *r-strategy*:

many offspring (at a time/per brood);
little care of offspring;
high mortality rate / only a small proportion reach maturity;
small (body) size;
short lifespan / fast maturation / reproduce at a young age;
reproduce only once;
favoured by unstable/changing environment / opportunists / broad niches;
pioneer species;
variable population size;

or

K-strategy:

few offspring (at a time/per brood);
much care of offspring;
low mortality rate / large proportion reach maturity;
large (body) size;
long lifespan / slow maturation / reproduce at advanced age;
reproduce repeatedly;
favoured by stable/consistent environment / broad niches;
climax species;
stable population size;

[6 max]

Award [3 max] if a candidate states that they are describing one of the options (r-strategy or K-strategy), but gives only answers from the other option.

Option H — Further human physiology

- H1.** (a) 11.4% (*accept answer in the range of 11.2% and 11.6%*) [1]
- (b) both lipids/LCT and LCT-MCT increase the percentage (of neutrophils secreting H₂O₂);
LCT causes greater increase than LCT-MCT;
both lipids increase the percentage more at the higher concentration;
higher concentration increases effect of LCT more than LCT-MCT;
both (lipid solutions) have highest values at end of the incubation period; [3 max]
- (c) lipids are hydrophobic/insoluble so form droplets/coalesce/cause blockages [1]
- (d) 0.06 mg cm⁻³ concentration / LCT-MCT treatment is best/safest;
supplies lipids;
avoids high/harmful hydrogen peroxide levels / percentages;
LCT at 0.6 mg cm⁻³/higher level causes high/increasing hydrogen peroxide;
danger of side effects from hydrogen peroxide;
conclusions uncertain due to lack of data / example of unavailable information; [3 max]
- H2.** (a) aorta;
carotid arteries; [2]
- (b) carbonic anhydrase [1]
- (c) curve shows saturation level at each partial pressure/concentration of oxygen;
curve is to the left of hemoglobin/rises steeply;
myoglobin's affinity for O₂ is very great/greater than hemoglobin;
becomes saturated at low oxygen concentrations;
provides oxygen when it is very low/delays anaerobic respiration in muscles;
curve not sigmoid because myoglobin only has one heme group/globin; [3 max]
Accept response in the form of a clearly drawn and correctly labelled diagram.
- H3.** ulcers are sores/inflamed/infected/damaged areas in the stomach wall;
strong relationship/association between *H. pylori* infection and ulcers;
H. pylori survives acid conditions in the stomach;
H. pylori lowers acidity of stomach / secretes urease which lowers acidity;
H. pylori secretes protease which damages stomach lining/protective mucus;
H. pylori allows damage of stomach lining by gastric acids;
H. pylori now treated as infectious disease / controlled as treatment for ulcers;
(prolonged) presence of stomach ulcers may lead to the formation of tumours/cancer;
association/correlation between *H. pylori* infection and stomach cancer; [6 max]