



MARKSCHEME

November 2003

BIOLOGY

Higher Level

Paper 3

General Marking Instructions

Subject Details: Biology HL Paper 3 Markscheme

Mark Allocation

Candidates are required to answer **ALL** questions in each of **TWO** Options (total **[20 marks]**).
Maximum total = **[40 marks]**.

General

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

When deciding upon alternative answers by candidates to those given in the markscheme, consider the following points:

- ◆ Each marking point has a separate line and the end is signified by means of a semicolon (;).
- ◆ An alternative answer or wording is indicated in the markscheme by a “/”; either wording can be accepted.
- ◆ Words in (...) in the markscheme are not necessary to gain the mark.
- ◆ The order of points does not have to be as written (unless stated otherwise).
- ◆ If the candidate’s answer has the same “meaning” or can be clearly interpreted as being the same as that in the mark scheme then award the mark.
- ◆ Mark positively. Give candidates credit for what they have achieved, and for what they have got correct, rather than penalising them for what they have not achieved or what they have got wrong.
- ◆ Occasionally, a part of a question may require a calculation whose answer is required for subsequent parts. If an error is made in the first part then it should be penalized. However, if the incorrect answer is used correctly in subsequent parts then **follow through** marks should be awarded.
- ◆ Units should always be given where appropriate. Omission of units should only be penalized once. Ignore this, if marks for units are already specified in the markscheme.
- ◆ Do not penalize candidates for errors in significant figures, unless it is specifically referred to in the markscheme.

Option D — Evolution

- D1.** (a) *Award [1] for the comparison of both groups.*
the *Polypodium* (species) are (completely) isolated in different parts of the continent **and** the *Pleopeltis* (species) much closer together / physically overlapping / share same habitats;
Polypodium grows in more northerly / temperate locations; **[1 max]**
- (b) (i) *Polypodium* as it has lower similarity/genetic identity values / *Pleopeltis* has higher similarity/genetic identity values; **[1]**
Reason required to achieve [1].
- (ii) *Pl. polylepis* and *Pl. conzattii*; **[1]**
- (c) geographic / ecological isolation / isolated by distance / by glacial periods / climatic changes;
reproductive or genetic separation of gene pools (led to speciation) / adaptive radiation; **[1 max]**
- (d) *Award [1] for Polypodium and [1] for a reason.*
Polypodium;
as more genetic difference between all three species than between the species of *Pleopeltis*;
takes time to accumulate mutations / genetic changes;
distance may have facilitated the process of reproduction isolation; **[2 max]**
- D2.** (a) *Award [1] for each comparison of pre-biotic and today.*
high temperatures versus moderate temperatures;
lightning much more frequent in pre-biotic than now;
UV light penetrated versus ozone blocks UV now / UV absorbed by the atmosphere;
reducing atmosphere / no oxygen versus 20 % oxygen in atmosphere;
free methane / ammonia / hydrogen versus N₂ and O₂ today; **[3 max]**
- (b) theory of origin of species by the arrival of material from outer space; **[1]**

D3. (a) *Must include both for full marks.*

transient polymorphism: *e.g.* industrial melanism / peppered moths / *any valid example*;
selection of different alleles depends on environmental changes / selection pressures /
temporary presence of certain genotypes;

balanced polymorphism: *e.g.* sickle cell anemia / *any valid example*;

heterozygous advantage in malaria as more fit / heterozygotes maintained in a
population due to adaptive value;

[4]

(b) chemical homology of molecules / closeness of structures;

indicate common ancestry;

phylogeny / evolutionary history of a species / relationship between species can be
determined;

proteins analyzed for amino acid sequences;

more similar the amino acid sequence, the more closely related the species are;

e.g. cytochrome C / hemoglobin / chlorophyll / *other valid example*;

DNA / mitochondrial DNA / gene nucleic acid sequence analyzed;

differences due to mutations at a certain rate / the number of difference is
proportional to the length of time since two species diverged;

evolutionary / molecular clock indicates closeness of species;

DNA – DNA hybridization;

[6 max]

Option E — Neurobiology and Behaviour

- E1.** (a) percentage of NGF in both areas is highest in AD patients;
percentage of NGF is similar in both pre-AD patients and controls in both areas;
less NGF in frontal than temporal in all three groups;
controls slightly more than pre-AD patients in both areas;
less difference between AD patients in both areas than other two groups;
lowest value in both groups is the pre-AD patients **[3 max]**
- (b) 50 %; (± 3) **[1]**
- (c) control to pre-AD has little change / slight drop in percentage of NGF;
pre-AD to AD has a (large) increase in percentage of NGF;
increase / percentage increase / progression is greater / more in frontal cortex; **[2 max]**
- E2.** (a) animal's behaviour rewarded / positive reinforcement;
animal's behaviour not rewarded;
learning by trial and error;
behaviour associated with reinforcement called operant response; **[2 max]**
Any other valid example of the above.
- (b) by increasing rate of movement non-directionally in unfavourable environment;
better chance of finding a more favourable environment for survival;
e.g. woodlice and humidity / other suitable example; **[2 max]**

E3. (a) stimulate adrenergic or cholinergic neurons / sympathetic nervous system;
overstimulate synapses with rapid, uncontrolled firing of postsynaptic neurons;
examples: nicotine / cocaine / crack / amphetamines / speed / ecstasy;
nicotine mimics acetylcholine / mimics action of transmitter molecules;
nicotine acts first as stimulant (increases heart beat and blood pressure) and then depressant;
speed releases noradrenalin / causes release of transmitter molecules;
ecstasy causes hallucinations;
amphetamines increase alertness / decreases fatigue / cause mood elevation / increase cardiac output;
overdose may develop psychosis / paranoid schizophrenia / psychotic personality changes;
crack / cocaine causes release of dopamine / intense feeling of pleasure / euphoria / greater physical strength / increased mental capacity; **[5 max]**

(b) *Award [1] for each comparison of rods **and** cones.*
distinguish dim / low intensity light versus bright / high intensity light;
night vision versus day vision;
evenly distributed versus concentrated in one zone / fovea centralis;
sensitive to all wavelengths versus sensitive to three wavelengths / trichromatic theory;
one type of pigment versus three types of pigment;
rhodopsin versus iodopsin;
impulses from group of cells to single neuron / optic nerve versus single cell to single neuron / optic nerve / synaptic convergence / retinal convergence;
poor visual acuity versus good visual acuity;
rod like shape versus cone like shape; **[5 max]**

Option F — Applied Plant and Animal Sciences

- F1.** (a) citrate; **[1]**
- (b) mitochondria (used in Krebs cycle); **[1]**
- (c) root tissue includes all the organelles / the cytoplasm / all metabolic acids of all the cells / more concentrated;
 the secreted acids are less / only those for complexing with Al^{3+} / in response to Al^{3+} / stress;
 not all acids secreted / acids needed for Krebs cycle; **[1 max]**
- (d) *Any other suitable suggestions; must mention **both** colours for full marks*
 for pink flowers: non-acid soil / minimize / neutralize acidity of soil;
 add organic acids to the soil to complex with Al^{3+} to have only pink flowers;
 for blue flowers: add acid for more Al^{3+} ions / add Al^{3+} ions to the soil;
 excess Al^{3+} could cause problems of H_2O and nutrient uptake;
 genetic manipulation to decrease citrate / organic acid production / secretion; **[3 max]**
- F2.** (a) *Award **[1]** for each comparison of organic **and** non-organic.*
 use of natural fertilizers versus synthetic / chemical fertilizers;
 biological pest control versus synthetic / chemical pesticides;
 less long term contamination of environment versus more long-term contamination;
 crop rotation versus more intensive / monoculture;
*Award **[0]** for ethical issues.* **[2 max]**
- (b) *Answers must mention **both** for full marks.*
 growth regulators are plant growth hormones / chemical messengers (that stimulate (or inhibit) plant growth);
 fertilizers are minerals (necessary for plant growth); **[2 max]**

- F3.** (a) artificial insemination;
vaccinations;
feed supplements / vitamins;
hormones;
antibiotics;
ultrasound scanning;
assistance to birth / delivery; **[4 max]**
- (b) vegetative propagation / a part of parent plant produces a new plant;
produce uniform quality of products / propagate the best plants;
genetic uniformity / no variety;
only mitosis / no meiosis;
rapid reproduction / many from one parent / shorter early stages of growth;
runners / lateral stems / rhizomes;
e.g. strawberries / *other valid example*;
cuttings that are rooted;
grafting shoot of one plant to roots of other;
e.g. fruit trees / *other valid example*;
tubers / bulbs / underground rhizomes / perennating organs survive in soil over winter;
e.g. tulip / iris / *other valid example*;
micropropagation of meristematic cells on nutrient agar / tissue culture;
e.g. African violets / *other valid example*;
disadvantage of genetic uniformity and susceptibility to disease / change; **[6 max]**

Option G — Ecology and Conservation

- G1.** (a) *Must include statements of both mass and density for full marks.*
in mass there is an inverse relationship with density;
in height there is an inverse relationship with density;
at low *Populus* density, the mass is high / maximum / about 155 g;
mass decreases from 160 g to 40 g;
at low *Populus* density, the height is maximum / high / 19 cm;
height decreases from 19 cm to 10 cm; **[3 max]**
- (b) *Tamarix* density has very small/no effect on *Populus* height at any density / high or low density; **[1]**
- (c) better underground / root growth;
to compete for water;
competition for minerals / nutrients;
greater resistance to drought / protection against dehydration / lower water needs;
resistance to higher salinity / changes in pH; **[2 max]**
- G2.** (a) in mutualism two members benefit / neither suffer;
in parasitism one benefits and one suffers; **[2]**
- (b) control of alien species / control of predators / control of herbivores;
restoration of degraded areas;
promotion of recovery of threatened species;
control of human exploitation; **[2 max]**

- G3.** (a) eutrophication of bodies of water;
excess nutrients for algal growth / bloom;
death of algae;
decomposition of algae / sewage;
increase in decomposers / bacteria;
deoxygenation of water;
decrease in population of oxygen sensitive species / lowering of diversity;
increase in BOD;
pathogens in bathing or drinking water / public health risk;
unpleasant smells / sight;

[4 max]

- (b) add artificial / chemical / synthetic fertilizers;
provide nitrates / ammonium;
easily absorbed / oxidized and absorbed;
expensive;
degrade soil;
both easily leached;
use of manure and compost;
must be decomposed by microorganisms;
less expensive;
improve soil quality / humus;
improve aeration of soil;
improve drainage of soil;
plowing / digging to mix earth (control weeds);
allow decomposition of organic matter in soil;
crop rotation as different crops have different nitrogen requirements;
use of legumes to release nitrates into the soil;
nitrogen-fixing bacteria / *Rhizobium* in root nodules;

[6 max]

Option H — Further Human Physiology

- H1.** (a) (i) late pregnancy [1]
- (ii) increase of 3.3 %; (± 0.3) [1]
Do not deduct the mark if the denominator is 6.3.
- (iii) mother with long-term effects of famine / affect child's development / famine over but nutrition remains poor; [1]
- (b) no / little insulin / diabetes / tissues do not respond to insulin [1]
- (c) increased blood glucose could lead to obesity (which is a risk factor for CHD);
increased blood glucose could be due to diabetes (which is a risk factor for CHD);
genetic factors could relate both conditions; [2 max]
- H2.** (a) *Must show **both** parts in correct relationship to each other for full marks.*
anterior and posterior pituitary and hypothalamus shown and labelled;
portal vein connecting hypothalamus and anterior pituitary shown and labelled;
neurosecretory cells connecting hypothalamus and posterior pituitary shown and labelled; [2 max]
- (b) bile molecules have hydrophilic and hydrophobic / lipophobic ends;
hydrophilic end dissolves lipase / water soluble enzyme for digestion;
hydrophobic end dissolves lipid molecule / emulsify fats;
provides maximum exposure / increases surface area to lipase; [2 max]
- H3.** (a) myogenic / initiated in heart muscle itself;
SA node / pacemaker sends waves of excitation / impulse to atria;
stimulus to the AV node;
conducting fibres / bundle of His / Purkinje fibres conduct impulses to lower ventricles;
moderated by ANS / vagus nerve / parasympathetic; [4 max]
- (b) exercise increases metabolism;
increases production of CO₂;
increased CO₂ causes more acidity in blood / decrease pH;
chemoreceptors in aorta / carotid artery detect change in pH;
message to breathing centre / (Pons) medulla oblongata;
message to diaphragm / intercostal muscles to increase breathing rate;
increase ventilation rate for more gas exchange;
long term effects of increased lung surface area / vital capacity;
breathing rate decreases with time; [6 max]
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