

MARKSCHEME

May 2004

BIOLOGY

Higher Level

Paper 3

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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 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 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. Indicate this with “**ECF**”, error carried forward.
- ◆ 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) panspermia / cosmozoan / extra-terrestrial origin of life [1]
- (b) all (12) amino acids present in both samples;
the levels of five of the amino acids are the same / both possess equal quantities of glycine/alanine/norvaline/isovaline/aspartic acid / *etc.*;
meteorite contains less sarcosine/*N*-ethylglycine/ α -amino-*N*-butyric acid;
meteorite contains more valine/proline/ α -aminoisobutyric acid/pipecolic acid;
pipecolic acid is lowest in both samples / glycine and alanine highest in both; [3 max]
- (c) inter-stellar material / the Earth's reducing atmosphere could have been a source of the first organic molecules;
the Murchison meteorite could approximate the chemistry of the pre-biotic Earth / lends support to the Miller experiment / the processes in the experiment replicates those in nature;
somewhere in outer space conditions may resemble pre-biotic Earth / a reducing atmosphere; [1 max]
- D2.** (a) name of disease;
the cause/consequence of the disease; [2 max]
e.g. PKU:
mutation in enzyme in phenylalanine metabolism / inability to convert phenylalanine to tyrosine.
cystic fibrosis:
mutation in chloride channel / mucous build-up.
sickle cell anaemia:
mutation in hemoglobin protein / inability to carry oxygen / deformation of blood cells.
other examples.
- (b) (i) sexual reproduction alone will not change the allele frequency in a non-evolving population / $p^2 + 2pq + q^2 = 1$ where p is the frequency of the dominant allele and q is the frequency of the recessive allele / where p is the frequency of the gene and q is the frequency of its allele; [1]
- (ii) no natural selection / no allele specific mortality;
random mating;
large population;
no mutation;
no immigration / no emigration / no migration;
constant allele frequency over time; [2 max]
Answer can be worded conversely.

- D3.** (a) theory that inheritance of acquired characteristics / characteristics conferring adaptive advantage acquired during lifetime;
structures not used during the lifetime eventually become vestigial in following generations;
can be transmitted to offspring;
law of use and disuse;
such as strength / long neck / vestigial organs / other example;
removing of tail of mice does not lead to mice without tails / other example to test theory;
explanation of why it refutes theory;
not generally accepted as valid for genetic evolution / origin of species; **[4 max]**
- (b) unit of genetic inheritance is the gene;
genetic evolution leads to changes in anatomy/physiology;
such as large brain / bipedality / other example;
unit of cultural inheritance is word / gesture / image / symbol / language / tool;
culture is largely acquired / Lamarkian;
genetic inheritance is Darwinian;
cultural evolution linked to technology / cultural revolutions (*e.g.* agriculture);
both genetic and cultural evolution allow humans to rise above environmental limiting factors;
such as food / water / shelter / disease;
cultural evolution more rapid than genetic evolution;
genetic evolution still occurring (through changes in allele frequency due to differential reproductive rates of certain races);
e.g. sickle cell anaemia and resistance to malaria / HIV resistance / other example;
genetic inheritance precedes cultural evolution;
brain size increases through genetic evolution enabling cultural evolution; **[6 max]**

Option E – Neurobiology and Behaviour

- E1.** (a) (i) 25 (± 3) % *[1]*
- (ii) 6.4 (± 0.6) : 1 / 32:5 *[1]*
- (b) resting and patrolling *[1]*
- (c) first activity is cell cleaning;
followed by building comb and capping comb;
finally the bee begins foraging;
eating pollen / tending brood / play fights occur at lower levels for most of the time;
dance following occurs towards the end of the 24 days; *[3 max]*
- (d) patrolling is altruistic / improves survival of hive / shows division of labour / helps others *[1]*
- E2.** (unconditioned) stimulus of food / sight of food accompanied by bell ringing;
salivation is the (unconditioned) response;
(conditioned) stimulus of bell ringing given before / without unconditioned stimulus / sight of food;
salivation became the conditioned response (to the bell ringing); *[3 max]*

E3. (a) *Award [2 max] for cannabis.*

affects ability to concentrate;
loss of muscle control;
impairs perception / painkiller / loss of time sense;
memory loss;
relaxed attitude;
increased appetite;
depression;

Award [2 max] for alcohol.

lowers inhibitions / relaxed attitude / increased aggression;
impairs reaction times;
reduces fine motor control / loss of muscle control;
memory loss;
slurred speech;
balance problems;
depression;
increased appetite;

[4 max]

(b) neurotransmitters released by pre-synaptic neurons;

diffuse across synapse;
bind to specific receptors on post-synaptic membranes;
some neurotransmitters increase permeability of post-synaptic membrane to positive ions;
causing localized depolarization;
which helps an action potential to form / raises membrane above threshold;
e.g. acetylcholine or other example;
others cause negatively charged chloride ions to move across post-synaptic membrane into the cell / K^+ moves out of the post-synaptic nerve cell;
e.g. GABA / other example;
leading to hyper-polarization;
which inhibits action potentials;

[6 max]

Option F – Applied Plant and Animal Science

- F1.** (a) $\frac{(11-25)}{25} \times 100\% = 56\%$ (decrease) / (-)56% ($\pm 5\%$) **[1]**
Working not needed to receive the mark.
- (b) both increased over the first 70 years / up to 1945;
cow population began to decline after 1945 while milk yield per cow continued to increase; **[2]**
- (c) genetic improvements in the breed / selective breeding;
increased health of cows / increased use of antibiotics in feed;
hormone treatment;
technological improvements / intensive farming;
higher protein / concentrates in diet; **[2 max]**
- F2.** (a) when a shoot is illuminated from one side;
auxin is transported laterally to the other side;
where it causes greater growth on one / dark side;
by stimulating cell elongation; **[3 max]**
- (b) gibberellic acid is normally produced by the seeds;
GA makes the fruit develop;
artificial spraying of GA;
means the fruit can develop independent of the need for seeds; **[2 max]**
- F3.** (a) *Award [1] for each of the structures correctly drawn and labelled. Grass or other suitable monocotyledonous wind pollinated example **required**.*
stigma labelled and drawn feathery;
stigma drawn protruding;
perianth / bracts reduced / labelled reduced;
filaments elongated in drawing / labelled elongated;
anthers labelled and shown protruding from the flower / exposed to wind; **[4 max]**
- (b) some flowering plants are short-day plants;
others are long-day plants;
important variable is length of darkness / photoperiod;
some plants grown in greenhouses with controlled light conditions;
short-day plants kept in the dark during daylight hours;
long-day plants artificially lit during the night;
using an appropriate wavelength / far-red light / 730 nm;
possible to expose only for brief periods to keep costs down but long enough to interrupt the dark period;
involves interaction of phytochromes with metabolic reactions;
controlled by the plant's biological clock; **[6 max]**

Option G – Ecology and Conservation

- G1.** (a) parasitism increases with increased deforestation;
some species are more greatly affected than others; **[1 max]**
- (b) same level of parasitism at 28 % deforestation;
both are increasingly parasitized with deforestation;
at low levels of deforestation worm-eating warbler is less parasitized;
at high levels of deforestation worm-eating warbler is more parasitized; **[2 max]**
Accept converse.
- (c) 64 – 67 % **[1]**
- (d) cowbird niche occupies larger area so cowbird population increases and parasitism increases;
cowbird prefers host nests in open areas because food source is in open area;
birds cannot build nests far enough from cowbird habitat when wood patches are small;
host species populations reduced so parasitism becomes more intense;
easier for cowbirds to find host nests in open woodland / host species concentrated into smaller area; **[2 max]**
- G2.** (a) index/D is a measure of species richness ;
a high value of D suggests a stable/ancient site;
a low value of D could suggest pollution / recent colonization / agricultural management / environmental stress;
the index is normally used in studies of vegetation diversity (but can also be applied to comparisons of animal / all species diversity);
involves collecting data on variety of species;
and relative numbers; **[3 max]**
- (b) indicator species are organisms that need particular environmental conditions;
diversity/abundance/groups of species/relative numbers of indicator species can be used to construct a biotic index;
biotic indices are used to monitor environmental change/status;
only organisms sensitive to specific environmental condition are included in the biotic index;
example of indicator species and condition to which it is sensitive;
e.g. stonefly lives in highly oxygenated water.
tubifex lives in poorly oxygenated water.
crustose lichens, tolerant to air pollution.
fruticose lichens, intolerant to air pollution.
other example.
any change in the environment will be seen as a change in numbers of these species/groups;
indicator species/biotic indices can be used to indicate pollution;
pollution can be seen by overall decrease in diversity / increased in numbers of tolerant species;
examples of biotic index (*e.g.* lichens communities and air pollution, fresh water invertebrates and organic water pollution); **[6 max]**

- G3.** (a) *Award [1] for each of the following processes correctly placed and labelled.*
nitrogen fixation (free-living, symbiotic, lightning and industrial) / N_2 converted to NH_3 ;
denitrification;
nitrification / NH_3 converted to NO_2^- / NO_3^- ;
feeding;
excretion;
root absorption;
putrefaction (ammonification); **[3 max]**
Do not accept decomposition.

- (b) methane;
wood;
ethanol; **[2 max]**
*If the candidate gives more than two answers for this question mark **only** the first two given.*
Do not accept coal or petroleum.

Option H – Further Human Physiology

- H1.** (a) (i) immersing the face causes a lowering of the heart rate **[1]**
- (ii) to reduce cardiac output;
to preserve oxygen for brain / heart needs;
slowing of metabolic rate;
to reduce production of CO₂ / maintain blood pH **[1 max]**
- (b) the lower the temperature, the greater the suppression of heart rate / effect more pronounced at lower temperatures **[1]**
Numerical answers accepted.
- (c) at 15 °C, expect a 19 % (± 1 %) reduction in heart rate;
therefore expect new heart rate of 56 / 57 beats per minute; **[2]**
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- H2.** (a) *Two of the following needed for [1].*
pancreatic;
salivary;
gastric pits / gastric glands;
glands in intestinal wall / krypts / Brunner's gland; **[1 max]**
liver;
- (b) erythrocytes rupture when they reach the end of their life span / after 120 days;
absorbed by phagocytosis / Kupffer cells in liver from blood;
hemoglobin split into globin and heme groups;
iron removed from heme leaving bile pigment / bilirubin;
bilirubin released into alimentary canal;
digestion of globin to produce amino acids; **[4 max]**

- H3.** (a) hypertension / high blood pressure;
having parents who have experienced heart attacks indicates a genetic precondition;
old age leads to less flexible blood vessels;
risk in females increases post-menopause because of fall in estrogen level;
being male (more risk than being female) because of less estrogen;
smoking raises blood pressure because nicotine causes vasoconstriction;
obesity strains heart;
eating too much saturated fat and cholesterol promotes plaque formation /
atherosclerosis;
sedentary life style / lack of exercise;
but excessive exercise can be dangerous;
high salt diet / excessive amounts of alcohol / stress can also affect coronary heart
disease; *[7 max]*
- (b) at high altitude there is a low partial pressure of O_2 / less O_2 in the air;
red blood cell production increases to increase O_2 transport;
ventilation rate increase to increase gas exchange;
people living permanently at high altitude have greater lung surface area;
and larger vital capacity than people living at sea level;
muscles produce more myoglobin to encourage O_2 to diffuse into muscles / store
 O_2 in muscles;
hemoglobin dissociation curve shifts to the right encouraging O_2 release into the
tissues; *[3 max]*
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