

MARKSCHEME

May 2004

BIOLOGY

Higher Level

Paper 3

*This markscheme is **confidential** and for the exclusive use of examiners in this examination session.*

*It is the property of the International Baccalaureate and must **not** be reproduced or distributed to any other person without the authorization of IBCA.*

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 penalizing them for what they have not achieved or what they have got wrong.
- ◆ Remember that many candidates are writing in a second language. Effective communication is more important than grammatical accuracy.
- ◆ 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 replicate those in nature;
somewhere in outer space conditions may resemble pre-biotic Earth / a reducing atmosphere;
levels of amino acids similar in both so support a similar origin/formation/conditions; **[1 max]**
- (d) (RNA) was a catalyst for polymerization reactions (with clay minerals);
(RNA) was the first genetic material (capable of replicating)/ template for genetic / protein synthesis; **[2]**
- D2.** (a) q /frequency of allele t : 0.02 / 0.017;
 $2pq$ /frequency of genotype Tt : 0.04 / 0.039 **or** 0.03 / 0.033;
Accept percentage values. **[2]**
- (b) 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) *Must have at least two from biochemical evidence and two from anatomical evidence to receive full marks.*

biochemical evidence:

similar amino acid sequence (*e.g.* cytochrome, hemoglobin);
DNA-DNA hybridization;
similar DNA sequences;
similar cell receptors (*e.g.* similar diseases);

anatomical evidence:

grasping limbs;
opposable thumb;
stereoscopic vision;
retention of juvenile features (hairless at birth) / neoteny;
similar cranial features;
no tail;
rotatable shoulder joint;

[6 max]

- (b) gene/genetic mutations;
chromosome mutations;
recombination during meiosis / crossing over during prophase I;
random alignment of homologues during meiosis/metaphase I / independent assortment;
random mating in the population / random fertilization;
environmental changes;
- Do not give a mark for mutation alone. "Random" must be qualified for mating or fertilization.*

[3 max]

Option E – Neurobiology and Behaviour

- E1.** (a) (i) as seed density increases the amount of time spent searching decreases / inversely proportional / negative correlation [1]
- (ii) easier to find seeds at higher seed density [1]
- (b) intake rate is greater on bare earth than grass (at all seed densities); intake rate on grass increases as seed density increases while for bare earth, intake rate fluctuates / peak intake rate on bare earth is 146 seeds m^{-2} compared to 219 on grass; there is a lot of variability for both surfaces / no significant changes in either taking into account error bars; [2 max]
- (c) bare earth is a better surface than grass for foraging/searching for food; time spent searching is lower on bare earth; intake rate is always greater on bare earth; [2 max]
Accept inverse statements.
- E2.** (a) learned behaviour – patterns that reflect the conditions that an animal experiences during development / acquired from experience; [2]
innate behaviour – behaviour which normally occurs in all members of a species despite natural variation in environmental influences / present from birth / independent from birth / instinct / genetic basis;
- (b) (i) detects/responds to chemical substances [1]
Accept a specific example e.g. taste buds detect flavours.
- (ii) detects/responds to mechanical energy in the form of movement/pressure/sound/gravity [1]
Accept a specific example, e.g. hair cells in (inner) ear detects movement.

- E3.** (a) (innate) behaviour patterns are inherited;
animals show variation in their behaviour;
behaviour patterns are adapted to the environment / selected by the environment;
those animals with adaptive behaviour more likely to survive;
animals which survive leave more offspring (than those less adapted) / change in allele frequency;
population/species starts to show more adaptive behaviour;
population has evolved;

[6 max]

- (b) altruistic behaviour – behaviour of an animal that is (potentially) harmful to itself but beneficial to another animal;
specific example of an animal and its role in the social organization;
risk/possible harmful effect of behaviour;
benefit gained;
e.g. worker bee feeds larva and protects the colony;
worker bee may die in defence of colony;
queen bee / rest of colony are protected;
Other examples can be used but not human ones.

[4 max]

Option F – Applied Plant and Animal Science

- F1.** (a) in Brigadier and Packman, glucoraphanin higher in concentration than progoitrin;
progoitrin approximately equal in Packman and Brigadier / greatest in Petro;
Brigadier has highest total glucosinolate concentration;
Brigadier has highest glucorphanin concentration;
Packman has lowest total glucosinolate concentration;
Packman has lowest glucorphanin concentration; **[3 max]**
- (b) (outbreeding is) reproduction involving fusion of gametes produced by genetically unrelated individuals;
can increase aliphatic glucosinolate concentration because more variation is due to genetic factors;
Brigadier and Petro have more aliphatic glucosinolates;
cross Brigadier with Petro;
because Brigadier has more glucoraphanin and Petro has more progoitrin; **[3 max]**
- F2.** (a) vigour / increase in desirable qualities (*e.g.* growth rate, yield, fertility) due to high levels of heterozygosity **[1]**
- (b) yield per unit area increases / less land required;
health of animals can be monitored;
cost per worker is lower / more efficient production;
quality of meat/food / desired characteristics can be better;
better control over reproduction; **[3 max]**

- F3.** (a) reservoir of genetic diversity / prevents inbreeding / prevents homozygosity;
more suited to local conditions;
may carry alleles for future needs;
may contain genes for medicinal products;
can be bred to give newer varieties;
hybrid vigour may combine genes for insect resistance/beneficial characteristics; **[4 max]**

- (b) *Responses must have at least two arguments for and two arguments against to receive full marks.*

arguments for:

transgenic plants do not survive long in wild;
reduced cost of food production / reduce amount of land used for food production;
transfer of genes occurs naturally;
DNA and proteins are digested (unlikely to cause problems);
longer shelf life for certain products;
increased yield / bred for faster growth;
better adaptation to certain conditions / eliminate possible plagues;
healthier food produced because use of pesticides can be decreased *e.g.* Bt corn /
increase food quality *e.g.* albumin gene has increased sulfur amino acid content of
alfalfa used to feed sheep;

arguments against:

uncertain long-term health effects from eating transgenic crops / may contain animal
genes;
new proteins in food crops could cause allergies;
genes could escape from transgenics to wild plants;
create superweeds / damage ecosystems;
monopoly (created by large companies) adversely affects small farmers; **[6 max]**

Option G – Ecology and Conservation

- G1.** (a) old-growth forests have more nocturnal hunters than second-growth forests;
second-growth forests have more web builders/diurnal hunters than old-growth forests;
web-builders most abundant in both; **[2 max]**
- (b) more herbivores are found than other groups;
there are less detritivores than other groups;
approximately the same percentage of predator and omnivore spiders are found;
more total consumers (omnivores plus predators); **[2 max]**
- (c) name of an indicator species and why chosen;
explanation of how it serves as indicator species;
example:
nocturnal hunters/detritivores/predator arthropods more abundant in old-growth forests;
if quantities change, indicate change in conditions/environment/pollution; **[2 max]**
- G2.** (a) diversity index determines species richness of ecosystem;
higher the index the greater the diversity;
changes in the index indicate environmental change;
so community B has a higher species richness; **[3 max]**
- (b) the role/functional position of an organism in its environment;
spatial habitat where species live;
feeding activities / how food is obtained;
interactions with other organisms in community;
no two species can occupy the same niche; **[2 max]**

- G3.** (a) *Do not award a mark if a factor is mentioned but not explained.*
- breeding sites – animals must breed and may need a special site;
 - food supply – may feed on specific foods / abundance;
 - territory – need to establish / defend for food/mates;
 - competition – for food/space may alter distribution/niche;
 - predation – can reduce the range of another species / be reduced by predation;
 - temperature/climate – need the proper range for survival;
 - water – need water to live in (aquatic) / proper amount for bodily functions;
 - natural (geographic) barriers – limit range/dispersion / natural disasters could destroy food supplies;
 - free of pollution/toxic substances – could cause death;
- [5 max]**
- (b) ozone in stratosphere absorbs some ultraviolet light / protects earth from UV;
- UV light can damage tissues in living organisms;
 - UV light increases mutation rate / creates thymine dimers;
 - UV light can cause cancer / increase skin cancer;
 - UV light can cause cataracts;
 - UV light reduces photosynthetic rate in algae / terrestrial plants;
 - affects food chain *e.g.* kills phytoplankton/zooplankton/terrestrial food chains;
- Accept inverse statements for the positive role of the ozone layer in each case.*
- [4 max]**

Option H – Further Human Physiology

- H1.** (a) insulin levels at start of test are very high / 60 mU dm^{-3} ;
insulin levels decreased after exercise began;
insulin levels reached a minimum level at the end of the exercise period / 5 mU dm^{-3} ;
insulin levels decreased most during the beginning of the pre-load period;
insulin levels drop and then increases at a lower rate during pre-load period; **[2 max]**
- (b) overall insulin levels decrease and glucagon increase (for both meals);
preload insulin levels decreased (for both meals) while glucagon levels remained constant/decrease slightly (for high fat) / decreased (for high carbohydrate);
insulin levels decreased during the incremental test while glucagon increased;
final levels of insulin and glucagon at end of incremental test for both meals almost equal; **[2 max]**
- (c) after meal glucose/fat levels increase causing insulin secretion;
exercise decreases blood glucose levels causing glucagon levels to increase;
in negative feedback, blood glucose levels that are higher/lower than the set point cause the pancreas to secrete insulin/glucagon; **[2 max]**
Accept inverse statements.
- H2.** (a) liver stores excess glucose as glycogen / releases glucose from glycogen (as levels drop);
liver breaks down red blood cells / hemoglobin and stores iron;
liver stores fat soluble vitamins / vitamin A / vitamin D / vitamin B12 / folic acid; **[2 max]**
- (b) lipids are hydrophobic / not water soluble;
bile helps to break up lipid droplets / bile emulsifies fats / increases surface area of lipid droplets for lipase attack;
lipids more accessible to lipase / lipase breaks down lipids;
pancreatic juices brings up pH as optimal pH for lipase is alkaline/ pH8; **[2 max]**

- H3.** (a) SA (sino atrial) node/pacemaker receives signal to fire;
when ventricle 70 %/almost full;
AV (atrio ventricular) valve opens and blood fills ventricle (to maximum) / atrial systole;
pressure increase in ventricle closes AV valve / ventricular systole;
AV node fires;
Purkinje fibres carry impulses to all areas of ventricles for simultaneous firing;
pressure increase causes semilunar valve to open;
blood pumped from ventricle to aorta/systole sound / ventricular diastole;
pressure lowers in ventricle closing semilunar valve / diastole sound;
pressure in ventricle lower than atria so AV valve opens;
increases blood ventricular volume;
both atria and ventricles are relaxed / diastole;
atria receives blood from veins;
cycle repeats;

[6 max]

- (b) *Named factors and explanation.*
genetic – some people predisposed for high cholesterol levels / high blood pressure;
age – older people greater risk / less elasticity in arteries;
sex – males at great risk than females;
smoking – constricts blood vessels / increases blood pressure/heart-rate / decreases oxygenation of heart muscle;
diet – increases fat/cholesterol/LDL in blood / leads to plaque formation in arteries;
exercise – lack of exercise increases risk;
obesity – increase in blood pressure / leads to plaque formation in arteries;
Accept any other factor correctly explained e.g. diabetes, atherosclerosis. Do not award a mark for the name of a factor and simply that it leads to CHD.

[4 max]
