

# **MARKSCHEME**

**November 2002**

**BIOLOGY**

**Standard Level**

**Paper 3**

**Subject Details:                      Biology SL Paper 3 Markscheme****Mark Allocation**

Candidates are required to answer **ALL** questions in each of **THREE** Options (total [15 marks]).  
Maximum total = [45 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.
- ◆ 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. Indicate this by “**U-1**” at the first point it occurs. 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 A – Diet and human nutrition**

- A1.** (a) both saturated and polyunsaturates remain constant through hunter-gatherer and agricultural societies;  
saturated fats rise earlier / sooner at 200 bp / beginning of industrial revolution  
whereas polyunsaturates rise later / in the last 100 years;  
saturated fats rise from 8–9 % to 18 % whereas polyunsaturated rise from 5 % to 7 %;  
saturated always more than polyunsaturated / polyunsaturated less than saturated; **[2 max]**
- (b) 11 % ( $\pm 1$ ) **[1]**
- (c) carbohydrates / sugar / protein **[1]**
- (d) (i) (city) people eat less unprocessed foods / fruits and grains;  
natural foods / fruits and grains are more expensive;  
change in diet to more meats; **[1 max]**
- (ii) are manufactured (to make food production more economical);  
eating more meat / milk / cheese;  
meat more available / cheaper;  
refrigeration of meat more common; **[1 max]**
- A2.** (a) amino acids are absorbed in the small intestine;  
amino acids are carried in the bloodstream;  
proteins cannot be stored;  
amino acids are used for building new proteins;  
amino acids must be deaminated (before they can be used for energy);  
transamination; **[2 max]**
- (b) certain amino acids are essential and must be ingested;  
meat is a single protein source for all essential amino acids / complete protein source;  
diets without meat may be deficient in certain essential amino acids;  
but dairy products / milk / yoghurt / cheese / eggs are also a complete source of essential amino acids;  
but certain combinations of plant proteins provide a complete source of essential amino acids;  
therefore meat is not indispensable; **[4 max]**

- A3.** (a) unequal distribution of wealth;  
insufficient resources to import food;  
insufficient resources to produce food;  
no money to distribute food;  
corruption;  
economic sanctions;  
poverty leads to bad education; *[2 max]*
- (b) preservatives;  
antioxidants;  
colouring;  
flavouring;  
stabilizers;  
acid-regulators; *[1 max]*  
*Must state two roles for [1]. Do not accept nutrient supplements e.g. vitamins and minerals.*

**Option B – Physiology of exercise**

- B1.** (a) control group **[1]**
- (b) control group always has highest blood pressure;  
weight management and exercise group always has lowest blood pressure;  
increase in activity from low to medium causes an increase in blood pressure for all three groups;  
increase in activity from medium to high causes an increase in blood pressure for only the control group;  
increase in activity from medium to high causes a slight decrease / no change in blood pressure for exercise and weight management and exercise-only groups; **[3 max]**  
*[1 max] for descriptions of each with no comparison.*
- (c) weight management and exercise reduce blood pressure;  
during low, medium and high physical activity;  
during low and high emotional distress;  
exercise-only is generally more effective than weight management and exercise in reducing blood pressure; **[2 max]**
- B2.** (a) identification of biceps and triceps;  
correct position of biceps and triceps (*insertion and origin details not required*); **[2]**
- (b) muscles consist of bundles of muscle fibres (cells);  
bundles of myofibrils contain (thick filaments called) myosin and (thin filaments called) actin;  
muscles contract when thin / actin filaments and thick / myosin filaments slide past each other;  
(head ends of ) myosin filaments have attached ATP;  
and attach to (parallel) actin filaments nearby;  
myosin release of ADP allows heads to flip back causing the sliding action; **[3 max]**
- B3.** (a) the physical condition of the body which suits it to the particular exercise which it performs **[1]**
- (b) vigorous exercise causes a build-up of lactate / 2-hydroxypropanoate in the blood;  
oxygen can enable the liver to breakdown lactate / 2-hydroxypropanoate;  
a lack of oxygen to breakdown the lactate / 2-hydroxypropanoate is an oxygen debt;  
training enables more oxygen to be brought into the body because;  
training enlarges the heart so it can provide greater output of blood / increased cardiac output / increased stroke volume;  
(in adolescents) training increase lung capacity to bring in more air;  
greater blood supply with more oxygen repays the oxygen debt more quickly; **[3 max]**

**Option C – Cells and energy**

- C1.** (a) greater binding by cells containing antigen receptor;  
both cell types show increase in antigen binding after treatment with DNA;  
greater increase in antigen binding (after additional DNA introduced) in cells without receptor;  
after additional DNA introduced, both cell types show similar maximum antigen binding / approximately  $10^3$  arbitrary units; **[2 max]**
- (b) cells without receptors and no additional DNA show high viability regardless of antigen concentration;  
cells without receptors but treated with DNA show significant loss in viability starting at low concentration of antigen;  
cells with receptors show little decrease in viability after treatment with DNA;  
cells with receptors / cells with receptors treated with DNA show lowest viability;  
cells with receptors / cells with receptors treated with DNA show large decrease in viability at an antigen concentration of  $10^{-11}$  mol dm<sup>-3</sup>;  
cells without receptors treated with DNA do not show same minimum viability as cells with receptors / still show some viability at highest antigen concentration; **[3 max]**
- C2.** (a) *Both of the following are required for [1].*  
labelled outer membrane in an oval or circular shape;  
labelled inner membrane showing folded cristae; **[1]**
- (b) oxidation of glucose and its intermediates;  
phosphorylation (substrate level) of ADP / production of ATP;  
reduction of NAD<sup>+</sup> / production of NADH (+H<sup>+</sup>)  
formation of 2-oxopropanoate (pyruvate);  
dephosphorylation of ATP; **[2 max]**
- (c) electrons are separated from NADH / FADH;  
electrons are deposited with inner membrane carriers (electron transport system);  
passage of electrons among carriers causes H<sup>+</sup> to be shuttled across the inner membrane;  
from the matrix to the intermembrane space (where they are pooled);  
passage of H<sup>+</sup> back through the membrane via channels;  
through ATPase complex;  
causes phosphorylation of ADP to ATP; **[3 max]**
- C3.** (a) both C<sub>4</sub> and CAM plants live in arid areas (where water loss threatens the plants);  
both types of plants have preliminary incorporation of CO<sub>2</sub> into organic acids (before transfer to the Calvin cycle);  
C<sub>4</sub> plants avoid water loss through unique anatomy;  
CAM plants use unique timing of stomatal opening / nocturnal stomatal opening;  
as a result, both types of plant reduce transpirational water loss; **[3 max]**  
**[1 max]** for descriptions of each with no comparison.
- (b) in low light the rate of photosynthesis increases linearly with increasing light intensity;  
as light intensity gets high the rate of photosynthesis usually levels off because of other limiting factors; **[1 max]**

**Option D – Evolution**

- D1.** (a) as the latitude increases so the length of day needed to induce hibernation increases;  
there is a direct correlation between daylength and latitude; [1 max]
- (b) the shortest daylength to induce hibernation is the same at the lowest latitude in 1972  
and 1996;  
at higher latitudes, the daylength to induce hibernation is less in 1996 than 1972;  
for the same daylength, the latitude at which hibernation occurs has moved further  
north in 1996 compared to 1972;  
at lower latitudes the change in daylength is less than at higher latitudes; [2 max]
- (c) colder areas / higher latitudes become warmer / resemble lower latitudes (with  
shorter daylength);  
warmer weather delays organisms from beginning hibernation / mosquitos stay  
active longer into winter;  
(the graphs show) that organisms at higher latitudes have adapted to a shorter  
daylength (to begin hibernation); [2 max]
- D2.** (a)  $^{14}\text{C}$  / carbon-14 /  $^{40}\text{K}$  / potassium-40 [1]
- (b) the time during which the radioactivity falls to half its original level [1]
- (c) a decay curve (for a particular radioisotope) is used;  
amount of radioisotope in sample is determined;  
half-lives are converted into total years which have passed / age of fossil; [2 max]
- D3.** (a) opposable thumb / power grip;  
well developed cerebral cortex / brain;  
limber shoulder joints;  
finger pads / fingerprints / nails (*not claws*);  
pectoral mammary glands; [2 max]
- (b) *H. habilis* and *H. sapiens* [1]
- (c) large brain size correlates with language;  
large brain correlates with improvements in tool-making;  
improved tools allow more nutritious diets for further brain development;  
increased brain size leads to rituals / burying the dead;  
excellent eye-hand coordination;  
increased brain size leads to written history / cave art / symbolic thought; [3 max]

**Option E – Neurobiology and behaviour**

- E1.** (a) *Award any **two** of the following [1] each.*  
B, C, D, E *[2 max]*
- (b) early in the interaction they sing the same songs;  
later in the interaction they sing different songs;  
later in the interaction there are longer intervals between songs of both birds;  
later in the interaction there are less shared songs / more unshared songs;  
bird J sings more than bird I; *[2 max]*
- (c) singing more frequently / singing with less delay between songs;  
singing an identical song as the other bird in succession;  
singing only shared songs;  
singing only a few different types of shared songs; *[2 max]*
- E2.** (a) *[2] for three structures, [1] for one or two structures.*  
I. synapse;  
II. rod / photoreceptor;  
III. bipolar neuron; *[2 max]*
- (b) humans have three different cones (with pigments);  
cones (with pigments) can absorb red, green or blue light;  
(yellow light will result in) equal stimulation of red and green cones;  
which synapse with bipolar cells;  
which synapse with neurons of the optic nerve;  
which transmit the signal to the visual cortex (in the brain);  
where yellow colour is perceived; *[4 max]*
- E3.** (a) Pavlov investigated alteration of behaviour / conditioning of dogs whereas Skinner investigated reinforcement of a particular behaviour / operant conditioning;  
Pavlov worked with dogs, Skinner with rats (and pigeons);  
Pavlov and Skinner investigated behaviour linked to associations;  
Pavlov's experiments required two external stimuli, Skinner used one; *[2 max]*
- (b) a form of intelligent activity as a function of cognitive effort, in contrast to a more passive trial and error mode of learning;  
to learn by perceiving how we learn; *[1 max]*



**Option F – Applied plant and animal science**

- F1.** (a) the overall trend is an increase **[1]**
- (b) approximately 600 % ( $\pm 50$ ) increase **[1]**
- (c) more aquaculture / fish farming / cattle feed;  
greater demand for food because of growing human population;  
new methods of preparing fish to improve taste makes other species acceptable;  
new equipment and methods of fishing;  
fishing in new locations; **[2 max]**
- (d) provides food / protein for intensive livestock production;  
controlled source of nutrients / known composition;  
avoids contamination by pathogens (BSE/mad cow disease);  
efficiency of growth of livestock;  
because quantity can be regulated / dosed; **[2 max]**
- F2.** (a) the ratio between the total area of leaves of a plant crop and the area of soil available to it **[1]**
- (b) the most profitable crop can be grown in same area every year;  
the same plant means that crops can be more easily planted with minimal space between them;  
the same machinery can be used for cultivating the entire crop;  
all plants can receive the same fertilizer(s) (at the same time) / the same pesticide(s) (at the same time);  
sowing and harvesting of the entire plot can be done at the same time; **[2 max]**
- F3.** (a) *Award [1] for each **two** of the following structures clearly drawn and labelled correctly.*  
anther, stigma, filament, petals, style, sepals, ovaries, nectary, stamen; **[3 max]**
- (b) pollination is the transfer of pollen whereas fertilization is the fusion of gametes;  
pollination may occur over great distances, fertilization does not;  
pollination may involve insects, birds *etc.*, fertilization does not; **[1 max]**
- (c) flower growers need to know whether a particular flower self-pollinates or cross-pollinates;  
because this may help in producing purebreds or hybrids;  
flower growers need to know how soon after pollination fertilization will occur;  
because flowers go to seed after fertilization and are not saleable;  
type of pollinator must be known because artificial pollination may be necessary; **[2 max]**

**Option G – Ecology and conservation**

- G1.** (a) thicker branches have more cover / branches near the tree have more cover;  
thinner branches have less cover / no change until the branch is 17.9–1 cm; [1 max]
- (b) with higher angles there is usually less coverage;  
there is less change between 0–30° and 31–60° than between 31–60° and 61–90° ;  
the coverage for horizontal and inclined branches is almost the same;  
the ends of branches show least coverage; [2 max]
- (c) the overall patterns are the same;  
for branch diameters of 40–9 cm there is 100 % coverage in the mountains compared  
to 40 % in the lowland forest;  
for thinner branches (8.9–1 cm) the percentage cover in lowland forests is almost zero  
whereas mountain branches have 40 % cover; [2 max]
- (d) mountain forests are often covered in mist or clouds so there is more moisture available;  
more precipitation in mountain forests;  
lowland forests are warmer and plants dry out more easily;  
more animal activity / grazers in lowland forest; [1 max]
- G2.** (a) *Award [1] for any two of the following.*  
precipitation, evaporation (solar energy), transpiration, condensation (clouds),  
drainage / capillary action in soils (runoff or groundwater back to lakes or sea); [2 max]  
*If a named ecosystem is not stated, [1 max].*
- (b) remove minerals from the soil;  
reduce erosion;  
increase rainfall;  
create more soil / more humus;  
alter river flows / lakes filled in; [2 max]
- G3.** (a) *Award [1] for any three of the following.*  
temperature, water, breeding sites, food supply, territory, predation, competition [1 max]
- (b) an index of diversity is a measure of species diversity;  
can be applied to plant or animal species;  
index diversity of species is a measure of health / stability / degree of stress of an  
environment;  
comparison of two values is a measure of change for better or worse;  
data can be used for policy decisions regarding the environment;  
measure of species richness;  
low diversity indicates environmental stress; [3 max]
- (c) *A named organization and at least one role is required.*  
*examples:*  
CITES – identifies endangered organisms / restricts trade / encourages sustainable  
exploitation of species / ecotourism;  
WWF – fund raising / education / public awareness research / coordination / lobbying;  
IUCN – coordination; [1 max]
-