

# **MARKSCHEME**

**May 2004**

**BIOLOGY**

**Standard Level**

**Paper 3**

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## Subject Details:      **Biology SL Paper 3 Markscheme**

### Mark Allocation

Candidates are required to answer **ALL** questions in each of **TWO** Options (total **[18 marks]**).  
Maximum total = **[36 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.
- ◆ 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 A – Diet and Human Nutrition**

- A1.** (a) 3.5 ( $\pm 0.2$ ) [1]
- (b) wine X stronger flavour overall;  
wine X tastes mainly of oak while wine Y tastes of apple;  
wine Y has greater flavour of citrus (and apple);  
wine X has greater flavour of vanilla and caramel (and oak);  
any other valid comparison, which could be numerical; [2 max]
- (c) wine Z and wine Y;  
because pattern is similar;  
apple predominant taste / flavour;  
same vanilla taste;  
same oak taste;  
similar flavour of butter, caramel and citrus; [2 max]
- (d) (i) preservative;  
antioxidant;  
colouring;  
flavouring;  
stabilizer;  
acidity-regulator; [2 max]  
*Do not allow food supplements.*
- (ii) allergy;  
cancer; [1 max]  
hyperactivity / headaches / nausea / asthma;
- A2.** (a) margarine / sunflower seeds / vegetable oil / peanuts / nuts, etc. (no animal products) [1]
- (b) energy storage / energy supply;  
hormone production;  
cushioning/protection;  
insulation;  
(constituent of) membranes;  
cell respiration;  
myelin sheath; [2 max]
- (c) saturated fatty acids cause high cholesterol;  
atherosclerosis / narrowing of (lumen of) arteries;  
CHD / formation of clots / heart attack / heart failure / thrombosis / stroke;  
hypertension / high blood pressure;  
obesity / overweight;  
which is linked to diabetes;  
although there are also genetic factors / some countries eat a lot of fats and have low  
CHD; [4 max]

- A3.** food poisoning organisms / bacteria can occur if food not well cooked/raw;  
organisms / bacteria can multiply if food is re-frozen;  
contamination if cooked and uncooked stored / placed together / cut with the same knife;  
food poisoning if food consumed after expiry date;  
contamination / disease if flies / animals allowed on/near food;  
(fecal) contamination / food poisoning if dirty utensils used / dirty workplace / dirty hands;  
(fecal) contamination if vegetables not washed properly;

***[3 max]***

**Option B – Physiology of Exercise**

- B1.** (a) diabetes [1]
- (b) *Award four or five correct [2], three or two correct [1].*  
joggers, no diabetes, no smoking, high income, high education, low drinking/less than 21 drinks per week; [2 max]
- (c) Copenhagen study confirms the hypothesis;  
joggers had less risk of death;  
0.61 times smaller;  
other factors seemed to affect more; [3 max]
- (d) (i) fall in resting heart rate / increase in stroke volume / more powerful heart beats / high cardiac output / greater heart size/thickening of left ventricle / decrease in pressure;  
stronger heart / heart rate increases / blood vessels kept elastic; [1 max]
- (ii) increased tidal volume / increased vital capacity / steady rate of oxygen uptake [1]
- (iii) increase in size / high capillary density / more muscle fibre / more mitochondria / more irrigation / more glycogen and fat stored / more myoglobin / stronger muscles [1]
- B2.** (a) *Award [2] for three of the following structures clearly drawn and labelled correctly. Award [1] for two of the following structures clearly drawn and labelled correctly. Award [0] for an incorrect diagram, such as motor neuron.*  
sensory plate / sensory receptor / sense organ;  
cell body / nucleus;  
dendron / dendrite;  
axon;  
nerve ending; [2 max]
- (b) movement in one plane;  
flexion (backward);  
extension / straightens / kicks (forward); [2 max]
- B3.** (a) binds oxygen when level is high;  
releases oxygen when level is low;  
acts as an oxygen store;  
allows muscles to continue with aerobic respiration for longer; [2 max]
- (b) secreted during (or before) vigorous exercise;  
glycogen stores broken down to release glucose / more glucose goes to muscle;  
heart rate increased;  
blood vessels to muscle dilate;  
more blood / oxygen to muscles; [3 max]

**Option C – Cells and Energy**

**C1.** (a) directly proportional / greater concentration, greater rate of reaction;  
at high concentrations the increase is smaller / plateau / levels-off (at approximately  
70 mmol dm<sup>-3</sup>); [2]

(b) (i) 1 mmol dm<sup>-3</sup> : 0.70 (±0.02)  
3 mmol dm<sup>-3</sup> : 0.55 (±0.02) [1 max]  
*Both needed for [1]. For 1 mmol dm<sup>-3</sup> accept 0.7.*

(ii) lower reaction rate at inhibitor concentration of 3 mmol dm<sup>-3</sup> / the greater the  
inhibitor concentration the slower the rate of reaction;  
trend / overall shape are the same / increases but then levels-off;  
but lower at greater concentration of inhibitor; [1 max]

(c) substrate and inhibitor (structurally) similar;  
inhibitor binds to active site;  
prevents substrate from binding;  
activity of enzyme prevented;  
named example (*e.g.* malonate inhibits succinate dehydrogenase as it is similar to  
succinate); [3 max]

**C2.** (a) ATP;  
CO<sub>2</sub>;  
ethanol;  
lactic acid;  
heat energy; [1 max]

(b)

Reaction	Oxidation	Reduction
<i>Electrons gained or lost</i>	loss of electrons	gain of electrons;
<i>Oxygen or hydrogen gained or lost</i>	gain of oxygen / loss of H <sup>+</sup> /hydrogen	loss of oxygen / gain of H <sup>+</sup> /hydrogen;

[2]

*Award [2] for four correct and [1] for two correct.*

(c) A – matrix: site for Krebs’ cycle / link reaction / ATP synthesis;  
B – inner membrane/cristae: site of oxidative phosphorylation / e<sup>-</sup> transport chain /  
increase surface area / ATP synthesis;  
C – inter membrane : H<sup>+</sup> / proton build up;  
**or**  
C – outer membrane: determines which substances enter the mitochondrion; [3 max]  
*Award [1 max] if only the three labels are given.*

- C3.** (a) stroma (of chloroplast) *[1]*
- (b) peak at about 450 and at 650 nm and follows pattern of absorption spectrum *[1]*
- (c) electron transport causes proton/hydrogen ion pumping;  
protons inside thylakoids;  
accumulation of protons /  $H^+$  / drop in pH;  
protons leave through proton channel (to stroma);  
ATP synthetase / enzyme catalyses phosphorylation of ADP; *[3 max]*



**Option D – Evolution**

- D1.** (a) lemurs / lorises [1]
- (b) Old World monkeys closer to Great apes / New World monkeys closer to lemurs / lorises;  
overlap / coincide at some point;  
wider range in New World monkey cerebrotypes than in Old World monkeys; [2 max]
- (c) coincides with DNA tree / different to morphology;  
because of exact match;  
shows that *Pan*/chimp and *Homo*/human are close;  
gorilla less close;  
orangutan / *Pongo* further away; [2 max]
- (d) carbon dating / <sup>14</sup>C dating / <sup>40</sup>K dating;  
measure the amount of isotope relative to original amount / less of the original  
isotope present the older the fossil / age can be calculated by knowing the half life  
of the isotope; [2]
- D2.** (a) apparatus to simulate early Earth conditions (*accept suitable drawing*);  
high energy chamber / sparks;  
gases introduced (CH<sub>4</sub>, NH<sub>3</sub>, H<sub>2</sub>) to form reducing atmosphere / like ancient pre-biotic  
atmosphere;  
boiling and condensing / simulation of rainfall;  
synthesis of organic molecules (amino acids, adenine, ribose); [2 max]
- (b) (i) *Award [1] each for any two of the following.*  
high temperature / high UV / reducing atmosphere (no O<sub>2</sub>) / lightning storms  
/ volcanic activity; [2 max]
- (ii) RNA can be replicated;  
can act as catalyst;  
RNA used instead of DNA;  
RNA used to synthesize proteins;  
offers a way round the “chicken and egg” problem / genes require enzymes  
and enzymes require genes (RNA can do both); [3 max]
- (c) Special creation — arrived from outer space  
Panspermia — created from inorganic matter  
Spontaneous generation — life made by God [1]
- D3.** about five million years ago;  
it became drier;  
it became cooler;  
dense forest was replaced by thin woodland / clearing;  
evolution of bipedalism (started leaving trees);  
vegetarians;  
incompleteness of fossil record causes uncertainties about human evolution; [3 max]

**Option E – Neurobiology and Behaviour**

- E1.** (a) (i) 75 ( $\pm 3$ ) [1]
- (ii) 25 ( $\pm 3$ ) [1]
- (b) intact spiders return to housefly location while damaged spiders walk in different directions / no defined direction;  
only a few were very close to housefly location in damaged spiders / approx 25 % were within 30° ;  
while most intact spiders reached housefly location / approx 75 % were 30° from housefly location; [2 max]  
*Accept any other comparative value.*
- (c) innate and learned behaviour / both;  
innate is the ability to navigate this way / could not see but still went back;  
innate because they searched for the fly;  
innate as nearly all show responses;  
learned is the ability to walk back / without slit sense organs can not find housefly;  
definition of innate: controlled by genes / inherited / despite variation of environment;  
definition of learned: experiences during development / not inherited; [3 max]
- E2.** (a) *Award four correct [2], two or three correct [1].* [2 max]
- (b) named example / reflex action;  
description / sensor and effector;  
how it helps;  
*example:*  
pupil reflex;  
object close to eye is seen by retina;  
muscles of eyelid close it;  
eye is protected from objects entering / harming it; [3 max]
- E3.** (a) imprinting [1]
- (b) trial and error learning;  
experimental chamber / Skinner box;  
lever operated food supply;  
after accidental encounters with lever, experimental animals pressed lever when hungry; [2 max]
- (c) named bird or mammal (*e.g. chaffinches*);  
the example of communication (*e.g. may sing at specific frequencies*);  
explain the outcome of the communication (*e.g. allows the source of the call to be located*); [3]

**Option F – Applied Plant and Animal Science**

- F1.** (a) greatest in alfalfa but lowest in Sudan;  
saltbush and sea blite higher than Sudan, lower than alfalfa;  
seawater average / total biomass is higher than the freshwater (*could be a numerical comparison*);  
no overall trend / no difference; **[2 max]**
- (b) greater daily weight gain in sea blite / 110 %, less in saltbush / 90 %;  
greater water intake in sea blite / 190 %, less in saltbush / 145 %; **[2]**
- (c) *Must have both advantages and disadvantages for full marks.*  
*advantages:*  
good biomass yield;  
good daily weight gain of sheep;  
(slight) improvement in meat quality;  
avoids using freshwater;  
*disadvantages:*  
lower food conversion efficiency;  
greater water intake by sheep; **[3 max]**
- F2.** (a) food;  
plowing;  
transport;  
fur / clothes / skins / wool;  
sheepdogs;  
guide dogs;  
pets;  
vaccines;  
medical trials; **[2 max]**  
*Accept other appropriate examples.*
- (b) (i) obtaining more vigorous offspring by crossing unrelated varieties **[1]**  
*The answer requires more than just a definition of a hybrid.*
- (ii) different rice varieties collected / assessed;  
varieties with desired characteristics bred;  
cross pollination;  
grown on and best ones chosen;  
seed saved;  
*example:*  
IR8;  
semi-dwarf variety (of Taiwan) crossed with fast growing (from Indonesia);  
new variety with short stem and heavy ears of large grain; **[3 max]**

- F3.** (a) apical dominance / growth promoter;  
induction of fruit development (even if no fertilization);  
root formation;  
phototropism;

*[2 max]*

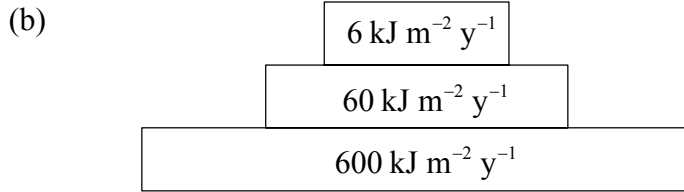
- (b) warmer temperatures for enzymes / glass or plastic retains long wave radiation;  
more carbon dioxide for photosynthesis / burning of fuel to increase CO<sub>2</sub> ;  
more light for photosynthesis / artificial lighting;  
high water availability / irrigation;  
ventilation to increase transpiration rate;  
exclusion of predators;  
shade to avoid excess of light;  
damage due to storm avoided;

*[3 max]*

**Option G – Ecology and Conservation**

- G1.** (a) (i) 70 (%) / 45 (%) and 25(%) [1]  
(ii) 101 ( $\pm 1$ ) [1]
- (b) fire;  
flood;  
logging/deforestation;  
hurricanes/strong winds;  
drought;  
land clearance;  
climatic changes;  
pollution; [2 max]  
*Accept other appropriate answers.*
- (c) small size more likely to suffer from habit loss;  
large size from persecution / predation; [2]
- (d) remove predators / persecution;  
may be *in situ* or *ex situ* conservation;  
national parks / nature reserves;  
hunting seasons;  
captive breeding (in zoos);  
legislation (e.g. endangered species list, quotas);  
agencies / examples; [3 max]
- G2.** (a) light;  
water;  
soil pH;  
salinity;  
soil drainage;  
mineral nutrients; [1 max]
- (b) to see if there is (significant) difference between means of two populations;  
a null hypothesis is stated / alternative hypothesis says data are different;  
mean heights found;  
a table is used according to degrees of freedom;  
if value is greater than critical value, there is (significant) difference / reject the null hypothesis;  
so temperature does make a difference;  
if value is not greater temperature has no effect; [3 max]

**G3.** (a) plant respiration = gross production – net production /  $6 \times 10^2 \text{ kJ m}^{-2} \text{ y}^{-1} - 5 \times 10^2 \text{ kJ m}^{-2} \text{ y}^{-1}$ ;  
=  $1 \times 10^2 / 100 \text{ kJ m}^{-2} \text{ y}^{-1}$ ; **[2]**  
*Units required.*



correct pyramid shape;  
 $6 \text{ kJ m}^{-2} \text{ y}^{-1}$  (*correctly calculated as energy passed to secondary consumer*);  
producer and primary consumer values correctly inserted; **[3 max]**  
*Award [2 max] if there are units omitted. Award [2 max] if a bar is included for the solar energy. Do not deduct marks if the areas of the bars are not proportional to the values, although they should get smaller going up.*

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