

# **MARKSCHEME**

**November 2007**

**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.
- ◆ Words that are underlined are essential for 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 markscheme then award the mark.
- ◆ Mark positively. Give candidates 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. 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) coarse normal gluten flour **[1]**
- (b) the point showing the highest increase is the same/similar in both types of bread;  
the point showing the greatest lowering came from the normal;  
the mean shows fine high gluten lowers lipids more than fine normal gluten;  
fine normal gluten has a greater spread of values; **[2 max]**
- (c) cardiovascular disease can be caused by a high blood lipid level;  
bread made with high gluten lowered the lipids level most;  
difference in lipids level is small for change in particle size / coarse and fine particles;  
the hypothesis is supported by the data;  
the wide spread of data may mean there is no significance and the hypothesis is not supported; **[3 max]**
- (d) helps peristalsis / prevents cancer / prevents obesity / prevents constipation **[1]**  
*Do not accept “removes waste”.*
- A2.** (a) component of thyroxin / needed for thyroid gland / prevents goitre **[1]**
- (b) controls the fluidity of the membranes **[1]**
- (c) vegans do not eat food containing animal products;  
rickets is caused by a deficiency of vitamin D/calciferol;  
most sources of vitamin D/calciferol are animal products / milk / butter;  
may be prevented by exposure to sunlight / use of supplements; **[3 max]**
- A3.** (a) preservatives;  
colouring;  
antioxidants;  
acid-regulators;  
change flavour;  
stabilizers;  
acid regulators; **[2 max]**  
*Do not accept examples of food supplements e.g. vitamin C.*
- (b) well cooked to kill bacteria;  
do not store cooked and raw meats together to avoid contamination;  
wash hands to get rid of bacteria;  
store in freezer so bacteria cannot multiply;  
do not expose to animals or insects that may carry diseases;  
food handlers dressed properly to avoid contamination;  
keep chopping boards/utensil separate/clean to prevent (spreading) bacteria;  
wash fruit/vegetables to prevent bacteria/organisms / to clean; **[4 max]**

**Option B — Physiology of Exercise**

- B1.** (a) 40% [1]
- (b) 21% to 37% inclusive (*accept any answer in between these percentages*) [1]
- (c) as distance increases Slow type I increases;  
as distance increases Fast type IIa/IIx decreases;  
as distance increase Fast type IIx decrease more than Fast type IIa; [2 max]
- (d) slow (twitch) muscle fibres have a very good blood supply, brings oxygen removes carbon dioxide;  
slow (twitch) muscle fibres have plenty of myoglobin for oxygen storage;  
slow (twitch) muscle fibres allow sustained period of activity / stamina;  
slow (twitch) muscle fibres have high rates of aerobic respiration; [3 max]
- B2.** (a) adrenalin / glucagon [1]
- (b) during heavy exercise the muscles respire anaerobically;  
lactate/lactic acid is produced / an oxygen debt occurs;  
heavy breathing to provide oxygen to break down lactate/lactic acid / repay debt; [2 max]
- (c) rise in carbon dioxide level in the blood;  
this lowers the pH of the blood;  
detected by chemoreceptors in the walls of the arteries;  
impulses sent to the breathing centre of the brain;  
impulses sent to the intercostal muscles / diaphragm;  
ventilation rate increases; [4 max]
- B3.** (a) ligaments attach bones to bones and tendons attach muscles to bones [1]
- (b) cheating / unethical / illegal / unfair advantage;  
may cause long-term negative effects on the body;  
give false impression of the athlete's ability;  
profit illegal dealers; [3 max]

**Option C — Cells and Energy**

- C1.** (a) as cadmium ion concentration increases, respiration rate decreases **[1]**
- (b) at  $50 \mu\text{mol dm}^{-3}$  respiration is lower than at  $0 \mu\text{mol dm}^{-3}$  for all temperatures;  
 at  $50 \mu\text{mol dm}^{-3}$  respiration is highest at  $15^\circ\text{C}$ , whereas at  $0 \mu\text{mol dm}^{-3}$  respiration is highest at  $25^\circ$ ;  
 respiration at  $35^\circ\text{C}$  is lowest at both cadmium concentrations; **[2 max]**
- (c) salinity / pH / clarity / oxygen level / pollution **[1]**
- (d) data shows results only for cadmium, not for all trace elements;  
 the hypothesis is always supported for changes of temperature from  $15/25$  to  $35^\circ\text{C}$  ;  
 the hypothesis is not always supported from  $15$  to  $25^\circ\text{C}$  ;  
 at  $35^\circ\text{C}$  the effect on respiration is greatest at all cadmium levels;  
 may be other factors causing the respiration to fall (such as activity of enzymes);  
 marine temperatures unlikely to reach  $35^\circ\text{C}$  ; **[3 max]**
- C2.** (a) stroma **[1]**
- (b) ribulose biphosphate (RuBP) combines with carbon dioxide / carboxylation;  
 transforms into glycerate-3-phosphate (GP);  
 reaction catalysed by ribulose biphosphate (RuBP) carboxylase;  
 reconverted to ribulose biphosphate (RuBP) and recycled; **[2 max]**
- (c) light is not the limiting factor;  
 another factor;  
*e.g.* temperature / carbon dioxide concentration is in short supply;  
 if this factor were increased, more light would cause more photosynthesis; **[2 max]**
- C3.** (a) name and function;  
*e.g.* hemoglobin carries oxygen **[1]**
- (b) order of amino acids in polypeptides;  
 primary structure determines higher structure;  
 primary structure reflects genetic information / is coded for by the DNA; **[2 max]**
- (c) competitive inhibitors are structurally similar to the substrate;  
 competitive inhibitors bind / block active site;  
 non-competitive inhibitors do not bind to the active site / bind somewhere else on enzyme;  
 they function by changing the shape of the enzyme so the substrate cannot fit in to the active site; **[3 max]**

**Option D — Evolution**

- D1.** (a)  $90(\pm 5) \mu\text{g m}^{-3}$  (*units required*) [1]
- (b) increase in fuel consumption / cold weather / more industry / *etc.* [1]
- (c) both decrease over the time of the study;  
in earlier years smoke level fell but percentage of melanic moths remained high;  
later when smoke level was low/constant percentage of melanic forms dropped; [2 max]
- (d) evolution requires a change in environmental conditions;  
the data shows the smoke level falls;  
natural selection is when the (environmental) changes favour certain individuals;  
they are selected and pass their genes to offspring;  
the change in the melanic form occurs as the smoke level falls providing evidence  
for evolution / the change in the melanic form occurs after the smoke level falls so  
is not responsible for the change in the moth;  
factors (other than smoke level) may cause the moths to change form; [3 max]
- D2.** (a) (groups of organisms) with structural similarities that may have a common ancestor [1]
- (b) phospholipids self assemble into double layered structures;  
they form into spheres capturing fluids;  
fluids contain molecules that can replicate / catalyse within their boundaries; [2 max]
- (c) mutations cause changes in the protein structure;  
mutations have a fixed frequency of occurrence;  
protein structure from common ancestor changes over time;  
the greater the difference between proteins, the more mutations have occurred;  
species more closely related have less differences in their protein structure; [3 max]
- D3.** (a) fossilization needs special conditions not always present;  
soft body parts may not fossilize;  
evolution may have happened relatively fast so few fossils;  
some fossils may not yet have been discovered; [2 max]
- (b) climatic change / drier in Africa;  
vegetation changed from dense forest to shrub and bush;  
bipedalism allowed freedom of hands / longer distance of vision;  
jaw adapted to vegetarian diet; [3 max]

**Option E — Neurobiology and Behaviour**

- E1.** (a) 10 [1]
- (b) 50% [1]
- (c) result I occurred more times than result VI;  
in I there was no change in ranking after separation but in VI there was a change;  
before separation each was ranked separately in I but not in result VI;  
the most dominant A remained dominant A in both I and VI;  
in both I and VI the cichlids were ranked separately after the separation; [3 max]
- (d) more dominant have choice of mates / habitat / more food / breeding site;  
they pass their genes on to the next generation / reproduce and pass on traits; [2]
- E2.** (a) receptor and sensory neuron dorsally with cell body in dorsal root ganglion;  
association/relay neuron within the grey matter;  
motor neuron and effector drawn ventrally with cell body in grey matter; [2 max]  
*Structures must be drawn and labelled correctly.*
- (b) temperature regulation / control hunger / osmoregulation / sleep / release hormones  
from the pituitary gland [1]
- (c) respond to a stimulus that causes movement, e.g. pressure, vibration, gravity;  
Pacinian corpuscle to pressure / pain receptor / free nerve ending / nociceptors in  
skin / touch in skin / hair cells in inner ear; [2]
- E3.** (a) learning a response to a stimulus just after birth / during a sensitive period [1]
- (b) bees live / interact together in a group;  
each is specialized for a particular task that helps the group as a whole;  
e.g. locating food / protecting others / reproduction;  
queen reproduces / forager forages for food / sterile male / worker; [2 max]
- (c) an individual sacrifices (reproductive chances) for the benefit of others;  
named example;  
description of altruistic behaviour;  
e.g. a meerkat /vervet monkey;  
stands guard by its burrow to warn others of predators / screeches when predators  
approach making themselves more susceptible to attack; [3 max]



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

- F1.** (a) 14 000(±500) kg ha<sup>-1</sup> (*units required*) [1]
- (b) as phosphorous uptake increases, biomass increases / directly proportional / positive correlation [1]
- (c) dry mass of useable crop produced in a given area [1]
- (d) increasing the amount of phosphorous fertilizer beyond 2 kg ha<sup>-1</sup> of phosphorous caused slight/no increase in rice yield;  
increasing the phosphorous fertilizer caused bigger gain in the biomass of the whole plant;  
fertilizers may be expensive;  
excessive fertilizer may lead to other ecological problems;  
some phosphorous is needed for rice to be produced / numerical reference to 0 kg ha<sup>-1</sup> to 2 kg ha<sup>-1</sup> phosphorous uptake; [3 max]
- F2.** (a) inbreeding is crossing closely related individuals, outbreeding is crossing unrelated individuals [1]  
*Award [0] if reference is given to closely related species.*
- (b) individuals with the most desired characteristics are kept for breeding;  
egg yield in poultry / milk yield in cows / meat yield in cattle / sheep; [2]
- (c) pesticides kill pests that may cause diseases;  
pesticides kill pests therefore may increase crop yield;  
chemicals may harm other organisms other than those intended;  
pesticides should be biodegradable / non persistent;  
pesticides can result in bioaccumulation / reference to food chains;  
pesticides should be specific and selective in targeting pests;  
pesticides are expensive; [3 max]
- F3.** (a) hydroponics [1]
- (b) an organism has more than two sets of chromosomes;  
*outline an example:* common wheat resulted from crossing between two different species; [2]
- (c) phototropism is a growth response to light;  
controlled by the plant hormone auxin produced at the tip;  
tip of shoot sensitive to light;  
auxin accumulates in the side of the plant away from the light;  
auxin causes cell elongation causing the shoot to bend toward the light; [3 max]

**Option G — Ecology and Conservation**

- G1.** (a) 3 [1]
- (b) grazing [1]
- (c) pollution affects more wilderness zones than climate change;  
climate change affects more biomes (5) than pollution;  
tropical humid forests / affected by climate change but not pollution;  
both affect temperate forests / wetlands / deserts / tundra;  
pollution effect on deserts/wetlands greater than climate change;  
climate change effect on tundra greater than pollution; [3 max]
- (d) biodiversity is reduced due to destruction of habitats / food / breeding grounds /  
killing species [1]
- G2.** (a)  $\text{MJ Ha}^{-1} \text{ year}^{-1}$  [1]  
*Accept other example of energy per unit area per unit time.*
- (b) predation is when a consumer eats another consumer;  
parasitism is when one organism/parasite lives in/on another organism and gets its  
food from it; [2]
- (c) trophic levels are energy/food levels in an ecosystem;  
consumers in the ecosystem (generally) feed on organisms in the trophic level  
below them;  
some organisms feed in more than one trophic level;  
*e.g.* hedgehogs can eat plants and animals;  
generally placed in the trophic level according to their main food source; [3 max]
- G3.** (a) conservation/preservation carried out in the organisms natural habitat [1]
- (b) example: *e.g.* Tasmanian tiger;  
cause: *e.g.* competition from dingo / hunting by man / habitat destruction; [2]
- (c) a biotic index uses an indicator species/living organism to measure (environmental)  
change;  
biotic index can be used as a measure of pollution / to measure the abiotic component  
of the ecosystem;  
organisms in an ecosystem are classified according to their tolerance to pollution;  
a study of the change in the numbers of these organisms indicates the health of the  
ecosystem;  
lichens for sulfur dioxide / insect larvae for water pollution / other example; [3 max]
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