



# **MARKSCHEME**

**November 2009**

**BIOLOGY**

**Standard Level**

**Paper 3**

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## General Marking Instructions

### Subject Details: Biology SL Paper 3 Markscheme

#### Mark Allocation

Candidates are required to answer questions from **TWO** of the Options [**2 × 18 marks**].

Maximum total = [**36 marks**].

1. A markscheme often has more marking points than the total allows. This is intentional. Do **not** award more than the maximum marks allowed for part of a question.
2. Each marking point has a separate line and the end is signified by means of a semicolon (;).
3. An alternative answer or wording is indicated in the markscheme by a slash (/). Either wording can be accepted.
4. Words in brackets ( ) in the markscheme are not necessary to gain the mark.
5. Words that are underlined are essential for the mark.
6. The order of marking points does not have to be as in the markscheme, unless stated otherwise.
7. If the candidate's answer has the same "meaning" or can be clearly interpreted as being of equivalent significance, detail and validity as that in the markscheme then award the mark. Where this point is considered to be particularly relevant in a question it is emphasized by writing **OWTTE** (or words to that effect).
8. Occasionally, a part of a question may require an answer that is required for subsequent marking points. If an error is made in the first marking point then it should be penalized. However, if the incorrect answer is used correctly in subsequent marking points then **follow through** marks should be awarded.
9. Only consider units at the end of a calculation. Unless directed otherwise in the markscheme, unit errors should only be penalized once in the paper.

**Option A — Human nutrition and health**

- A1.** (a) mean zinc content higher in control group;  
control group more variable;  
overlap between two groups / highest of anorexia nervosa group equals mean of control group; [2 max]
- (b) (data suggest this is) probable / could be symptom;  
other conditions could lead to low zinc;  
 $6\mu\text{g g}^{-1}$  is within the lower range of “normal”; [2 max]
- (c) zinc supplementation is necessary for insufficient dietary intake / improvement in below normal intake would be resolved;  
improved appetite may result;  
low zinc may be effect not cause of anorexia nervosa / other causes of anorexia; [2 max]
- (d) minerals are inorganic while vitamins are organic;  
minerals tend to be in ionic elemental form/small molecules while vitamins tend to be larger molecules; [1 max]
- (e) (below a BMI of)  $18.5\text{ kg m}^{-2}$  (*units needed*) [1]
- A2.** (a) lack of blood plasma proteins;  
subsequent tissue fluid retention;  
swelling of abdomen;  
retarded physical and mental development of children;  
muscle wastage; [1 max]
- (b) sedentary lifestyle/occupations / lack of exercise;  
diets high in processed contents / low in complex carbohydrates;  
diets high in fat;  
availability of inexpensive food / large portion sizes; [3 max]
- (c) *advantages:*  
less consumption of aviation fuel / less fossil fuel consumption per food unit;  
reduced pollution/road congestion;  
food will be fresher;
- disadvantages:*  
reduction in choice / less access to exotic foods;  
reduction in access to foods out of season;  
reduced international trade (with developing countries);  
might be more expensive (short-term); [3 max]
- Award [2 max] for responses that address advantages or disadvantages only.*
- A3.** cis (isomers) or trans (isomers);  
saturated or unsaturated;  
monounsaturated or polyunsaturated;  
location of the double bond;  
can be short chain or long chain; [3 max]

**Option B — Physiology of exercise**

- B1.** (a) both rates increase with time;  
rate of release of  $H^+$  always higher;  
rate of release of  $H^+$  increases faster than that of lactate; [2 max]
- (b) lactate production indicates anaerobic cell respiration;  
a correlation between lactate and  $H^+$  / some support for hypothesis;  
expect 1  $H^+$  to 1 lactate / ratio of  $H^+$  to lactate higher than 1:1;  
 $H^+$  cannot account for all the acid / there must be another source of  $H^+$ ; [2 max]
- (c) both will continue to rise;  
because of the acid, they cannot both continue to rise indefinitely / will level off;  
because of muscle fatigue, they cannot both continue to rise indefinitely / will level-off; [2 max]
- B2.** (a) *Award [1] for each structure clearly drawn and correctly labelled.*  
light and dark bands;  
Z line;  
(thin) actin filaments shown with no gap between these and Z line;  
(thick) myosin filaments shown with heads; [3 max]
- (b) 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]
- B3.** (a) (with exercise) switch to anaerobic respiration from aerobic respiration;  
switch from fat to carbohydrate;  
eventually no fat respired / 100% of respiration of carbohydrate; [2 max]
- (b) blood flow to brain unchanged with exercise;  
blood flow to heart wall/skeletal muscles/skin increased with exercise;  
blood flow to kidneys/stomach/intestines/other abdominal organs reduces with exercise; [2 max]
- (c) speed is how quickly the body/body parts move a given distance per unit time;  
stamina is the capacity of sustaining effort/exercise level;  
if exercise not sufficiently challenging, then stamina appears higher than expected;  
the appropriate fitness measure depends on a particular activity;  
stamina is important for endurance sports *e.g.* marathon running; [3 max]

**Option C — Cells and energy**

- C1.** (a) overall photosynthesis rates go down with increasing salt concentration [1]  
 (b) decline in activity for photosystem II but not for photosystem I [1]  
 (c) cyclic photophosphorylation dependent on photosystem I;  
 photosystem I is not affected by increasing salt concentration; [2]  
 (d) reduced growth;  
 due to reduction in rates of photosynthesis/energy fixation; [2]

- C2.** (a) keratin / collagen / myosin / silk/fibroin / elastin [1]

(b)

secondary structure refers to regular repeating regions within the overall protein structure	while tertiary structure refers to the protein overall / 3-D;
secondary structure $\alpha$ helix/ $\beta$ sheets	while tertiary is globular/fibrous;
forces between amino and carboxyl groups/atoms within backbone in secondary structure	while intramolecular forces between R-groups for tertiary structure;
H-bonds	H-bonds / disulfide bonds / ionic bonds / hydrophobic interactions;

[3 max]

*To award a mark responses must refer to both secondary and tertiary structures.*

- (c) form of non-competitive inhibition;  
 (inhibitor) binds to a site that is not the active site;  
 causing conformational change;  
 changes the active site;  
 so substrate can no longer bind to active site; [3 max]

- C3.** (a) inter-membrane space / outside inner membrane / between outer and inner membrane [1]

- (b) in the electron transport chain;  
 final electron/hydrogen acceptor;  
 combines with  $H^+$  (and electrons) to produce water; [2 max]

- (c) cristae for increasing surface area;  
 small inter-membrane space for rapid build-up of concentration gradient;  
 matrix with chemical concentration to support unique chemical reactions; [2 max]

**Option D — Evolution**

- D1.** (a) native species is more rounded; (*accept converse*)  
 introduced species has larger seeds; (*accept converse*)  
 both species divided into three compartments / have three seeds;  
 the seeds are closer to the surface in the introduced species; (*accept converse*) [2 max]
- (b) (i) proboscis length has decreased;  
 proboscis length has become less variable; [2]
- (ii) variation in proboscis length in original population;  
 the short proboscis can feed more easily on the introduced species;  
 takes less resources to make short proboscis;  
 soapberry bugs with a short proboscis are more likely to survive to reproductive age;  
 the short proboscis is selected for / genes passed on to the next generation;  
 increased frequency of introduced species/*Koelreuteria elegans*; [3 max]
- D2.** (a) (under the hypothesized conditions) on the pre-biotic Earth, simple organic molecules could have been created [1]
- (b) smaller/70S ribosomes in mitochondria/chloroplasts (as in prokaryotes);  
 circular DNA in mitochondria/chloroplasts (as in prokaryotes);  
 mitochondria/chloroplasts have double membrane;  
 similar size/shape of mitochondria/chloroplasts to prokaryotes; [2 max]
- D3.** (a) both involve reproductive isolation / separation of gene pools;  
 sympatric is speciation due to isolation of populations living in the same geographic area whereas allopatric is speciation due to geographic isolation; [2]
- (b) (i) *e.g. A. afarensis / A. africanus / A. garhi* [1]  
*Award [0] if species name has a capital letter.*
- (ii) *Award [1] for a value within date range and [1] for geographic distribution.*
- | species             | date range      | geographic distribution |
|---------------------|-----------------|-------------------------|
| <i>A. afarensis</i> | 3.9 to 2.9 mya; | <u>eastern</u> Africa;  |
| <i>A. africanus</i> | 2 to 3 mya;     | <u>southern</u> Africa; |
| <i>A. garhi</i>     | 2 to 3 mya;     | <u>eastern</u> Africa;  |
- (c) long periods of stability;  
 environmental change / sudden change;  
 leads to rapid speciation/evolution;  
 helps to explain absence of intermediate forms;  
 competing theory is gradualism; [3 max]

**Option E — Neurobiology and behaviour**

**E1.** (a) (i) (mean) chick mass increases in presence of helpers [1]

(ii) female survival probability increases in presence of helpers [1]

(b)  $\frac{1300-1225}{1300} \times 100\%$  *or* other correct calculation; [2]  
 5.8%;  
*Accept the correct answer if it is not rounded up to 5.8% or if it is rounded up to 6%.*

(c) with helper, smaller egg volume;  
 less resources from mother to produce egg/rear young;  
 more resources toward survival of mother; [2 max]

**E2.** (a)

<i>Rods</i>	<i>Cones</i>
work better in dim conditions	only stimulated by bright light;
absorb all the visible wavelengths of light / but do not distinguish wavelengths/colours	different kinds of cones absorb different wavelengths / different types for different wavelengths/colours of light;
spread through retina	concentrated in centre of retina;
multiple rod cells per neuron	one cone cell per neuron;

[3 max]

(b) receptors detect stimuli;  
 transmit information regarding stimuli to the central nervous system;  
 via sensory neurons;  
 central nervous system sends impulse to effector;  
 via motor neuron; [3 max]

(c) *Award [1] for every two correct answers.*  
 thermoreceptor / chemoreceptor / photoreceptor / mechanoreceptor / baroreceptor / proprioceptor [2 max]

**E3.** (a) a conditioned response is learned whereas an unconditioned response is innate;  
 an unconditioned response is made to an unconditioned stimulus whereas a conditioned response is made to a conditioned stimulus; [2]

(b) binds to cannaboid/pre-synaptic receptors;  
 inhibits neurotransmitter release;  
 therefore no excitation of post-synaptic membranes; [2 max]



**Option F — Microbes and biotechnology**

- F1.** (a) 1.05 kg (*units needed*) [1]  
*Accept answer in the range of 1.03 kg to 1.07 kg.*
- (b) 5 piglets [1]
- (c) improvement in survival;  
improvement in body mass gain;  
sample size for survivorship data is very small;  
possibly no benefit after day 20 as control group survive anyway;  
study was only undertaken over four weeks;  
other possible reasons for survivorship; [3 max]
- (d) probiotics may multiply in gut / less possibility of multiplication of disease-causing pathogens;  
antibiotics leave residues in meat;  
antibiotic resistance develops;  
release of antibiotics into environment;  
antibiotics do not control viruses (but probiotics may limit); [1 max]
- (e) methanogens [1]
- F2.** (a) virus;  
protein coat;  
RNA/riboprotein; [2 max]
- (b) removal of white blood cells / bone marrow cells;  
using a vector;  
insert gene into chromosome;  
cells are replaced in the body of the patient;  
the normal gene can be expressed;  
*e.g.* SCID where the replaced gene allows for the production of ADA/Adenosine deaminase; [3 max]
- F3.** (a) ethanol;  
methane; [2]
- (b) the yeast feeds off the starch in the flour giving off carbon dioxide;  
fermentation / anaerobic respiration;  
as the carbon dioxide is released it expands with the heat making the dough rise; [3]
- (c) *Saccharomyces* heterotrophic while *Chlorella* autotrophic/photosynthetic [1]

**Option G — Ecology and conservation**

- G1.** (a) (i) ice cover has decreased (slightly);  
the data show much variability/fluctuates; [2]
- (ii) warmer air/atmosphere/water temperatures/global warming (bringing about more ice melt) [1]
- (b) (i) increase in summer ice cover has a positive effect on mass increase;  
high proportion of ice cover has little effect / (slightly) negative effect on chick mass/growth; [2]
- (ii) changes in (water) temperature/climate change influence fish populations/ food available for chick growth;  
changes in habitat affect chick growth / rearing of chicks; [2 max]
- (c) mass may go down as proportion of ice cover has decreased;  
mass may increase as most recent data shown in (bar) graph shows increasing proportion of ice area; [1 max]
- G2.** (a) named example of herbivore;  
named example of plant; [2]  
*e.g.* aphid  
rose
- (b)  $\text{kJ m}^{-2} \text{ yr}^{-1}$  / kilojoules per meter squared per year / example of energy per unit area per time unit (*must be metric units*) [1]
- (c) much loss of energy / 10/20 % retained / 80/90 % loss of energy;  
respiration;  
egestion;  
less valuable as a food source than primary producers; [2 max]
- G3.** (a) named alien species *e.g.* western mosquitofish / small Indian mongoose / rosy wolfsnail;  
introduced for removal of pests;  
competes with native species;  
excessive predation on native species that do not have defences;  
impacts industry such as tourism/harvesting of natural resources; [3 max]  
*Accept other specific examples of effects.*
- (b) ultraviolet/UV light penetrates tissues;  
damages DNA / causes gene mutation;  
can lead to uncontrollable cell division;  
can cause skin cancer; [2 max]
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