



# **MARKSCHEME**

**May 2008**

**BIOLOGY**

**Standard Level**

**Paper 3**

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## 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. Remember that many candidates are writing in a second language. Effective communication is more important than grammatical accuracy.
9. 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. Indicate this with **ECF** (error carried forward).
10. 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. Indicate this by writing **–1(U)** at the first point it occurs and **U** on the cover page.

**Option A — Diet and Human Nutrition**

- A1.** (a) 14.5 [1]
- (b) 366 / 370% (*units required*) [1]
- (c) lowest percentage with normal BMI;  
highest percentage in very obese;  
birth defects increase as BMI increases; [1 max]
- (d) more born with birth defects;  
more born with specific example of a problem from the data *e.g.* respiratory problems, low blood sugar;  
more born premature;  
lower percentage born naturally/vaginal delivery / more born by Caesarean; [3 max]
- A2.** (a) component of food that performs a physiological function in the body / chemical substance that must be supplied to the body (from its environment) [1]
- (b) A/retinol, for visual pigments / rhodopsin;  
B12 (not B)/cyanocobalamin, for enzyme production;  
C/ascorbic acid, anti-oxidant/collagen synthesis;  
D/calciferol, helps calcium uptake, for strong bones/teeth;  
E/tocopherol, anti-oxidant; [2 max]  
*Allow other valid examples.*
- (c) saturated fats have no double bonds / unsaturated fats have one or more double bonds;  
saturated fats raise cholesterol level;  
(higher) risk of CHD/coronary heart disease;  
(higher) risk of arteriosclerosis;  
many unsaturated fats cannot be synthesized by the body, saturated fats can;  
unsaturated fats essential to the body, saturated fats are not; [3 max]
- A3.** (a) vegetarians eat all foods except animal flesh whereas vegans eat only foods from plants or microorganisms / do not eat any foods derived from animals (animal flesh, dairy products, eggs, honey, *etc.*) [1]
- (b) cell membrane structure;  
used in bile synthesis;  
used in (steroid) hormones;  
*example of steroid hormone e.g. testosterone/oestrogen/progesterone;* [2 max]

- (c) poverty;  
ignorance / lack of education about the importance of a balanced diet;  
no investment at subsistence level;  
large population growth;  
population dispersal / refugee influx;  
one type of food stuff predominates / limited variety;  
excess consumption (due to affluence) / appetite for high sugar/salt diet;  
drought / other environmental conditions;  
lack of a nutrient due to geography *e.g.* iodine (mountainous regions, “Derbyshire neck”);

**[3 max]**

**Option B — Physiology of Exercise**

- B1.** (a) hormone/testosterone treatment [1]
- (b) 130(±5) [1]
- (c) no difference between results in muscle mass / both show increase compared to placebo and muscle strength is increased by high activity exercise / muscle strength decreased by low activity exercise (compared to placebo).  
*Answer must contain reference to effect on both muscle strength and muscle mass.* [1]
- (d) testosterone improves both strength and mass;  
 testosterone improves mass greatly;  
 high activity exercise is better for improving strength;  
 combination of testosterone and high activity exercise;  
 early treatment could be placebo only (if testosterone is likely to cause problems);  
 placebo is more effective than low activity exercise programmes in gaining muscle strength; [3 max]
- B2.** (a) axial and appendicular [1]
- (b) *knee and hip*: flexion/bending and extension/straightening/bends in one plane;  
*hip*: rotation/movement in more than one plane/abduction and adduction/circumduction; [2 max]  
*No credit for simply describing the joints as hinge/ball and socket.*
- (c) nervous stimulation triggers depolarization of muscle tissue;  
 actin and myosin filaments;  
 slide past one another;  
 cross bridges form between filaments;  
 change in proportion of light and dark bands / zones;  
 ATP used; [3 max]  
*Credit annotated diagram showing above information.*
- B3.** (a) lactic acid/lactate [1]
- (b) oxygen binding pigment / takes up oxygen;  
 (oxygen) from hemoglobin / greater affinity for oxygen than hemoglobin;  
 stores oxygen in muscles;  
 releases oxygen required for cell respiration/during exercise; [2 max]
- (c) *metabolic effects: Award [2 max]*  
 promotes conversion of glycogen to glucose;  
 releases fatty acids from fat cells (for use by muscle);  
 increases metabolic rate / glycolysis/ATP synthesis;

*respiratory effects:*

widens bronchioles / easier breathing;

*circulatory effects: [2 max]*

direct flow of blood to muscles / away from non-muscular tissues;

dilation / constriction of arterioles;

increases heart rate;

**[3 max]**

**Option C — Cells and Energy**

**C1.** (a) 210 ml kg<sup>-1</sup> min<sup>-1</sup> (±2) (*units required*) [1]

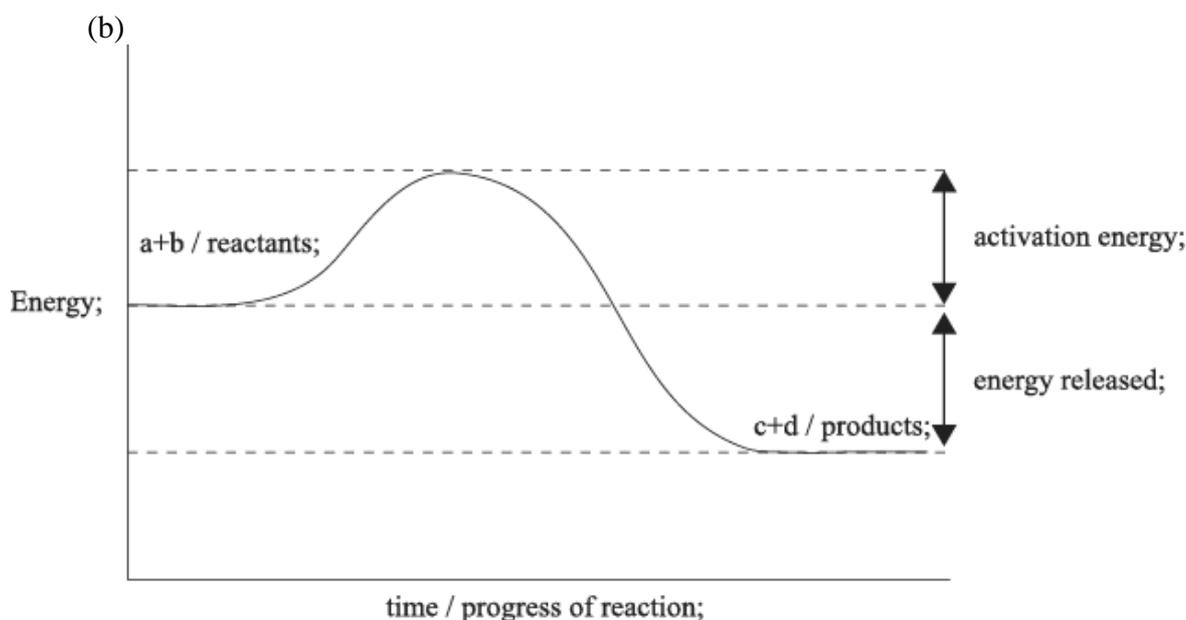
(b) Accept 86 (±2) or 46 (±2) [1]

(c) oxygen delivery is similar to healthy;  
 oxygen use is lower/half;  
 insufficient energy / ATP produced by aerobic respiration;  
 forced to respire anaerobically;  
 lactic acid builds up; [3 max]

**C2.** (a) *Both name and function required for [1];*

(i) *fibrous:*  
 collagen, structural/strength/flexibility;  
 actin/myosin, contraction of muscles;  
 keratin, in hair;  
 silk in spider webs;  
 elastin in ligaments; [1 max]

(ii) *globular:*  
 a named enzyme *e.g.* pepsin, accept general function *e.g.* speeds up reaction;  
 hemoglobin, carries oxygen;  
 antibodies, for immunity;  
 albumin, osmotic balance; [1 max]



[2 max]

*One mark for each correct annotation. The marks for a+b / reactants or substrates or c+d / products can only be awarded if the label is on the horizontal parts of the line.*

- (c) example of negative feedback  
*e.g.* ATP inhibition of phosphofructokinase, in glycolysis;  
controls rate of product synthesis / amount of product produced / inhibits earlier stage / switches off pathway when too much product made;  
binds to enzyme but not active site / allosteric / allosteric site;  
enzyme changes shape / substrate cannot bind / enzyme cannot catalyse; **[3 max]**

**C3.** (a) light dependent **and** light independent/Calvin cycle **[1]**  
*Do not accept "light" and "dark" reactions.*

- (b) *Light*  
low light;  
less ATP;  
less NADPH + H<sup>+</sup> ;

*Carbon dioxide*  
low carbon dioxide;  
less available for fixation in Calvin cycle;

*Temperature*  
enzymes less active at low temperatures;  
enzymes denature at high temperatures;  
RuBP carboxylase as example;  
*Do not award mark for factor without effect.*

**[2 max]**

- (c) light excites electrons in chlorophyll/photosystem;  
electrons pass along carriers;  
protons/H<sup>+</sup> pumped across thylakoid membrane/into thylakoid space;  
proton/H<sup>+</sup> concentration rises inside;  
protons/H<sup>+</sup> diffuse out/down concentration gradient;  
produces ATP from ADP;  
involvement of ATP synthetase/synthase; **[3 max]**

**Option D — Evolution**

- D1.** (a) haplotype D **[1]**
- (b) D predominates in the *C. albrechti* population;  
 D is only found in one sample of the *C. lewisianus* population;  
 B predominates in the *C. lewisianus* population;  
 B is common in both populations;  
*C. albrechti* contains only B,D,E / or A,C missing;  
 E missing in *C. lewisianus*; **[2 max]**
- (c) they both share haplotype B;  
 common ancestor must have contained haplotype B;  
 mutations (accumulating over time) could lead to differences in haplotype composition;  
 the more geographically isolated have no overlapping haplotypes; **[3 max]**
- D2.** (a) clay (minerals) and RNA **[1]**
- (b) high temperature;  
 high radiation levels;  
 reducing/low oxygen/ammonia and methane/in atmosphere;  
 electrical storms;  
 comet / meteorite bombardment;  
 intensive volcanic activity; **[2 max]**
- (c) theory to explain origin of eukaryotes / some organelles;  
 prokaryotes lack mitochondria or chloroplasts;  
 these organelles may have originated as prokaryotes;  
 engulfed by a larger cell;  
 and continued to work/evolved together / became symbiotic;  
 have their own DNA/protein synthesis / both mitochondria and chloroplasts contain DNA that is different from that of the cell nucleus / have naked/circular DNA similar to prokaryotes;  
 and have different (70S) ribosomes / similar to prokaryotes;  
 organelles have double membrane;  
 inner membrane has proteins similar to prokaryotes;  
 organelles have internal membranes;  
 against the theory, that mitochondria and chloroplasts cannot survive outside the cell; **[3 max]**

- D3.** (a) resins / amber / tar;  
frozen in ice;  
acid environments / peat;  
fossils / print / moulds;  
rotting/decay prevented by lack of oxygen; *[2 max]*
- (b) remains destroyed by bacteria;  
soft tissue easily destroyed;  
unsuitable environments for preservation;  
present but not yet found; *[1 max]*
- (c) cooler climate so thinning of forest/more grassland;  
humans retain juvenile features of apes / neoteny;  
such as lack of hair / delayed puberty / delayed tooth eruption;  
increased time of parental care;  
bipedalism/upright posture so;  
shorter arms;  
stronger/longer legs;  
changes to hip/knee joints;  
skull changes/foramen magnum on underneath of skull;  
larger brain;  
linked to use of tools;  
opposable thumbs; *[3 max]*

**Option E — Neurobiology and Behaviour**

**E1.** (a) POA [1]

(b) 76% ( $\pm 3\%$ ) [1]

(c) more serotonin in subordinate/least aggressive lizards / least aggressive lizards have low serotonin levels;  
 in most parts of the brain;  
 one exception/correlation doesn't match for LA;  
 maybe LA region is not associated with aggression / other brain areas are associated with aggression; [3 max]

**E2.** (a)

Type of behaviour	Named example	Explanation
<i>Communication</i>	chaffinches / bees / gulls / frogs / meerkats / humans <i>Do not accept "birds"</i>	courtship / territory / warning others/expressing ideas;
<i>Migration</i>	Arctic tern / swallow / banded goose / monarch butterfly / gray whale / right whale / humpback whale	food sources / better climate/breeding grounds;
<i>Grooming</i>	baboons / cats	hierarchy/hygiene;

*Award [1] for each correctly completed row. Allow other correct examples.* [3 max]

(b) I: bipolar neuron;  
 II: ganglion; [2]

(c) cones detect colour, rods do not;  
 cones give greater acuity;  
 cones concentrated in fovea, rods across retina;  
 cones 1:1 synapse with bipolars, several rods synapse with one bipolar;  
 rods active in low light, cones active at high light levels;  
 cones have faster response to light;  
 cones have more pigments (3 against 1); [2 max]

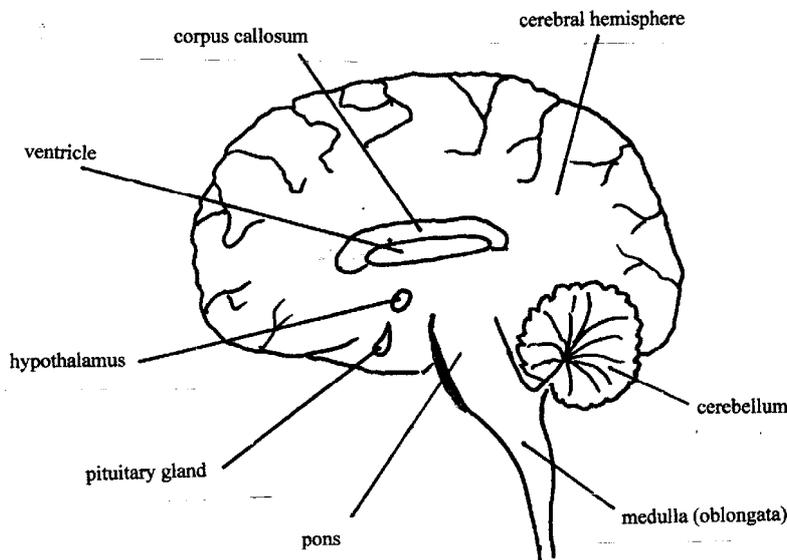
E3. (a) behaviour that develops independent of environment / shared in all members of a species / inherited/inborn/genetic [1]

(b) pituitary gland;  
cerebral hemispheres;  
cerebellum;  
medulla (oblongata);  
hypothalamus;  
corpus callosum;  
pons;  
ventricle; [2 max]

*Each structure should be clearly drawn and correctly labelled.*

*Award [2] for four or more correct, [1] for three or two correct, [0] for one correct.*

*Example of diagram*



(c) cranial reflex;  
controlled by brain;  
involves medulla/brainstem;  
light causes constriction of pupil;  
no constriction means that brain (stem) is not functioning;  
therefore cannot maintain life sustaining activity;  
explanation of brain death e.g. brain cells not functioning but heart and respiratory organs can be kept functioning (it is a legal definition); [3 max]

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

**F1.** (a) 22-24 hours/h (*units required*) **[1]**  
 Allow answer referring to damaged skin not reaching the required level.

(b) both increase over time;  
 spores on normal skin rise quickly in first 15 hours, whereas spores on lenticels do not;  
 after 12 hours spores on normal skin rise more slowly, whereas spores on lenticels rise quickly;  
 spores in lenticels do not reach the same level as spores on normal skin (at any time); **[2 max]**

(c) stored at low humidity;  
 overall less spores develop;  
 causing less damage/wastage;  
 little difference between high and low humidity for spores on lenticels in both time and number; **[3 max]**

**F2.** (a)

<b>Importance to humans</b>	<b>Named example</b>
<i>Use in clothing</i>	flax/cotton/nettles;
<i>Used as a fuel</i>	named tree/sugar cane/peat/maize/rape seed;
<i>Building material</i>	named tree/bamboo;
<i>Aesthetic or decorative use</i>	any appropriate named floral/foiar species;

*Award [1] for every two correct.* **[2 max]**

(b) increased temperature;  
 increases rate of photosynthesis / enzyme action / prevents frost damage;

light controlled;  
 to control flowering time / optimum photosynthetic rate;

water controlled;  
 to prevent wilting;

fertilizer/mineral level controlled;  
 to prevent deficiency disorders;

pest control;  
 to reduce crop damage;

can raise carbon dioxide levels (by burning fuel);  
 for optimum photosynthetic rate; **[2 max]**

*Accept two factors or one factor plus an explanation.*

- (c) example of biological control;  
introduce predator/consumer of pest;  
example given *e.g.* lady birds to eat aphids;  
alien species can damage ecosystem causing unforeseen problems;  
example given: *e.g.* cane toads in Australia;  
effect not immediate / long term planning required;  
predator must have limited diet;

**[3 max]**

**F3.** (a) pruning/removing plant tip **[1]**

(b) auxin: for rooting / weed killers;  
ethylene/ethane: to speed up fruit ripening;  
auxin/gibberellins: to produce seedless fruit; **[2 max]**  
*[1] for the growth regulator and [1] for its (correct) effect.*

(c) *artificial insemination:*  
allows selection of good paternal stock / high success rate / nearly all cows fertilised;

*vaccination/use of antibiotics:*  
prevention of disease / mother produces antibodies for offspring/better health promotes fertility;

*nutrition:*  
supplements to improve health / example of supplement;

*use of sex hormones:*  
to control estrous cycle and therefore birth times;

*use of ultra sound scanning:*  
to confirm pregnancy; **[2 max]**

*Accept two methods or one method with an explanation*

**Option G — Ecology and Conservation**

**G1.** (a) 43 ( $\pm 1$ ) % (*units required*) **[1]**

(b) (i) *Lowest: May 2001*  
*Highest: August 2001* **[1]**  
*Both required for [1]*

(ii) 55 ( $\pm 5$ ) % (*units required*) **[1]**  
*Error carried over from b(i)*

(c) location C;  
 more disturbance sensitive species;  
 fewer disturbance indifferent;  
 sum of I + II never falls below 75% (except in Sept. 2000);  
 however location A doesn't have any opportunistic species which suggest little disturbance;  
 accept reference to differences caused by different distances from sea coast; **[3 max]**  
*Award [1 max] if wrong location chosen but answer is suitably justified*

**G2.** (a) total production of organic material by a plant;  
 gross production = net production + respiration **[1 max]**

(b)

Interaction	Description
<i>Competition</i>	different species needing the same resource;
<i>Parasitism</i>	harmful organism living in or on another;
<i>Mutualism</i>	two species that both benefit from living together;
<i>Herbivory</i>	consumer that feeds on plants;

*Award [1] for every two correct.* **[2]**

(c) soil develops/ deeper soil;  
 more water retention;  
 minerals retained;  
*e.g.* reduced salt concentration in sand dune succession;  
 altered river flows;  
 increased rainfall; **[3 max]**

- G3.** (a) *Both species and factor required for [1].*  
*the Red List has 85 species, see <http://extinctplants.petermaas/extinct/plants.htm>*  
*e.g. Bennetts Seaweed, due to harbour changes / St Helena Olive, loss of habitat* **[1]**
- (b) identifies high or low diversity in an ecosystem / species richness;  
shows change in diversity (over time/distance);  
monitors pollution levels / disturbance;  
can be used for both animal / plants; **[2 max]**
- (c) need to monitor stocks;  
increase size of fish caught;  
reference to larger mesh size;  
monitor / set quotas / reduce number of licences;  
ban indiscriminate methods / ban blasting/cyanide;  
ban catching some/several species;  
promote aquaculture / fish farms;  
create no/no remove fishing zones;  
reach international agreements; **[3 max]**
-