



MARKSCHEME

November 2008

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 — Diet and Human Nutrition

A1. (a) between 2002–2003 **[1]**

(b) difficulty collecting data in some areas;
 many people/countries not studied / no idea of sample size;
 doctors misdiagnosing condition; **[1 max]**
Accept any other suitable suggestions.

(c) increase in proportion of children receiving one/two doses;
 increase for two doses is greater than for one dose;
 trend for one dose always higher than for two doses;
Allow numerical examples.
e.g. 42% increase for children receiving two doses;
18% increase when only receiving one dose;
gap in 1999 was 34% / gap in 2004 was 10% ; **[3 max]**

(d) possible blindness / affects sight;
 growth retardation;
 decreases rhodopsin/rod cells production;
 acne / keratosis; **[2 max]**

A2. (a) (i) *Award [1] for any three of the following.*
 lipids / proteins / minerals / vitamins / fibre / water **[1]**

(ii) *Award [1] for a correct example and natural source.*

	<i>examples</i>	<i>natural sources</i>
<i>Disaccharides</i>	lactose	milk;
	sucrose	sugarcane/sugar beets;
<i>Polysaccharides</i>	glycogen	meat;
	starch	beans/plant products;

[2 max]

Do not accept beer, bread, chocolate, etc. as they are not natural sources.

(b) age, as a growing child requires more energy;
 gender, as females use less energy than males (generally) due to a smaller body size;
 activity, as energy requirements related to physical activity;
 condition, as pregnant mothers require more energy; **[3 max]**
Accept any other suitable examples. Do not allow lists.

- A3.** (a) (i) *Award [1] for any two of the following.*
preservatives / antioxidants / colouring / flavouring / stabilizers / acidity regulators **[1]**
Do not allow food supplements.
- (ii) name of additive; **[2]**
harmful effect;
*e.g. tartrazine (E102);
asthma / skin rashes / hyperactivity;
e.g. sulfites;
allergic reaction / asthma;
e.g. olestra;
diarrhea / dehydration;
e.g. nitrates / nitrites;
stomach cancers;
e.g. monosodium glutamate (E622);
allergic reaction / rapid heart beat / headache / sweating;
e.g. salt;
high blood pressure;
e.g. artificial colouring;
possible reactions such as asthma / skin rash;
Accept any other suitable examples.*
- (b) vegans do not include animal products in their diets;
vegetarians exclude meat and fish, but include eggs/dairy products; **[2]**

Option B — Physiology of Exercise

- B1.** (a) 400 minutes (*units required*) $\left\{ \begin{array}{l} \text{(Allow answers in the range of 390 minutes to} \\ \text{400 minutes)} \end{array} \right. \quad [1]$
- (b) they ran very short distances during first 14 days/beginning of experiment;
followed by continuous increase / peaks up to approximately 28/42 days;
plateaus between days 28–35;
decrease in distance between days 35–40;
slight decrease during the last 21 days of experiments/end of experiment; [3 max]
Award [1] for any other reasonable observation of a trend.
- (c) both groups suffer small increase in heart rate values;
but standard deviations very large / no significant differences between both groups;
it would be expected group under exercise conditions to lower their heart rate;
group under exercise conditions did not have time to change heart rate;
70 days / short period to observe changes in heart rate;
high blood pressure of rats may cause differences; [2 max]
- B2.** (a) (i) motor neuron [1]
- (ii) muscles/fibres/myofibrils contain (repeating) units called sarcomeres;
muscle/sarcomeres contain actin filaments and myosin filaments;
myosin heads bind/form cross-bridges to (expose) actin binding sites;
myosin heads swivel/move actin;
myosin filaments move actin filaments towards centre of sarcomere;
sliding of filaments/actin and myosin shortens the sarcomere; [3 max]
- (b) speed, time to move a limb *e.g.* legs of a runner;
stamina, the ability to maintain prolonged physical activity *e.g.* rowing; [2]
Allow other examples.
- B3.** (a) it is a protein similar to hemoglobin / it contains iron;
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; [3 max]
- (b) (i) minor tearing of ligaments;
due to over-extension of joint; [2]
- (ii) *Award [1] for any two of the following.*
torn muscle / dislocation / inter-vertebral disc damage [1]

Option C — Cells and Energy

- C1.** (a) (i) responses are linear/directly proportional at each light intensity;
biomass increases as CO₂ concentration increases;
rate of increase greatest at high light intensity; [2 max]
- (ii) increase in biomass is greater at high light intensity;
at lower concentration of CO₂ differences are smaller / differences of
biomass are greater at higher concentrations of CO₂ ;
at a CO₂ concentration of approximately 3 ppm the change in biomass is the
same;
at low concentrations of CO₂ all light intensities show reduction in biomass; [2 max]
- (b) rate of photosynthesis would increase until reaching the optimal temperature;
increased rate of photosynthesis causes increase in biomass;
at higher temperatures enzymes would denature;
plant could not carry out photosynthesis / no further increase in biomass; [2 max]
- C2.** (a) *e.g.* CN inhibition of cytochrome oxidase by binding to SH groups; (*other valid
example*)
an inhibitor molecule binds to an enzyme;
not at the active site;
causes a conformational change in the active site;
preventing substrate binding; [3 max]
Award [2 max] if no example given.
- (b) cytoplasm [1]
- (c) two-carbon acetyl fragments;
intermediate product between glycolysis and Krebs cycle;
intermediate product between fat metabolism and Krebs cycle;
intermediate product in amino acid;
(two-carbon acetyl fragments) combine with coenzyme A;
which are passed to Krebs cycle to be metabolized; [3 max]
- C3.** (a) *Award [1] for each of the following clearly drawn and correctly labelled.*
double outer membrane/envelope – shown as two concentric, continuous lines
close together;
granum/grana – shown as a stack of several disc shaped subunits;
thylakoid membrane – shown connecting at least two grana;
ribosomes / circular DNA / lipid globules / starch granules / stroma; [3 max]
- (b) large surface area of thylakoids for light absorption/photosynthesis;
(small) space inside thylakoids for accumulation of protons;
stroma provides space and enzymes for Calvin cycle/light independent reaction; [2 max]

Option D — Evolution

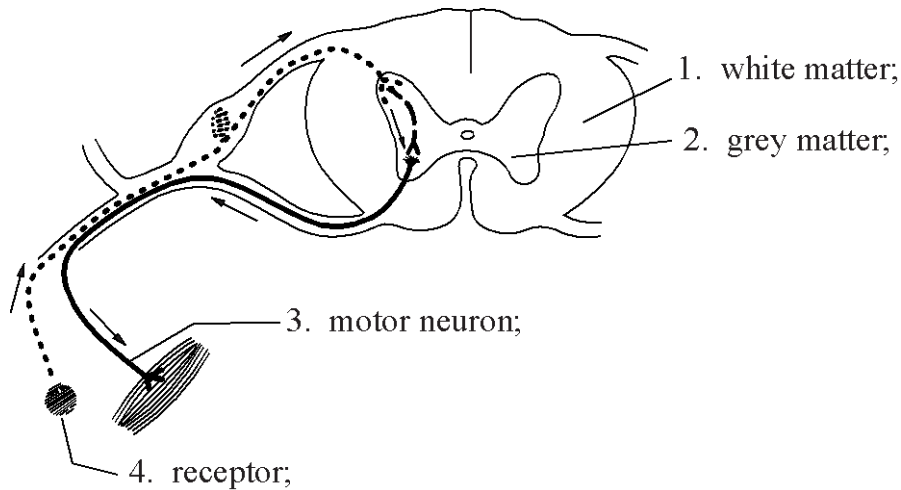
- D1.** (a) (i) owls [1]
- (ii) 28 [1]
- (b) both curves follow normal distribution;
hawk values slightly skewed towards smaller male size;
RSD ranged from 0.62 to 0.99 in hawks / RSD ranged from 0.69 to 1.16 in owls;
mode value for hawks is 0.85 / mode value for owls is 0.90;
there are no male hawks larger than female hawks / there are very few male owls larger than female owls; [2 max]
- (c) female larger to overpower prey;
females become larger to protect eggs/to increase incubation efficiency/to increase egg size;
female size has increased to dominate the male/aid maintenance;
smaller males are more agile;
females are larger because females compete for males; [2 max]
- D2.** (a) *Award [1] for any two of the following.*
no free O₂/ reducing atmosphere;
water;
free methane / ammonia / CO₂ in atmosphere;
strong UV light levels reaching surface;
frequent electrical storms / lightning; [1 max]
- (b) chemical homology of molecules / closeness of structures;
indicate common ancestry;
phylogeny/evolutionary history of a species/relationship between species can be determined;
proteins analysed for amino acid sequences;
the more similar the amino acid sequence, the more closely related the species are;
e.g. cytochrome C / hemoglobin / chlorophyll; (other valid example)
DNA/mitochondrial DNA/gene nucleic acid sequence analysed;
differences due to mutations at a certain rate / the number of differences is proportional to the length of time since two species diverged;
evolutionary/molecular clock indicates closeness of species;
DNA – DNA hybridization; [3 max]
- (c) (endosymbiosis is) one cell living inside another cell with mutual benefit;
eukaryotic cells evolved from aerobic prokaryotes;
mitochondria and chloroplasts suggested to be originated by endosymbiosis;
mitochondrion/chloroplast is similar size to bacteria;
mitochondrion/chloroplast has its own DNA; [3 max]

- D3.** (a) organisms can acquire/develop characteristics during their lifetime;
characteristics develop through use;
example of an acquired characteristic;
acquired characteristics can be passed on to offspring/inherited; **[3 max]**
- (b) *Class:* mammal / mammalia;
Order: primate;
Family: *Hominids / Hominidae;* **[2 max]**
Award [2] for three correct responses, [1] for two correct responses and [0] for one correct response.

Option E — Neurobiology and Behaviour

- E1.** (a) (i) 3 *[1]*
- (ii) 19 *[1]*
- (b) (observed) results suggest greater nursing activity at night than during the day;
(observed) results show/resemble a normal curve/distribution;
no honey bee shows exclusive night nursing activity;
no honey bee shows exclusive day nursing activity; *[3 max]*
- (c) worker *[1]*

E2. (a) (i)



[2 max]

Award [2] for four correct answers, [1] for three or two correct and [0] if one correct.

- (ii) stimulus/tap detected by sensory neuron/sense receptor/stretch receptors; association neuron/intermediate neuron, in spinal cord, motor neuron stimulates/relays message to (upper) thigh muscle which contracts / knee jerks up; [2 max]
Do not accept cranial reflexes such as blinking or pupil reflex.

- (b) *Award [1] for any three of the following.*
 bees / chimpanzees / ants / wolves / dolphins [1]
Accept any other example with known animal social behaviour.

(c) *Award [1] for each correct row up to [2 max].*

<i>rod cells</i>	<i>cone cells</i>
dim light	bright light;
one type of cell	three types of cells;
sensitive to all wavelengths	each sensitive to one colour/red/blue/green;
impulse from group of rod cells to single neuron of optic nerve	single cone cell to single neuron;
drawing of rod cells showing shape	drawing of cone cell showing shape;
contains one type of pigment/rhodopsin	contains three types of pigment/iodopsin;
distributed around retina	concentrated at fovea;

[2 max]

- E3.** (a) (i) innate behaviour **[1]**
- (ii) named animal showing grooming behaviour;
establishes rank within a group;
reinforces bonding within a group;
gets rid of skin parasites;
reduces conflict;
example of self-grooming (*e.g.* waterproofing feathers); **[3 max]**
- e.g.* baboons;
using fingers or tongues to clean;
serves sanitary functions/cleaning;
serves as a social function;
submissive gesture which reinforces ranking within the group;
Award [2 max] if no animal name is given.
- (b) behaviour that develops as a result of the association of reinforcement with a particular response / trial and error learning **[1]**

Option F — Applied Plant and Animal Science

F1. (a) 7.8×10^9 eggs **[1]**

(b) in both countries family systems are most important;
99% in Ethiopia and 80% in Nigeria;
Nigeria has a much higher number of chickens; **[2 max]**

(c) (i) genetic selection in commercial farming;
poor disease control in family farming;
poor feeding in family farming; **[1 max]**

(ii) commercial system (produces) more efficient/eggs per hen/significantly heavier eggs/lower mortality rate;
breeding programs may increase the total productivity;
percentage of family systems may decrease / commercial systems increase; **[2 max]**

F2. (a) Award **[1]** for a correct use and a named example.

<i>uses of plant</i>	<i>named example</i>
fuel	sugar cane;
clothing	cotton;
building material	pine tree;
aesthetic values	roses;

[2 max]

(b) temperature can be controlled inside the greenhouse;
higher temperature will increase photosynthesis and encourage growth;
change of temperature may affect the onset of flowering/seed germination;
allows continual production not just seasonal;
if temperature rises too high shading/ventilation can be used;
enables the maintenance of plants for commercial purposes; **[3 max]**
Do not allow non temperature answers.

- F3.** (a) (i) non-random mating among very close relatives **[1]**
- (ii) close relations may share many identical alleles;
inbreeding may result in expression of deleterious genes/increased congenital disorders/can alter the gene pool;
show defects such as, reduced fertility/lower birth rates;
can lead to desired phenotypes;
can lead to extinction;
some species have mechanisms to avoid inbreeding (*e.g.* male mice use olfactory cues to discriminate against close relatives when selecting mates); **[3 max]**
- (b) (i) promoting rooting of cuttings / killing weeds / inducing fruit ripening / producing seedless fruits **[1]**
- (ii) *name of plant e.g.* bananas are picked while green, *name of hormone e.g.* ethylene;
is a plant growth hormone stimulates ripening / chemicals are spread onto fruits; **[2]**
Award [1] for the plant name and hormone, and [1] for the effect or application technique.

Option G — Ecology and Conservation

G1. (a) fish at pH 5.0–5.4 **[1]**

(b) observed values are (significantly) lower than expected;
difference between expected and observed increases at lower pHs;
difference between observed and expected is maximum at pH 5.0–5.4; **[2 max]**
Award relevant numerical calculations.

(c) both increase with pH;
observed values are always lower (except at pH <5.0 observed greater than expected in zooplankton);
differences between expected and observed are higher in fish;
number of species richness is lower for fish at lower pHs;
changes in number of species remains relatively constant / slight fluctuations for zooplankton with pH increase;
for fish number of species decreases significantly with decrease in pH; **[3 max]**

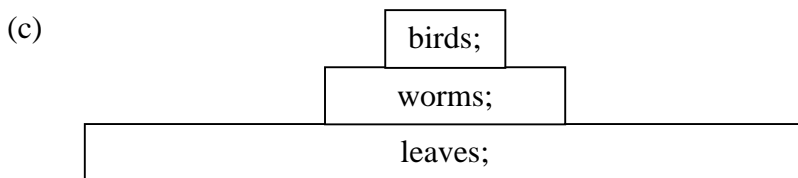
G2. (a) *Award [1] for any three of the following.*
soil pH / acidity / alkalinity;
temperature;
humidity / rainfall;
light intensity;
wind;
mineral content / soil nutrients;
salinity; **[1 max]**

(b)

<i>type of interaction</i>	<i>examples</i>
<i>herbivory</i>	cows and grass;
<i>parasitism</i>	roundworms (<i>Ascaris</i>) and humans;
<i>mutualism</i>	sea anemones and fish;

[2 max]

Award [2] for three correct examples, [1] for two correct and [0] for one correct.



- G3.** (a) name of organism;
factor resulting in extinction;
effect of factor;
another effect of factor;

e.g. passenger pigeon;
commercial hunting;
loss of habitat;
loss of food; *[3 max]*
- (b) name of measure;
method; *[2]*

e.g. captive breeding;
conservation animals are transferred to a protected area/zoos;
sometimes returned to wild;
- (c) the total amount of organic matter made by producers in an ecosystem;
plant respiration + net production; *[1 max]*
-