

MARKSCHEME

May 2003

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 **ALL** questions in each of **TWO** Options (total [*17 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:

- w Each marking point has a separate line and the end is signified by means of a semicolon (;).
- w An alternative answer or wording is indicated in the markscheme by a “/”; either wording can be accepted.
- w Words in (...) in the markscheme are not necessary to gain the mark.
- w The order of points does not have to be as written (unless stated otherwise).
- w If the candidate’s answer has the same “meaning” or can be clearly interpreted as being the same as that in the mark scheme then award the mark.
- w Mark positively. Give candidates credit for what they have achieved, and for what they have got correct, rather than penalising them for what they have not achieved or what they have got wrong.
- w 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.
- w 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.
- w 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) (i) parsley; [1]

(ii) egg; [1]

If the answers to A1 (a) (i) and (ii) are correct, but inverted, i.e. (i) egg and (ii) parsley, award [0], but apply Error Carried Forward (ECF) to marking points (b) and (c). Write ECF beside the answer and use the alternative marking points given below.

(b) plant products more effective overall / animal products least effective;
the three / four / five most effective foods are all plant products / ratios given of 3 plants;
but soy-beans is an exception / similar to egg;
potato and skimmed milk are similar in effectiveness;

With ECF:

plant products least effective overall / animal products more effective;
the three / four / five least effective foods are all plant products / ratios given of 3 plants;
but soy-beans is an exception / similar to egg;
potato and skimmed milk are similar in effectiveness; [3 max]

(c) give supplements of parsley / garlic / onion to a group of people;
use women after the menopause / with osteoporosis;
use women with ovaries removed;
have another control group of similar people who are not given the supplement;
measure changes in bone density during the trial period / measure calcium loss;

With ECF:

give supplements of egg / meat / soy-bean to a group of people;
use women after the menopause / with osteoporosis;
use women with ovaries removed;
have another control group of similar people who are not given the supplement;
measure changes in bone density during the trial period / measure calcium loss; [3 max]

A2. (a) (i) lipids / fats / amino acids / proteins / fatty acids / alcohol; [1]

(ii) energy storage;
synthesis of glycoproteins;
synthesis of nucleic acids;
synthesis of some amino acids;
synthesis of lipids / fats;
component of cell membrane;
dietary fibre / roughage; [2 max]

(b) (i) two of honey / fruit / another named fruit / candy / biscuits / cakes / other; [1]

(ii) two of bread / liver / potato / rice / pasta / other; [1]

A3. (a) atherosclerosis / atheroma / fatty deposits in artery walls / causes blocked arteries / blood clots;
coronary heart disease / heart attacks / heart problem;
high blood pressure;
obesity;

[2 max]

(b) hens reared for egg laying are often kept in small cages / unsuitable conditions;
male chicks / non-productive females cannot lay eggs so are killed;
long periods of egg laying may cause stress to hens;
laying infertile eggs is not natural behaviour for hens;
hens produce food for humans without having to be killed;
occasionally eggs are fertile so an embryo is killed;
chickens force fed hormones / steroids;

[3 max]

Option B – Physiology of Exercise

B1. (a)

	Low intensity	Moderate intensity	High intensity
lowest PAL	82	11	7
highest PAL	56	36	8

[2] for five or six answers ± 2 of values in table above.

[1] for three or four answers ± 2 of values in table above.

[2 max]

(b) (i) negative correlation / relationship / as percentage increases, PAL decreases; **[1]**

(ii) positive correlation / relationship / as percentage increases, PAL increases; **[1]**

(iii) no relationship / independent; **[1]**

(c) increasing high intensity exercise is unlikely to affect PAL;
 difficult to spend more than 15 % of daytime on high intensity exercise;
 increase moderate intensity exercise;
 decrease low intensity exercise;
e.g. cycle to work instead of driving / other example; **[3 max]**

B2. (a) axial and appendicular; **[1]**

(b) proteins / collagen gives flexibility / prevent brittleness;
 minerals / calcium phosphate in bone tissue gives it strength;
 hollow shaft is stronger than a solid shaft of the same mass;
 solid heads of bone absorb impacts from different directions without fracturing;
 spongy bone in the heads / cartilage acts as a shock absorber / does not fracture easily; **[3 max]**

(c) movement in three planes / all directions;
 two movements stated;
for the second mark, two movements from the following must be stated:
 flexion / backwards and extension / forwards;
 abduction / inwards and adduction / outwards;
 rotation; **[2 max]**
If the answer gives all three movements, award [2].

B3. (a) cerebral cortex; **[1]**

(b) proprioceptors monitor how stretched a muscle is;
 proprioceptors send impulses to the brain;
 brain deduces how contracted / relaxed a muscle is;
 allows brain to decide whether a muscle needs to contract more / less; **[3 max]**

Option C – Cells and Energy

- C1.** (a) (i) increasing fructose 6-phosphate concentration (initially) causes an increase in activity;
activity levels out / remains constant as (substrate) concentration continues to rise; [2]
- (ii) more collisions with active site as concentration rises;
at high substrate levels all active sites are occupied so no further increase in rate / enzyme working at maximum rate; [2]
- (b) (i) decreases activity;
at all fructose 6-phosphate concentrations;
most effect at intermediate fructose 6-phosphate concentrations / little difference at high fructose 6-phosphate concentrations;
ATP acts as an inhibitor; [2 max]
- (ii) end-product inhibition;
respiration rate decreased if ATP already available; [1 max]
- C2.** (a) peptide bonds / peptidic bonds; [1]
- (b) alpha-helix / alpha helices; [1]
- (c) ionic / polar / hydrogen / hydrophobic / van der Waals' / disulfide; (*not covalent*) [1]
- (d) linking together of polypeptides to form a single protein;
using the same bonding as for tertiary structure;
linking of a non-polypeptide structure / prosthetic group;
named example of quaternary structure *e.g.* hemoglobin (has four polypeptides); [2 max]
- C3.** (a) more chlorophyll / photosystems;
so more light absorbed; [2]
- (b) insufficient light / poor absorption hence low rate of photosynthesis;
higher leaves absorb majority of red and blue wavelengths;
only green / orange / yellow wavelengths available for lower leaves; [2 max]
- (c) catalysis of reaction in the Calvin cycle;
RuBP carboxylase not very effective so much needed / reference to photorespiration;
used for carbon fixation;
carbon fixation is vital to the plant / carbon dioxide needed for photosynthesis; [2 max]

Option D – Evolution

- D1.** (a) 7; [1]
- (b) classification is supported by the data;
valid numerical information;
fewer differences between humans and Neanderthal than humans and chimps;
but all three species could be close enough to place in a single genus / far enough
apart to place in separate genus;
only one Neanderthal sequenced so not enough data; [3 max]
- (c) 28–52 (*accept any answer within this range*); [2]
humans diverged from *Australopithecus* longer ago than Neanderthals but not
as long as chimps / closer to humans than chimps;
- D2.** (a) (i) conditions on pre-biotic Earth were recreated in their apparatus;
mixture of **any three of** methane, ammonia, water vapour and hydrogen;
water boiled and recondensed to simulate high temperatures;
electrical discharge / sparks to simulate lightning; [2 max]
- (ii) organic compounds / amino acids were formed from inorganic compounds;
organic compounds could have existed on pre-biotic Earth;
life might have arisen from non-living material; [2 max]
- (b) (i) panspermia;
(special) creation;
spontaneous generation;
inheritance of acquired characteristics / Lamarck; [2]
- (ii) **either panspermia:**
no / little evidence for panspermia;
only transfers problem of life's origin to elsewhere;
experiments have shown that organic compounds might form in outer space;
no scientific evidence that organic matter can travel to Earth from elsewhere;
or special creation:
no scientific evidence for special creation;
not possible to disprove special creation;
all theories for the origin of species seem implausible;
or spontaneous generation:
no scientific evidence for spontaneous generation;
must have happened in the origin of life;
reference to Pasteur's experiments with soup;
or inheritance of acquired characteristics:
reference to acquired antibiotic resistance in bacteria;
few / no cases of inheritance of acquired characteristics found;
directed mutation of genes needed;
little / no evidence available;
or Lamarck:
observed characters can change in lifetime;
offspring often have similar characteristics to parents;
example (the increased neck length of giraffe or other);
theory seems implausible; [3 max]

- D3.** marsupials / monotremes found in Australasia / Australia / on one side of Wallace's line;
placental mammals found in rest of world / on other side of Wallace's line;
separation of land masses allowed different groups to evolve in isolation / no competition
from placentals;
convergent evolution / different species evolving to occupy same niche in different areas;
reference to marsupials (opossums) in South America also;
little variation in northern hemisphere as it was separated more recently;

[3 max]

Option E – Neurobiology and Behaviour

- E1.** (a) activity reduced / drops from 100 % to 75 %; [1]
- (b) (i) left hemisphere becomes less active than with both eyes closed;
left hemisphere is more active than with both eyes open;
right hemisphere remains more active than with both eyes closed;
right hemisphere becomes more active than the left hemisphere; [2]
- (ii) left hemisphere; [1]
- (iii) left eye to right hemisphere and right to left; [1]
- (c) seeing a predator before it attacks;
using less energy / allows part of brain to rest; [2]
- E2.** (a) central area on both left and right sides shown as grey matter;
peripheral areas shown as white matter; [2]
- (b) location of cell bodies of motor neurones shown in the grey matter;
location of cell bodies of sensory neurones shown in the dorsal root ganglion; [2]
- E3.** (a) name of bird or mammal species and brief outline of courtship;
details of male behaviour during courtship;
details of female behaviour during courtship; [3]
- (b) courtship behaviour allows members of a species to identify each other;
courtship helps to attract a mate;
individuals that do more (vigorous) courtship displays are more successful;
genes for (vigorous) courtship displays are inherited by offspring; [3 max]
- (c) reflexes / taxis / kinesis / mate selection / grooming / communication / other; [1]

Option F – Applied Plant and Animal Science

- F1.** (a) (i) firmness test; [1]
- (ii) sweetness test; [1]
- (b) organic apples were least acid and integrated apples most acid (in both tests);
greater difference between the sourness results than the chemical analysis results;
organic significantly different in sourness from both others but only from integrated
in chemical analysis; [2 max]
- (c) flavour of organic not (significantly) different from conventional;
organic apples are (significantly) sweeter than conventional;
organic apples are (significantly) less sour;
personal taste preferences vary / some people prefer less sweet / sour apples;
taste may vary from year to year; [2 max]
- F2.** (a) ancient breeds are reservoirs of alleles / have different alleles from modern breeds /
maintain genetic variability;
ancient breeds may have characteristics which are needed in the future;
alleles / characteristics could be transferred from ancient to modern breeds;
(Do not accept prevent extinction) [2 max]
- (b) *Accept either points for cattle or sheep or chicken.*
sheep / cattle are fed on grass / hay / silage / grain;
sheep / cattle graze / eat / fodder crops in fields;
sheep / cattle are fed (hay/silage) in houses / feed lots;
extra food / named concentrate / food supplement fed to cattle / sheep that are
being fattened;
extra food / named concentrate fed to lactating cattle (to increase milk production);
extra food / named concentrate fed to female sheep before mating (to get more
twins);
extra food / named concentrate fed to pregnant cattle / sheep (to get larger calves /
lambs);
chickens are fed wheat / corn / maize / oats / grain;
free range chickens also eat insects / weeds / other foods that they find;
chickens in houses are fed using troughs / feed dispensers;
limestone added to feed (for grinding action in gizzard);
feed is (usually) given ad lib; [3 max]
- (c) greater variety of males can be used for breeding program on a farm;
better quality males can be used than the farm's own males;
bulls / boars / rams / males can be dangerous / may hurt female;
males used in AI are progeny tested so are more reliable;
one male can fertilize more females by AI;
semen can be transported more easily than male animals;
semen can be stored for long periods;
higher rate of successful insemination with AI; [2]

- F3.** (a) temperature;
availability of nutrients;
diseases of the plants;
predators / pests eating the plants;
genotype of the plants;
soil composition / acidity / drainage;
competition / space from other plants; *[2 max]*
- (b) temperature higher inside the greenhouse than outside;
as short wave radiation can pass through the glass and re-emitted long wave cannot;
carbon dioxide levels can be enriched;
humidity levels can be kept higher so there is less transpiration;
biological control of pests works more effectively;
less wind so less transpiration / mechanical damage to crops;
possible use of artificial light; *[3 max]*

Option G – Ecology and Conservation

- G1.** (a) (i) asbestos cement;
grows closest to city centre on asbestos cement roofs;
only grows on asbestos cement roofs between concrete / cement and asbestos lines; [2 max]
- (ii) acid rain is neutralized by alkaline building materials; [1]
- (b) gives a measure of acid rain levels / indicator species allow a variable to be measured;
monitoring of environmental change / shows if conditions are getting worse or better;
shows if pollution control / conservation projects are working;
organisms are there all the time so give a longer-term measure / not just at an instant; [3 max]
- G2.** (a) *in situ* is conservation of species in their habitats and *ex situ* is conservation of species removed from their habitat; [1]
- (b) (captive) breeding programs (in zoos);
cultivation of plants (in botanic gardens);
storage of seeds (in seed banks);
storage of sperm / ova / micro-organisms; [3]
- (c) international limits on sizes of catches / quotas for each national fleet;
minimum mesh sizes to prevent catching of immature fish / disallow dragnets;
protection of nursery areas / closed seasons during which no fishing takes place;
fish can swim in and out of national waters so international measures needed;
most sea area is outside territorial waters so international measures needed;
international control / laws on pollution levels; [3 max]
- G3.** (a) total amount of energy / CO₂ fixed by photosynthesis / plants / organic matter produced; [1]
- (b) net production is gross production minus respiration;
all species respire; [2]
- (c) gross production rises;
as small plants are replaced by larger plants;
eventually stabilizes;
more stratification as leaf area index increases; [2]
-