

MARKSCHEME

May 2002

BIOLOGY

Standard Level

Paper 3

Subject Details: Biology SL Paper 3 Markscheme**Mark Allocation**

Candidates are required to answer **ALL** questions in each of **THREE** Options (total [15 marks]). Maximum total = [45 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.
- ◆ 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 mark scheme then award the mark.
- ◆ 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.
- ◆ 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) control: 25 (± 3);
experimental: 75 (± 3); **[2]**
- (b) less energy in experimental, then greater % survival / longevity;
very young have same possibility of survival / no effect until 200 days old;
more energy, then death / mortality rate higher / less surviving;
valid numerical example / 50 % survival level comparison; **[2 max]**
- (c) carbohydrate / protein / lipid / minerals (or any in particular) / vitamins (or any one) /
water / fibres **[1]**
A list of, for example, three vitamins, three sugars, etc. should be allowed.
- (d) experimental live longer because:
overweight / obesity / excess fat in control;
less cholesterol so less coronary heart disease in experimental / vice versa in control;
variation of metabolic rate good in experimental;
variation of respiratory quotient in experimental;
switch from glucose to lipid-protein supported metabolism in experimental;
lower glucose concentration in experimental / higher in control;
less glycated proteins in experimental / higher in control;
less free radicals in experimental / higher in control;
less damage to cell membranes in experimental;
protection against mutagenic action of carcinogens in experimental;
delay of onset of diseases common in later life in experimental; **[2 max]**
- A2.** (a) helps thyroid gland / component of thyroxin / avoids goitre **[1]**
- (b) retain water / solidify faeces;
help defecation / prevent constipation / help bowel movement / helps peristalsis;
prevent intestinal disorders / named disorder (*e.g.* colitis, haemorrhoids/piles, appendicitis);
prevent (intestinal) cancer / retard appearance of cancer;
reduce absorption of cholesterol / reduce risk of heart attack; **[3 max]**

A3. (a) cannot be synthesized / must be ingested / necessary in the diet

[1]

(b) useful as they act as:

- preservatives;
- antioxidants;
- colouring;
- flavour / taste;
- stabilizers / emulsifiers / texturisers;
- acidity-regulators;

Do not accept nutrient supplements such as vitamins or minerals.

disadvantage because can produce:

- nausea / migraine;
- cancers;
- allergies;
- behaviour disorders / hyperactivity;

[3 max]

[2 max] for benefits, **[2 max]** for disadvantages.

Option B – Physiology of exercise

- B1.** (a) marathon **[1]**
- (b) marathon more slow type / sprinter less;
marathon less fast IIa / sprinter more;
marathon no fast IIx; **[2 max]**
Allow for any numerical comparison.
[1 max] for descriptions of each with no comparison.
- (c) slow type I **[1]**
- (d) IIx;
sprinters utilize anaerobic respiration;
in sprinters greater amount of fast type IIx;
IIx absent in marathon runners / greater in sprinters than in average person; **[2 max]**
- B2.** (a) great affinity for O₂;
O₂ store in muscle / combines with O₂;
O₂ released when demand exceeds supply / O₂ released during exercise; **[2 max]**
- (b) insufficient O₂ to supply demands;
anaerobic respiration (produces lactic acid);
2H needed to form lactate / pyruvate uses 2H (from NADH + H) to form lactate;
O₂ needed to oxidize lactic acid (Kreb's cycle) / O₂ needed for electron transfer system / as final e⁻ acceptor;
O₂ needed to supply ATP (for gluconeogenesis);
reconversion of muscular lactic acid to glucose (in liver) / Cori cycle;
repaid by resting;
panting / increased breathing rate; **[3 max]**
[2] for how created and **[1 max]** for how repaid.
- B3.** (a) physical condition suiting particular exercise performed **[1]**
- (b) flexibility: use of joints;
agility: changing position quickly;
speed: sprinting;
stamina: sustained / endurance / duration activity;
cardiovascular efficiency: recovery time / pulse rate / heart beat;
strength: muscle size / weight lifting; **[2 max]**
[1 max] if only listing.
- (c) sprain / torn ligament / dislocation / intervertebral disk damage / tendonitis /
cartilage damage **[1]**

Option C – Cells and energy

- C1.** (a) 0.2 (arbitrary units) **[1]**
- (b) cyclic increase and decrease of activity;
 approximately every 20 minutes;
 increase in 10, 30, 50 minutes;
 decrease in 0, 20, 40, 60 minutes;
 maximum in 30 minutes; **[2 max]**
- (c) when stressed, bacteria produce more proteins but only at certain times / experimental usually make more proteins / higher rates;
 stressed / experimental has greater maximums;
 less protein in control except 20 and 40 minutes / control usually lower rates;
 greatest activity at 30 minutes for experimental / at 10 and 50 for control;
 slower cycle for control / cycle every 50 minutes;
 both show fluctuations / greater fluctuations in the experimental group; **[3 max]**
[1 max] for descriptions of each with no comparison.
- C2.** (a) produced by oxidation of fatty acids / β oxidation;
 occurs in mitochondria;
 oxidized to CO_2 ;
 takes part in intermediate reaction of / enters citric acid (Krebs) cycle;
 energy produced / phosphorylation of ADP to ATP / synthesis of ATP;
 may be converted to ketone bodies; **[2 max]**
- (b) CO_2 / ethanol / ATP **[1]**
Both need for [1].
- C3.** (a) high light / high temperature / drought **[1]**
- (b) negative feedback / end-product inhibition;
 (metabolite) acts as allosteric inhibitor;
 non-competitive;
 binds to enzyme not in active site / in allosteric site;
 changes shape of enzyme (active site);
 inactivating / stops substrate attaching / prevents formation of enzyme – substrate complex; **[3 max]**
- (c) definition of limiting factor / factor nearest its minimum value;
 increase in light intensity produces increase in photosynthesis;
 stable when no longer a limiting factor / other limiting factors;
 graph; **[2 max]**

Option D – Evolution

- D1.** (a) *Archaeopteryx* [1]
- (b) *Velociraptor* no flight and *Columba* flight;
flapping in both;
three fingers in both;
half-moon-shaped wrist bone in both (allows flapping);
bones fuse / less in *Columba* and separate / more in *Velociraptor*;
digit II is the longest in both;
both have hollow bones; [3 max]
[1 max] for descriptions of each with no comparison.
- (c) comparative anatomy / homologous anatomical structures / similar basic structural features but structure adapted to function / similar to pentadactyl limb example; paleontological / fossil evidence; [2]
- D2.** (a) mammals [1]
- (b) 2 (± 0.5) million years ago in (sub-Saharan) Africa;
uncertain because:
fossils lacking or not in good form;
soft parts do not fossilize;
interbreeding of species;
migrations;
scientists have different views;
fossil dating method not totally accurate; [3 max]
- D3.** (a) biochemical evolution;
coacervate droplets / colloids separated from aqueous phase;
containing polynucleotides / RNA;
assembly of chains of amino acids;
formation of proteins;
alignment of lipids / formation of membrane;
synthesis of ATP / anaerobic respiration;
asexual reproduction; [3 max]
Do not accept theories of origin of life (e.g. panspermia) nor reference to experiments by Miller / Urey / or others.
- (b) arrival of material from outer space / cosmozoan theory;
micro-organisms in meteorites;
no real evidence; [2 max]

Option E – Neurobiology and behaviour

- E1.** (a) 1.2 (± 0.1) ng g⁻¹ (fecal matter) (*units required*) [1]
- (b) group I had more (3) fights per day than group II (2.5) / I had 0.5 more fights per day than II [1]
- (c) more anxiety in crowded with vocal neighbours (group I);
same in crowded and isolated (group II and group III); [2]
- (d) not true;
less aggression in crowded than isolated;
more anxious in crowded with vocal neighbours (so noise affects);
stress low and aggression high;
when stress is high aggression is not highest;
not enough data to arrive at a conclusion / other factors involved; [3 max]
- E2.** (a) learning procedure with reinforcements following a particular response / reward
(positive reinforcement) or punishment (negative reinforcement) [1]
- (b) build-up of neural net / more neurones / more neural connections;
formation greatest in early years of life;
synapses strengthened or weakened;
may involve Ca²⁺ ions;
development of receptor sites between neurones; [2 max]
- E3.** (a) named example;
courtship behaviour; [2]
e.g. grasshoppers - rub hind legs against each other (or elytron) to produce sound that attracts members of the opposite sex / musk deer - secretion of pheromones to attract females. Example must not be vague - "parrots have coloured feathers..." is acceptable but "birds have coloured feathers..." is not acceptable.
- (b) deterioration of family life;
job loss;
economic impact;
increased chances of accidents;
increases aggressiveness / crime;
self destructive;
addiction / dependence / withdrawal effects;
less reasoning / judgement / common sense;
underweight babies;
brain damage to fetus; [3 max]

Option F – Applied plant and animal science

- F1.** (a) 11.1 (± 0.1) **[1]**
- (b) greater in composted (II and III) than non-composted (I);
greater in III than in I / 4.7 g pot⁻¹ more;
greater in III than in II / 1 g pot⁻¹ more; **[2 max]**
[1 max] for descriptions of each with no comparison.
- (c) III;
(most) neutral pH;
better yield;
more N assimilation by plant;
more inorganic N (which is that absorbed);
not for any plant / only tested with ryegrass; **[3 max]**
- F2.** (a) ovary, style and stigma / gynoecium / carpel / pistil;
anther and filament / androecium / stamen;
petals, sepals, receptacle; **[3]**
*The structures must be drawn and correctly labelled for the marks. Good drawing,
no labels [1].*
- (b) proper time to cultivate;
artificial pollination;
vegetative propagation;
change photoperiod;
when and where to cut;
cold stage / vernalization; **[2 max]**
- F3.** (a) domestication and selection / choose with desired characteristic and breed **[1]**
- (b) increase survival rate;
increase yield / products;
protection from infection;
named example and improvement (e.g. vaccination of cats and dogs to help prevent
spread of rabies to farm animals); **[3 max]**

Option G – Ecology and conservation

- G1.** (a) 1997 / 97 **[1]**
- (b) direct proportion;
greater temperature, greater ozone thickness;
lower temperature, less ozone;
any numerical example; **[2 max]**
- (c) thinner ozone layer in 1990s (except 1991 and 1998) / more in 1980s;
lower temperature in 1990s / higher in 1980s;
more scattered data in 1990s / vice versa 1980s; **[2 max]**
Responses could be numerical.
[1 max] for descriptions of each with no comparison.
- (d) less CFC / gases that reduce ozone / pollution;
so less greenhouse effect thus more ozone;
or warmer year;
so less ozone lost;
or stable vortex circulation / winds;
so ozone not blown away / CFC not blown there;
more environmental awareness / laws / precautions;
random fluctuations;
cannot compare as only minimum temperatures given; **[2]**
[1] for reason and **[1]** for effect.
- G2.** (a) interaction between individuals of different species that live together by which both benefit;
both named organisms; **[2]**
*e.g. sea anemone and hermit crab / cellulose-digesting prokaryotes and cow / legumes
and Rhizobium / fungi and algae in lichen etc.*
- (b) more efficiency in forests than deserts;
in deserts more light reflected;
in forests more plants to absorb light / greater leaf area index;
forests less extremes of climate;
forests' canopy (usually) no limiting factors (CO₂, H₂O, nutrients, light); **[3 max]**
- G3.** no two species can coexist in same niche;
one is displaced / one survives;
one species has an advantage over competitor / species compete with each other;
description of (Gause's) experiments with Paramecium; **[3 max]**
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