

# **MARKSCHEME**

**May 2004**

**BIOLOGY**

**Standard Level**

**Paper 3**

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## Subject Details:      **Biology SL Paper 3 Markscheme**

### Mark Allocation

Candidates are required to answer **ALL** questions in each of **TWO** Options (total **[18 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:

- ◆ 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 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 credit for what they have achieved, and for what they have got correct, rather than penalizing them for what they have not achieved or what they have got wrong.
- ◆ 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. 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) obese [1]
- (b) 35 kg ( $\pm 2$ ) [1]
- (c) as height increases, body mass index decreases;  
as height decreases, body mass index increases; [1 max]
- (d) saturated fats common in solid fats / animal products, unsaturated in liquid oils / plants / fish;  
saturated fats linked with cardiovascular disease / CHD / build up of atheroma;  
saturated fats lead to higher levels of LDL / cholesterol;  
unsaturated fats lead to higher levels of HDL / lower cholesterol; [3 max]
- A2.** (a) vegetables / rice / fruit / cereals / pulses [1]
- (b) cellulose / lignin / hemicellulose / pectin [1]
- (c) helps move food through the alimentary canal / peristalsis;  
prevents constipation;  
lowers risk of intestinal cancer;  
may lower cholesterol levels;  
adds bulk / non-digestible so may help prevent obesity;  
slows down sugar absorption; [3 max]
- A3.** (a) *iodine*: production of thyroxine / needed by thyroid gland / prevents goitre / cretinism;  
*zinc*: carbon dioxide transport / protein digestion / cofactor of certain (digestive) enzymes / component of certain proteins / help healing wounds; [2]
- (b) sulfites: allergy attacks and asthma;  
saccharin: cancer;  
olestra: intestinal cramps / diarrhea;  
nitrates / nitrites: stomach cancer;  
monosodium glutamate: headaches / allergic reactions / rapid heartbeat;  
tartrazine: asthma / hyperactivity; [2 max]
- (c) wash hands before handling food to prevent spread of bacteria;  
bacteria cause diseases;  
keep cooked meats and raw meats apart to prevent contamination;  
refrigerate food to prevent bacteria multiplying;  
use clean cooking utensils to prevent contamination;  
organisms / bacteria can multiply if food is re-frozen; [3 max]

**Option B – Physiology of Exercise**

- B1.** (a) 335 ( $\pm 5$ ) W (*units required*) [1]
- (b) as velocity increases power increases / positive correlation [1]
- (c) both have same/similar maximum power;  
both show increased power at greater velocities;  
power tends to be higher at each velocity for  $V_{70}$ ;  
there is a greater range of powers at  $V_{70}$  between 2.0 to 2.5 m s<sup>-1</sup>; [2 max]
- (d) risk of heart attack/heart failure from strenuous exercise [1]
- B2.** (a) stamina: the ability to maintain prolonged physical activity [1]  
*Do not accept only "endurance".*
- (b) greater strength / more developed muscles / greater muscle bulk;  
better blood supply to muscles / faster removal of waste *e.g.* lactic acid;  
more mitochondria in muscles;  
increased myoglobin; [2 max]
- (c) competition should be fair and equal with no discrimination / not all have access to drugs;  
result should not be more important than the process;  
provides the user with an unfair advantage over others / cheating;  
against the rules;  
athletes are role models / bad example to youngsters;  
drugs harmful to athletes / shorten life expectancy of athletes; [3 max]
- B3.** (a) arrow in correct direction;  
*Award [1] for any two of the following structures clearly drawn and correctly labelled, up to [2 max].*  
nucleus;  
cell body;  
axon;  
dendrites;  
myelin sheath;  
node of Ranvier;  
synaptic knob; [3 max]
- (b) tendon [1]
- (c) hollow therefore lighter;  
hollow / allows compression forces / slight bending;  
shaft of compact bone gives strength;  
spongy head allows shock absorption;  
smooth cartilage covers the ends of the bone, reducing friction; [3 max]

**Option C – Cells and Energy**

- C1.** (a) 06:00 / 19:30 to 19:45 [1]  
*Accept 6 am / 7:30 pm to 7:45 pm.*
- (b) 2.3 mg CO<sub>2</sub> h<sup>-1</sup> (±0.1) (*units required*) [1]
- (c) more uptake at 15°C than 30°C during the hours of daylight;  
both are high during the hours of daylight / reverse argument;  
greater uptake at 30°C than 15°C during the hours of darkness;  
at only 15°C uptake become negative; [3 max]
- (d) respiration rate greater than photosynthesis (during the hours of darkness) [1]
- C2.** (a) (i) mitochondrion [1]  
(ii) crista;  
*Award [1] for each of the following, up to [2 max].*  
folded membrane;  
provides large surface area;  
for electron transport chain / site of ATP synthesis;  
moves protons to inter membrane space from matrix; [3 max]
- (b) fatty acids oxidized / broken down;  
form two-carbon atom (acetyl) fragments;  
which are passed to Krebs' cycle to be metabolized; [2 max]
- C3.** (a) held together by hydrogen bonds;  
between CO and NH groups;  
(α-helix for) structure of fibrous proteins / keratin;  
one of four levels of structure;  
provides stability of structure;  
α-helix;  
β-sheet; [3 max]
- (b) malonate / Prontosil [1]
- (c) competitive similar to substrate and non-competitive not;  
competitive attaches to the active site, non-competitive does not bind to the active site;  
non-competitive changes enzyme shape, competitive does not;  
competitive change reversible; [2 max]

**Option D – Evolution**

- D1.** (a) 70 – 74 [1]
- (b) more spread of pair differences in African than non-African;  
greater maximum of frequency of pair differences in non-Africans than Africans;  
non-Africans maximum frequency is at 30–34 pair differences and Africans at 70–74;  
neither population had zero pair differences; [3 max]
- (c) African;  
more pair differences show a longer genetic history; [2]
- D2.** (a) parents produce more offspring than survive;  
there is competition among members of a species for survival / struggle for existence;  
species show variation;  
certain variations will give a selective advantage / survival of fittest;  
depending on the environment;  
these variations will be passed on to the next generation;  
leading to change in allele frequency; [4 max]
- (b) change of beak shape in Galapagos finches;  
resistance to pesticides / antibiotics;  
bird predation on moths; (*allow, though some evidence refutes this*)  
heavy metal tolerance in plants;  
melanism in ladybirds (ladybugs); [2 max]
- (c) fossils;  
prints / moulds;  
preserved in amber / tar / peat / petrification;  
frozen in ice; [2 max]
- D3.** (a) mammalia / mammal [1]
- (b) arches on feet;  
stronger bones in legs / stronger legs;  
longer legs;  
shorter arms;  
non-opposable big toe;  
foramen magnum;  
knees closer together;  
wide pelvis;  
lumbar spine curved;  
larger muscles on legs; [3 max]

**Option E – Neurobiology and Behaviour**

- E1.** (a) 5.2 to 5.3 mm (*units required*) [1]
- (b) 15 [1]
- (c) as head width increases, mating success increases;  
highest mating success at head width 5.6 – 5.7 mm;  
above 5.6 – 5.7 mm head width, mating success drops; [2 max]
- (d) smaller so not so good at fighting;  
lighter so can hover easily; [1 max]
- E2.** (a) photoreceptor [1]
- (b) cranial reflex;  
impulse in sensory neurone to brain;  
impulse back in motor neurone;  
bright light causes contraction of circular muscles of iris;  
pupil constricts;  
less light enters the eye; [2 max]
- (c) *Award [1] for each two structures correctly labelled.*
- I. cornea;
  - II. lens;
  - III. retina;
  - IV. vitreous humour;
  - V. blind spot;
  - VI. optic nerve;
- [3 max]
- E3.** (a) young animals identifying and becoming associated with another organism or object /  
learning a response to a stimulus during a sensitive time of development [1]
- (b) behaviour is species characteristic / instinctive;  
Lorenz worked with young geese;  
followed him as substitute parent / sign stimulus;  
may be innate releasing mechanism;  
explanation of innate behaviour *i.e.* not learned / instinctive; [3 max]
- (c) animals move towards favourable condition / positive taxes;  
animals move away from unfavourable conditions / negative taxes;  
*e.g.* light / chemicals / temperature / humidity;  
animals move faster in unfavourable conditions / kinesis;  
animals slow down in favourable conditions / kinesis;  
withdrawal from harmful stimulus / reflex action;  
*e.g.* withdraw from hot object;  
explanation of innate behaviour *i.e.* not learned / instinctive; [3 max]

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

- F1.** (a)  $83 (\pm 2) \times 10^6$  tonnes (*unit required*) [1]
- (b) sheep [1]
- (c) both increased;  
cow meat always more than poultry meat;  
poultry meat percentage increase much greater than cow meat; [3 max]
- (d) new technology / shift in tastes / countries increasing meat production prefer pig meat /  
increased population / more intensive / cheaper [1]
- F2.** (a) cotton / banana / flax / nettle [1]
- (b) more sustainable / less harmful to environment;  
organic uses biological control;  
mineral bearing rocks added;  
relies on crop rotation;  
animal manure as fertilizer;  
no artificial fertilizers;  
less productive;  
crop residues as fertilizers;  
mechanical cultivation;  
more diseased crops / animals;  
excludes pesticides / growth regulators / feed additives; [3 max]
- (c) no soil needed;  
plants grown in water/sand;  
nutrients added to water  
needs less space;  
plants can be grown in places where could not normally / inside homes;  
bigger yields / more yields per year;  
can be grown out of season; [3 max]
- F3.** (a) animals are less likely to catch diseases so bigger yield/ grow faster;  
may lead to antibiotic resistance in humans / animals; [2]
- (b) pruning involves cutting parts from the plant;  
apical dominance occurs when most growth is at the apex (end bud);  
this growth is stimulated by auxins;  
auxin concentration is too high for/inhibits lateral bud growth;  
removal of the apex causes a fall in auxin concentration;  
lateral buds can then grow / this makes a bushier plant;  
makes cuttings available for extra plants; [3 max]

**Option G – Ecology and Conservation**

- G1.** (a) 25 ( $\pm 1$ ) (%) [1]
- (b) in 1960, the capture was the same in both oceans;  
more fish caught in the Pacific Ocean than Atlantic Ocean after 1960;  
% increase greater in Pacific Ocean than Atlantic Ocean;  
in 2000, Pacific Ocean yield more than doubled Atlantic Ocean yield;  
between 1980 and 1990 decrease in Atlantic Ocean capture and increase in Pacific Ocean;  
from 1970 to 1980 no change in Pacific Ocean but increase in Atlantic Ocean yield; [3 max]
- (c) *Atlantic Ocean:* quotas decreased / depleted stocks / consumer tastes / smaller fleet / yield decreased;  
*Indian Ocean:* better technology / quotas increased / consumer tastes / more stocks / bigger fleet / yield decreased; [2]
- G2.** (a) gross production – respiration = net production [1]  
*Accept answer using initials.*
- (b) energy per unit area per unit time / KJ hectare<sup>-1</sup> year<sup>-1</sup> (*or similar*) [1]
- (c) parasitism – the host suffers and the parasite benefits;  
mutualism – both species benefit and neither suffers;  
*e.g.* is tapeworm and human *etc.*;  
tapeworm gains nutrients, human loses nutrients;  
*e.g.* lichens;  
algae photosynthesises food for both, fungus provides water and nutrients for both;  
mycorrhiza - fungi and plant roots;  
hydra and zoochlorella;  
bacteria in ruminants stomach;  
*e.g.* cleaner wrasse on damelfish; [4 max]  
*Accept similar named examples.*
- G3.** (a) maintain natural habitat / biodiversity / protects other species cheaper than *ex situ* / organisms continue to evolve in their natural habitat [1]
- (b) dodo / passenger pigeon / Tasmanian Tiger / Carolina Parakeet;  
hunting / competition with alien species / predation / habitat destruction / pollution; [2]
- (c) control of introduced or alien species;  
restoration of degraded areas;  
recovery of threatened species;  
control of human exploitation / tourism;  
population control / culling; [3 max]
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