

MARKSCHEME

November 2005

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 **[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 candidate’s answer has the same “meaning” or can be clearly interpreted as being the same as that in the markscheme 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.
- ◆ 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.
- ◆ Units should always be given where appropriate. Omission of units should only be penalized once.
- ◆ 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) 89(±3)% (no units required as question asks for percentage) [1]
- (b) 0.45 kg / 450 g (units required) [1]
- (c) adult [1 max]
- (d) adults have lower percentages water and fat than babies / adults have lower percentages of water and approximately the same fats as babies;
adults have higher percentages protein and minerals than babies;
water highest percentage in both and minerals lowest percentage in both; [2 max]
- (e) baby storing fat for energy / fetus has constant supply from mother so does not need to store fat;
baby drinking more milk;
baby needs fat for protection;
baby needs fat for insulation; [2 max]

A2. (a)

	<i>Milk</i>	<i>Egg</i>	<i>Beef</i>	<i>Potato</i>
<i>Vegan</i>				✓
<i>Vegetarian</i>	✓	✓		✓

[2]

Award [1] for vegan row completed correctly and [1] for vegetarian row completed correctly.

- (b) cyanocobalamin/vitamin B₁₂ but can get from yeast and cereals / supplements;
Vitamin D / calciferol deficiency avoided by exposure to sunlight / supplements; [2]
- A3.** (a) total food taken in by an individual [1]
- (b) *Award [1] for naming the food additive and [1] for the possible harmful effect.*
tartrazine – causes hyperactivity asthma / skin rashes;
MSG – leading to brain damage / allergic reactions;
aspartame – increasing brain tumors;
olestra – diarrhea;
nitrite – carcinogenic;
salt – hypertension; [2 max]
- (c) anemia is deficiency of red blood cells due to lack of iron;
iron is component of haemoglobin / cytochrome chains;
blood cannot carry sufficient oxygen;
need to eat green vegetables / lean meat / legumes / shellfish / liver / other example;
common in pregnant women;
lack of vitamin C / folic acid / ascorbic acid / B₁₂ / cyanocobalamin; [4 max]

Option B — Physiology of Exercise

- B1.** (a) 50 minutes (*units required*) [1]
- (b) 145 beats per minute (*units required*) [1]
- (c) initially heart rate rises at both temperatures;
from about 45 minutes / from 45 minutes in group A and 50 minutes in group B /
there is a decrease in heart rate trend at each temperature;
heart rate of those trained at 20°C is always lower than those trained at 37°C;
both heartbeats show fluctuation throughout the 90 minutes;
both start at same heart rate; [3 max]
- (d) a lower heart rate during exercise can be a measure of fitness;
training at higher temperatures caused greater difference in heart rate / higher
temperatures greatly increased heart rate so the hypothesis is not supported; [2]
- (e) so the difference was due to training conditions and not individual differences [1]
- B2.** (a) slow / tonic / red fibres [1]
- (b) has a good blood supply to provide oxygen for respiration;
has a lot of myoglobin to give oxygen to the muscles;
capable of sustained activity for extended exercise;
mainly carries out aerobic respiration so continuous energy supply; [3 max]
- B3.** (a) warm muscles less likely to tear / get damaged;
raises the body temperature;
improves the oxygen supply to the muscles;
stimulates the blood sugar level to increase;
stimulates adrenaline ready for action;
prepares the cardiovascular / respiratory / nervous / musculoskeletal systems; [2 max]
- (b) oxygen demand is greater than oxygen supply / produces an oxygen debt;
carbohydrate demand is greater than carbohydrate supply;
muscle respire anaerobically;
lactic acid accumulates;
ATP not provided fast enough to sustain muscle contraction; [4 max]

Option C — Cells and Energy

- C1.** (a) $317 \mu\text{g g}^{-1}$ (*units required*) [1]
- (b) (i) 300% (*no units required*) [1]
- (ii) magnesium is a component of chlorophyll so less chlorophyll;
plants make more carotenoids to compensate for less chlorophyll; [2]
- (c) iron deficiency lowers the chlorophyll content in both strains;
iron deficiency increases the carotenoid content in both; [2]
- C2.** (a) oxidation is loss of electrons / hydrogen / gain in oxygen;
reduction is gain of electrons / gain in hydrogen / loss of oxygen; [2]
Do not award points if a correct statement is then contradicted.
- (b) matrix [1]
- (c) ethanoyl CoA / $\text{C}_2 + \text{C}_4 \rightarrow \text{C}_6$;
 $\text{C}_6 \rightarrow \text{C}_5 \rightarrow \text{C}_4$;
2 CO_2 released;
1 ATP produced;
3 $\text{NADH} + \text{H}^+$ produced;
1 FADH_2 produced;
 $\text{NADH} + \text{H}^+$ and FADH_2 ; $\left\{ \begin{array}{l} \text{If both listed with no numbers worth [1] if neither of} \\ \text{the above two marking points have been awarded.} \end{array} \right.$ [4 max]
- C3.** (a) chains / cycles of enzyme controlled/catalysed reactions [1]
- (b) peptide linkages [1]
- (c) both prevent the substrate from binding to the enzyme;
competitive binds to active site, non-competitive binds elsewhere on enzyme;
increasing substrate concentration reduces effect of competitive but not non-competitive inhibitor;
both cause the reaction to slow down; [3 max]

Option D — Evolution

- D1.** (a) insectivore [1]
- (b) 30 % [1]
- (c) all lemurs have a greater percentage of cortex than insectivores / numerical comparison; [2 max]
most lemurs have a greater brain volume / numerical comparison; *(do not accept all)* the data shows more insectivores than lemurs;
For numerical comparison, as the candidate is not required to read log graphs, accept brain volume for insectivores from 100 to between 1000 and 10000 and for lemurs from between 1000 and 10000 to 10000 and 100000 e.g. "insectivores have a brain volume ranging from 100 to almost 10000 whereas lemurs have a brain volume of 2000 to 60000 is worth [1].
- (d) (i) data point in the top right of the graph labelled [1]
- (ii) largest brain volume and largest cortex percentage [1]
- D2.** (a) mammals / mammalia [1]
- (b) adaptations for tree life; [3 max]
opposable thumb;
fine manipulation of fingers segmented digits;
wrist can rotate / radius can move over ulna;
arms can move freely in shoulder sockets;
nails instead of claws;
- (c) *differences: [2 max]*
genetic evolution is carried in the genes and cultural by word and observation;
genetic evolution is much slower than cultural evolution;
genetic evolution changes the individual and cultural the behaviour;
similarity: [1 max]
both are passed on from generation to generation;
both are responses to the environment; [3 max]
- D3.** (a) organic molecules stick to the clay; [2 max]
the clay molecules act as catalysts;
organic molecules that can combine are brought together by chance;
- (b) RNA can be self-replicating; [3 max]
RNA can be a template for proteins;
RNA can act as a ribozyme/catalyst;
enzymes needed for building macromolecules are proteins;
nucleotides of RNA are similar in structure to coenzymes;
heating ribonucleotides can produce RNA strands;

Option E — Neurobiology and Behaviour

- E1.** (a) 20 [1]
- (b) 12 [1]
- (c) (i) with predator they choose brave (over timid);
without predator they chose bright (over dull); [2]
- (ii) brave males will defend (females) against predator;
brave males will pass on (genes for) bravery to offspring;
bravery cannot be detected without a predator;
bright males are attractive to females; [2 max]
- (d) in the presence of a predator, bravery is more important than colour;
in the absence of a predator, colour is more important than bravery;
difference between brave and timid is less than the difference between bright and
dull therefore, bright is more important; [2 max]
- E2.** (a) I: lens;
II: retina;
III: optic nerve;
IV: cornea; [2 max]
Award [2] if all four are correct, [1] if two or three are correct and [0] if one or none are correct.
- (b) photoreceptor [1]
- (c) photoreceptor cells / rods and cones are stimulated by light;
transmit the impulses to the bipolar cells;
they transmit the impulse to the ganglion cells;
optic nerve transmits impulse to visual cortex (of brain); [2 max]
- E3.** (a) learning due to the response to events (stimuli) that occur in the environment [1]
- (b) taxis is a directional response to a stimulus whereas kinesis is a non-directional response [1]
- (c) acquire information from past experiences to adapt to new situations;
can better obtain food / shelter;
can increase mating chances;
learns to avoid dangerous situations;
co-operation between individuals may increase survival; [3 max]

Option F — Applied Plant and Animal Science

- F1.** (a) 3.7 (± 1) tonnes hectare⁻¹ (*units required*) [1]
- (b) 96 kg hectare⁻¹ (*units required*) [1]
- (c) increases up to 96 kg hectare⁻¹;
falls slightly/remains fairly constant at 144 kg hectare⁻¹; [2]
- (d) it gives a high yield of barley with no nitrogen added;
reaches a maximum yield at 48 kg hectare⁻¹ N;
it gives a higher yield than PK fertilizer at all levels of N;
it is organic/natural;
it is a cheap fertilizer/waste product / recycle; [3 max]
- F2.** (a) *plowing*: ox / horse / buffalo / bull;
transport: horse / buffalo / camel / elephant / mule / donkey; [1 max]
Both needed for [1].
- (b) *advantages*: greater yield / less unhealthy animals / more survivors / faster growth rate / kill harmful bacteria in gut;
disadvantages: harmful effects on consumers / bacterial resistance in animals / humans / expensive; [2]
- (c) milk in cows / meat on sheep / eggs from poultry;
animals showing biggest yield are used for breeding / artificial selection; [2]
- F3.** (a) level of carbon dioxide;
water/humidity;
temperature;
quantity of light;
exposure to predators/biological control; [2 max]
- (b) monoculture is repeatedly growing only one type of crop in an area;
for: [2 max]
efficient land use leads to increased crop production;
farmers can become specialized with machinery and techniques;
against: [2 max]
invasion by pests can ruin entire crops;
nutrient depletion of the soil;
relies more on artificial fertilizers / pesticides; [4 max]

Option G — Ecology and Conservation

- G1.** (a) 5.5 years [1]
- (b) the flowering plants were initially very much destroyed by the fire;
after several years the number of flowering plants started to increase;
numbers of flowering plants increase to higher levels than before the fire (after 8 years); [2 max]
- (c) index would decrease;
because lower species diversity/richness;
the graph shows that there are fewer species after 10.5 years; [2 max]
- (d) different habitats/niches;
different food sources;
different breeding sites;
different responses to predators; [2 max]
- G2.** (a) total dry mass of all/a group of organisms in an ecosystem/habitat [1]
- (b) algae, fungus (lichen) / sea anemone, hermit crab / aphid, ant / bacteria (*Rhizobium*),
legumes / etc. [1]
- (c) organisms feed on species lower in food chain;
each trophic level is made up of what is passed on from one below;
there is loss of biomass at each trophic level / energy transfers between trophic levels
are inefficient;
due to respiration / excretion;
not all biomass is available as food to the next trophic level; [3 max]
- G3.** (a) t-test/student test/student t-test [1]
- (b) control of alien species;
restoration of degraded areas;
control of human exploitation;
promotion of the recovery of threatened species; [2 max]
- (c) a species in an ecosystem occupies a niche;
the niche is all the roles of the organism in the community;
no two species can occupy the same niche in the community;
there is competition for same resources;
one will increase in number and the other decrease/die out; [3 max]
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