

MARKSCHEME

November 2006

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.
- ◆ Words that are underlined are essential for 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. However, if the incorrect answer is used correctly in subsequent parts then **follow through** marks should be awarded.
- ◆ 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) 11 to 14 years (*units required*) [1]
- (b) (100% – 80% =) 20% [1]
- (c) boys average intake is above girls for iron and calcium;
iron is above the RDA in boys, girls have no mineral above the RDA;
zinc average intake is higher in girls than in boys;
biggest difference is in iron intake;
greater percentages of girls are (well) below the RDA in all three minerals; [2 max]
- (d) anemia is caused by iron deficiency;
as girls get older average intake of iron decreases;
dietary preferences / eat less meat / vegan diets;
weight conscious / social pressure;
start to menstruate so loss of blood; [3 max]
- A2.** (a) beans / rice / soya / milk / egg / cheese / nuts / dairy products [1]
- (b) essential amino acids cannot be synthesized, must be ingested and other amino acids
can be synthesized in the body [1]
- (c) (digested to) amino acids;
they are deaminated / nitrogen/amine group removed;
in the liver;
converted to urea / excreted in urine;
can be converted to fat/glucose; [3 max]

- A3.** (a) joules / kilojoules / J / kJ **[1]**
Award [0] for calories.
- (b) bigger person requires more energy as bigger body;
more active/strenuous individuals need more energy to maintain level of activity;
pregnant women need more energy to provide for developing fetus;
males require more energy than females;
younger adults need more than older adults;
extra energy is needed during breast-feeding / illness; **[2 max]**
Award [0] for growth as the question is about adults.
- (c) excess fat could be stored leading to obesity;
active people may burn up excess lipids;
saturated fatty acids cause high cholesterol;
increased cholesterol can lead to atherosclerosis / fats deposited in and around the
heart can cause heart attacks;
obesity increases chance of diabetes / high blood pressure;
saturated lipids more harmful than unsaturated lipids;
other factors could increase the effects of the higher lipid diet *e.g.* genetic, smoking,
high blood pressure; **[3 max]**

Option B — Physiology of Exercise

- B1.** (a) 110 beats per minute (*units required*) [1]
- (b) (resting) heart rate before and after exercise is lowered;
rate of increase of heart is similar / follows the same pattern before and after training;
during the exercise heart rate is lower in trained volunteers;
(initial) rate of recovery is faster in trained volunteers; [3 max]
- (c) (as heart rate lowered) volume of output per beat must have increased;
increase in the number of capillary vessels;
vasodilation; [1 max]
- (d) more oxygen to muscles;
more glucose / other nutrients to muscles;
remove carbon dioxide;
remove lactate / heat / other waste products produced; [2 max]
- B2.** (a) lubrication/reduction of friction [1]
- (b) their shape allows attachment of muscles/tendons;
they are (slightly) curved / have spongy heads to allow for shock absorption;
they are hollow so less weight / site for blood cell production;
ends are shaped to allow articulation at joints;
shaft of compact bone gives strength;
smooth cartilage covers the ends reducing friction; [2 max]
- (c) rest: to prevent muscle from further injury / body uses energy for healing;
ice: for short-term pain relief / reduce swelling;
compression: for pain relief / limit swelling;
elevation of injury above heart: lowers swelling;
massage/heat: to increase blood circulation / remove waste products;
anti-inflammatory/drug: to reduce pain/inflammation; [3 max]
- B3.** (a) transmission occurs across a synapse;
neurotransmitter released/moves across the synapse;
influx of calcium ions;
neurotransmitter destroyed;
initiates transmission of impulse in second neuron; [2 max]
- (b) impulse is initiated in the motor area of the cerebral cortex;
impulse travels from CNS to effector;
impulse carried in the motor neurons;
motor end plates of the neurons form synapse with muscle fibre;
stimulate contraction of muscle fibres / actin and myosin in biceps;
proprioceptors detect how stretched the muscle is;
feedback to the brain; [3 max]

Option C — Cells and Energy

C1. (a) light dark [1]

(b) $\left(\frac{1.00}{0.5} \times 100 =\right)$ 200 % [1]

(c) dark has least of both pigments;
light has most β -carotene;
light-dark has most chlorophyll;
most total pigment in light;
light – dark is the only condition where more chlorophyll is made than β -carotene; [2 max]

(d) pigments absorb light for photosynthesis / absorption spectrum;
more light absorbed more photosynthesis / action spectrum;
different pigments absorb different wavelengths of light;
can photosynthesize in different environmental conditions; [3 max]

C2. (a) (i) curve drawn below curve in graph;
line is the same at substrate and product section; [2]

(ii) exergonic as energy is released / products have less energy than substrates [1]

(b) enzymes are proteins;
e.g. ATP inhibition of phosphofructokinase in glycolysis / inhibition of aspartate carbamoyltransferase (ATCase);
provide end product inhibition / negative feedback;
product of reaction bonds to the enzyme;
this changes the shape of the enzyme;
bind to allosteric site / not active site / non-competitive inhibition; [3 max]

C3. (a) 2 [1]

(b) matrix (fluid) [1]

(c) Award [1] for each row, up to [3 max].

Respiration	Photosynthesis
both make ATP;	
both involve electron transport;	
protons move against a concentration gradient in both;	
both require ATP synthetase;	
occurs in mitochondrion	occurs in chloroplasts/thylakoids;
uses energy from oxidation	uses energy from light;
has NADH for electron production	has water for electron production;

[3 max]

Option D — Evolution

- D1.** (a) 350 (\pm 10) million years (*units required*) [1]
- (b) fossil evidence [1]
- (c) dinosaurs are most recent reptiles to be separated from birds;
 some dinosaurs may have actually been birds;
 separation from birds may have come after warm blood evolved / common ancestor;
 some may have been warm blooded, others not;
 two lines show that different dinosaurs evolved at different times; [3 max]
- (d) all came from a common ancestor (less than 100 million years ago);
 continents divided isolating some;
 these evolved independently;
 first the ancestors of monotremes were isolated, then marsupials and placental mammals
 divided;
 Australia separated and marsupials found there / other examples; [2 max]
- D2.** (a) Lamarck proposed evolution was by acquired characteristics;
 Darwin-Wallace by natural selection; [2]
- (b) no, as the scientific method requires evidence / cannot be repeated;
 special creation depends on faith (with no evidence); [2]
- (c) allows hands free for tool use / collecting food;
 taller so can see further;
 easier to walk long distances carrying water/food/tools/infants; [2 max]
- D3.** (a) high temperature;
 lightning;
 UV light;
 reducing atmosphere / lack of oxygen;
 presence of carbon dioxide/ammonia/methane;
 volcanic activity;
 water vapour present;
 radioactive elements present; [2 max]
- (b) endosymbiosis theory that eukaryotes are formed from prokaryotes;
 symbiosis is an association between two or more species;
 mitochondria of eukaryotes evolved from aerobic bacteria;
 chloroplasts evolved from primitive autotrophic prokaryotes;
 eukaryotes formed membranes that could contain the prokaryotes;
 mitochondria/chloroplasts have DNA / RNA similar to prokaryotes;
 mitochondria/chloroplasts have double membrane; [3 max]

Option E — Neurobiology and Behaviour

- E1.** (a) 25 (± 1) **[1]**
- (b) Song Sparrow song always longer than Swamp Sparrow;
isolation increases Song Sparrow song length but decreases Swamp Sparrow song length;
Answers may be numerical. **[2]**
- (c) a behaviour that occurs in all members of a species / behaviour determined genetically / inherited / stereotyped behaviour / not learnt / instinctive **[1]**
- (d) innate characteristics would be the same (or nearly the same) in normal and isolated;
notes per song / number of songs very different so probably not innate;
number of syllables / song length similar / not so different so possibly innate;
hypothesis not supported for all song characteristics; **[3 max]**
- E2.** (a) (i) osmoregulation/thermoregulation/hormone production **[1]**
- (ii) coordination of movement/balance/posture **[1]**
- (b) photoreceptor;
receptor stimulated by light; **[2]**
- E3.** (a) name of animal;
action; **[2]**
- e.g. baboons;*
groom to remove ticks/lice;
- (b) taxis is a directional response to or away from a stimulus;
kinesis involves random/changing non directional movement to a stimulus; **[2]**
- (c) remember food sources needed for survival;
recognize predators / toxic food;
finding a mate / breed successfully;
social organization for survival;
allows animals to gain a competitive advantage;
leads to a more efficient energy use; **[3 max]**

Option F — Applied Plant and Animal Science

- F1.** (a) 186 (± 1) [1]
- (b) the later they are planted the less the yield / negative correlation [1]
- (c) both show fluctuations in production early in the planting period;
both showed a drop in production later in the planting period;
yield in 1995 dropped earlier in the year than in 2000;
yield in 1995 dropped faster than in 2000; [2 max]
- (d) factor; [2]
effect;
e.g. temperature low;
reduces germination;
Credit any other feasible examples.
- F2.** (a) biomass per leaf area per unit time [1]
- (b) promote rooting;
promote flowering;
kill weeds;
induce fruit ripening;
produce seedless fruits; [2 max]
- (c) yield is often less;
debate over quality of the food;
less pollution with organic fertilizer;
pest control is difficult;
more land required to obtain similar yields;
higher risk of pathogen transmission; [3 max]
- F3.** (a) cat / dog / horse / other examples [1]
- (b) overcrowding so no room to move;
short lives as killed when ready for market;
deprived of natural feeding;
given unnatural supplements and drugs;
transported inhumanely leading to injury;
subjected to unnatural day length; [2 max]
- (c) artificial insemination improves fertilization chances / fecundity;
artificial insemination allows selective breeding;
vaccination prevents diseases;
nutrient supplements improve yields;
growth hormones to increase yield; [3 max]

Option G — Ecology and Conservation

- G1.** (a) 2002 [1]
- (b) 6 / A B E F G H [1]
- (c) hypothesis seems to be supported;
 in most / five sites the red squirrel density has increased since 1999;
 some sites decreased in density from 2000 to 2002;
 may be other factors controlling squirrel density;
 however there is no information about red squirrels in 1998 / more data is required
 starting with same density of grey squirrels in 1998 and different densities of
 red squirrels; [3 max]
- (d) (principle of) competitive exclusion;
 competition occurs between them;
 most successful of the two increases in numbers;
 displaces the other from the population; [3 max]
- G2.** (a) $(GP = NP + R = 42 + 100) = 142 \text{ kJ m}^{-2} \text{ yr}^{-1}$ (*units required*) [1]
- (b) organisms can occupy several different trophic levels;
 food sources may change / different diets at different times of the year;
 feeding habits can vary through an organism's life cycle; [2 max]
- (c) roots break down rocks to form soil particles;
 roots prevent soil erosion by binding action of roots / erosion is increased due to
 roots / burrowing / grazing animals;
 plants decompose returning minerals / humus / organic matter to soil;
 plants reduce wind;
 plants produce shade;
 lichens/mosses trap organic matter;
 soil structure improves as organic content rises / increasing water retention/aeration;
 increase oxygenation of water due to photosynthesis / decrease oxygenation of water
 due to decay;
 light intensity decreases due to leaf canopy; [3 max]
- G3.** (a) *ecological*: trees provide habitats / food / food chains / other examples;
economic: trees provide timber / livelihoods / medicines / drugs; [2]
- (b) (CITES is the) Convention on International Trade on Endangered Species;
 status of species is regularly monitored;
 prevent trade of products of threatened species;
 both fauna and flora;
e.g. exotic goods / medicines / tourist items / pets / other examples; [2 max]
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