

MARKSCHEME

May 2007

BIOLOGY

Standard Level

Paper 3

*This markscheme is **confidential** and for the exclusive use of examiners in this examination session.*

*It is the property of the International Baccalaureate and must **not** be reproduced or distributed to any other person without the authorization of IBCA.*

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 penalizing them for what they have not achieved or what they have got wrong.
- ◆ 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.
- ◆ 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) (i) essential for the functioning of hormones/enzymes/nerves / construction of structural components of cells / act as cofactors in proteins/vitamins; named example and function (*e.g.* Ca bone formation); **[1 max]**
Do not accept vague answers e.g. required for chemical reactions or avoid deficiencies.
- (ii) needed to manufacture (the hormone) thyroxin **[1]**
- (b) (soil) iodine has no/little effect on the incidence of goitre; soil selenium raises incidence of goitre / positive correlation; accept numerical data; **[2 max]**
- (c) iodine in water is effective so iodine supplements are likely to be effective; selenium in water is linked to low goitre so selenium supplements are likely to be effective; support for taking iodine supplements is greater than that for selenium supplements; high levels of selenium in soil is linked to high incidence of goitre, so supplement may not be advisable; no data about selenium and iodine content of food eaten/other sources; **[3 max]**
- A2.** (a) *Award [1 max] for any two of the following.*
cane sugar / honey / onion / milk / maple syrup / fruit / soft drinks / other answers **[1]**
- (b) provide energy / cell respiration ; excess carbohydrate (glucose) can be converted into fat/glycogen for storage; synthesis of glycoproteins / combine with proteins to form glycoproteins; components of nucleic acids *e.g.* ribose in mRNA / deoxyribose in DNA; required for the synthesis of some amino acids; constituent of connective tissue; **[3 max]**
- (c) diets high in saturated lipids increase risk of heart disease/atherosclerosis; diets high in saturated lipids increase risk of obesity; obesity linked to a variety of health problems *e.g.* diabetes; atherosclerosis is narrowing of artery lumen; atherosclerosis leads to high blood pressure / increased risk of coronary thrombosis/stroke; smoking/lack of exercise in combination with diet high in saturated lipids compounds risk of heart disease; relationship may be affected by genetic factors; **[4 max]**

A3. (a) *Award [1 max] for any two of the following.*

preservative;
antioxidant;
colouring;
flavouring / sweetening;
stabilizers / texture enhancer;
acidity-regulator;

[1 max]

(b) *One named additive and one possible harmful effect is needed to achieve full marks.*

additive: benzoic acid (preservative);
effect: asthma / rhinitis / urticaria;

additive: tartrazine (colouring);
effect: hyperactivity / asthma;

[2 max]

Option B — Physiology of Exercise

- B1.** (a) (i) 1982 [1]
- (ii) heat stroke temperatures were generally higher than exercise hyperthermia [1]
- (b) there is no change/a slight increase in the maximum body temperature recorded for exercise hyperthermia;
the data is limited so difficult to draw a conclusion;
accept numerical data (*e.g* 1993 is highest recorded body temperature); [2 max]
- (c) reducing exposure to high temperature conditions;
drinking sufficient water/fluids while exercising;
reduce body hair;
minimize clothing;
spray with water;
acclimatisation training; [2 max]
- B2.** (a) *Award [1] for each two of the following clearly drawn and correctly labelled.*
cartilage;
synovial fluid;
synovial membrane
tendons;
ligaments;
biceps;
triceps;
humerus;
ulna;
radius; [4 max]
Award [3 max] if inaccurate diagram.
- (b) (i) skeletal muscle [1]
- (ii) *Award [1 max] for any two of the following features.*
muscle is composed of fibres;
each fibre is composed of myofibrils;
muscle is striated/multinucleate; [1 max]

B3. (a) oxygen binds to myoglobin (in muscle);
myoglobin acts as an oxygen reserve/store;
oxygen released from myoglobin under anaerobic conditions/when muscles need
oxygen; *[2 max]*

(b) adrenalin stimulates conversion of glycogen to glucose / increased blood glucose
concentration;
resulting in increased supply of glucose to muscles;
causes breathing rate/depth to increase, resulting in increased supply of oxygen to
muscles;
causes dilation of bronchioles and thus more oxygen in the blood;
causes dilation of arteries leading to muscles resulting in increased blood supply;
causes blood vessels not supplying muscles to constrict, directing more blood to
muscles; *[4 max]*

Option C — Cells and Energy

- C1.** (a) (i) leads to an increase in calcium in tissues / accept numerical data [1]
- (ii) leads to a decrease in other metals in tissues [1]
- (b) competitive inhibition / calcium and the other metals compete for the transport mechanism;
as calcium concentration within the cell increases, uptake of the other metals is prevented;
entry of calcium into cells may be linked to increased export of the other metals; [2 max]
- (c) monitoring of water quality for metals can indicate amount of metals in tissue;
(toxic) metals found in water will (most likely) be found in bivalves;
analysis of bivalve tissue could be used as a measure of water quality;
high levels of heavy metals in bivalves may poison consumers; [3 max]
- C2.** (a) (i) A: cristae / inner membrane;
B: matrix; [1]
Both needed for [1].
- (ii) A: electron transport / proton transport;
B: Krebs cycle / ATP synthesis; [1]
Both needed for [1].
- (b) large surface area of cristae allows electron transport/oxidative phosphorylation to be very efficient;
matrix provides necessary chemical environment for the Krebs cycle;
small distance between inner and outer membranes allows rapid movement of molecules between cytosol and matrix;
small space between membranes allows protons to be accumulated/concentrated; [3 max]
- C3.** (a) *Award [1] for each two of the following clearly drawn and correctly labelled.*
outer membrane;
inner membrane;
thylakoids;
grana;
ribosomes;
DNA;
starch grains / oil droplets;
stroma;
lamellae; [3 max]
Award [2 max] if inaccurate diagram.
- (b) pigments absorb light as a source of energy for photosynthesis;
absorption spectrum indicates wavelengths/frequency of light absorbed by each pigment;
action spectrum indicates rate of photosynthesis for each wavelengths/frequency;
pigment absorption peaks match photosynthetic rate peaks / strong correlation; [3 max]

Option D — Evolution

- D1.** (a) (i) slope and (occlusal) relief decrease with wear / teeth become flatter
(ii) teeth of early Hominids have a greater slope/occlusal relief (at all stages) than *A. afarensis*;
wear has greater effect on slope in *A. afarensis* than in early Hominids;
wear has less effect on occlusal relief in both;
the (occlusal) relief of Hominids progressively decreases whereas it remains relatively stable for *A. afarensis*; [2 max]
- (b) early Hominids ate more elastic foods such as meat;
early *A. afarensis* ate more hard, brittle foods;
the diets were similar at wear stage 3; [2 max]
- (c) tools found with early Hominids fossils;
bones of prey found with early Hominids fossils;
plant remains (*e.g.* pollen, seeds) found in the immediate area; [2 max]
- D2.** (a) (i) half-life is the time taken for a sample of an isotope to decay 50 % [1]
(ii) *e.g.* ^{14}C and ^{40}K [1]
Two examples are needed for [1].
- (b) differences between amino acid sequences in proteins can be compared;
amino acid sequences in proteins / mapping differences in various proteins;
the larger the number/type of differences the further away the relationship / *vice versa*;
nucleotide sequences in DNA change gradually over time / DNA can be compared to establish when divergence occurred; [3 max]
- D3.** (a) Urey and Miller mixed the gases ammonia, methane and hydrogen/pre-biotic gases;
electricity was passed through the gas mixture (to replicate lightning);
the mixture was boiled;
amino acids/organic compounds were generated; [3 max]
- (b) lipids present in the pre-biotic Earth could have joined together to form small spheres/micelles;
simple proteins/nucleic acids are produced when organic monomers are poured over sand/clay/rock;
nucleic acid/RNA present in the pre-biotic Earth may have been enclosed by small spheres/micelles (to form protobionts);
lipid-protein films formed;
long period of time required for simple prokaryote formation; [3 max]

Option E — Neurobiology and Behaviour

- E1.** (a) (i) high-strain nectar foragers **[1]**
- (ii) in both strains/all groups the number of bees responding fully increases with the number of trials;
in both strains/all groups the number of bees responding fully increases significantly up to four trials/initially and then plateaus;
the differences between pollen and nectar foragers in the low strain is less than in the high strain / *vice versa*; **[2 max]**
- (b) classical conditioning;
the bees learn to associate the conditioned stimulus/grooved plates with full proboscis extension/conditioned response; **[2]**
- (c) when food is scarce competition occurs;
bees better at learning/finding food are more likely to survive;
the bees best able to find food will pass on their genes to their (more numerous) offspring;
over time, bees best able to find food will increase as a proportion of the population; **[3 max]**
- E2.** (a) innate behaviour is inherited and not modifiable / irrespective of environment **[1]**
- (b) the pain withdrawal reflex results in automatic withdrawal of a limb/part of the body from a source of pain (for protection) **[1]**
- (c) (i) *Award [1] for each two of the following clearly drawn and correctly labelled.*
receptor;
dorsal root ganglion;
sensory neuron;
association / relay neuron;
motor neuron
central canal;
white matter;
grey matter;
ventral root;
dorsal root;
effector; **[3 max]**
Award [2 max] if inaccurate diagram.
- (ii) arrow from direction of receptor to effector **[1]**

- E3.** (a) *e.g.* waggle dance (in honey bees);
grooming (in baboons);
courtship; **[1 max]**
Two examples needed for [1].
- (b) named society/group of animals;
example of altruistic member of population;
example of action of the individual which may be detrimental to itself but protects
the group as a whole; **[3]**
e.g. Belding's ground squirrels;
female ground squirrels;
female squirrel raises alarm to warn relatives/others of danger;
but in doing so is at greater risk of predation;
e.g. vampire bats;
those that have fed;
regurgitate to those who are hungry;
less food for themselves;

Option F — Applied Plant and Animal Science

- F1.** (a) (i) conventional farming [1]
- (ii) 29-29.5 % less by organic / 41-42 % more by conventional
Farming type must be stated. [1]
- (b) conventional farming is more efficient;
 milk output outweighs the (slightly) higher feeding cost incurred;
 milk output is more for less time on pasture / less area used; [2 max]
- (c) organic farming does not use artificial pesticides/fungicides reducing possible
 pollution risk / *vice versa*;
 organic farming does not use synthetic fertilizers reducing possible environmental
 risk / *vice versa*;
 organic farming relies on local sustainable processes such as crop rotation/recycling
 of animal manure *etc.*;
 organic farming does not use synthetic food additives to promote growth / *vice versa*;
 organic farming do not use hormones/antibiotics to promote growth / *vice versa*; [3 max]
Do not accept answers referring to ethical or financial issues.
- F2.** (a) (i) crossing members of different species to produce offspring [1]
- (ii) *e.g. Geospiza fortis and Geospiza scandens* (two species of Galapagos finches);
 resultant offspring have bill size intermediate of the parental species;
e.g. donkey mated with horse;
 mule produced; [2 max]
Accept other appropriate example.
- (b) *named example: e.g. rice;*
what was done: rice yield has been improved by cross breeding fast growing varieties
with those with high yield;
outcome: new variety which grows quickly with a high yield; [3]
Accept other appropriate example.
- F3.** (a) *technique: artificial insemination / vaccination / nutrient supplements;*
example: female cows are artificially inseminated with semen from a male cow in
good health/found to produce desired offspring; [2]
Accept other appropriate example.
- (b) *use: [2 max]*
 to increase size of animals (to be slaughtered), increasing food production;
 to increase growth rate of animals so that they reach full size faster;
- misuse: [2 max]*
 hormones may enter the food chain and affect other organisms;
 long-term effect of hormone use is unknown;
 animals forced to grow faster than normal/to a size greater than normal may suffer; [3 max]

Option G — Ecology and Conservation

- G1.** (a) (i) permanent (wetlands) [1]
- (ii) permanent (wetlands) [1]
- (b) permanent (wetlands);
total abundance of food (over the two years) is always greater (in each month); [2 max]
- (c) temporary wetlands would be affected first/the first to disappear;
N. erythrogaster neglecta numbers would decrease/risk of extinction;
N. erythrogaster neglecta would have to travel (further) to find food/new habitat;
increased competition with other predator species for prey; [3 max]
- G2.** (a) transition/change in species composition/number in a community over time [1]
- (b) *e.g.* beach sand dunes show transition from hardy grasses on seaward edge/after forest fires;
to small, salt and wind tolerant shrubs;
grasses create the conditions necessary for shrubs to survive;
accept other appropriate example; [2 max]
- (c) *e.g.* volcano slopes moss colonisation / detritus feeders increase aeration of soil;
make abiotic environment more hospitable, supporting greater species diversity;
greater energy capture (per unit area) as succession proceeds;
e.g. nitrogen accumulation by bacteria improves plant productivity;
plant roots help reduce soil erosion; [3 max]
- G3.** (a) *example:* Sexton Mountain mariposa-lily/*Calochortus indecorus*;
factor leading to extinction: a highway was built that destroyed the habitat of this plant;
example: St Helena Olive/*Nesiota elliptica*;
factor leading to extinction: habitat loss and susceptibility to fungal infection; [2]
- (b) indicator species provide information on the health of an ecosystem;
indicator species are usually high in the food web/more sensitive than other species to factors that may damage the environment;
e.g. frog species are good indicators of the health of rainforest ecosystems;
knowledge of the health of an ecosystem/damage to an ecosystem may lead to action which avoids extinction of threatened species; [3 max]
-