IB DIPLOMA PROGRAMME
PROGRAMME DU DIPLÔME DU BI
PROGRAMA DEL DIPLOMA DEL BI

MARKSCHEME

MAY 2006

BIOLOGY

Standard Level

Paper 3

10 pages

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 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.
- 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) positive correlation / higher incidence with higher meat consumption ***[1]***

(ii) fat consumption is correlated with / causes colon cancer;
meat contains (high levels of) fat; ***[2]***

(b) (i) 12 (±1) deaths per 100 000 women ***[1]***

(ii) same meat consumption but higher colon cancer rate in Sweden;
other factors cause colon cancer (in Sweden) / *e.g.* genetic factors, lack of fibre;
only some types of meat may cause colon cancer;
meat may contain more fat in Sweden / other chemical differences;
other foods may protect against cancer (in Hungary); ***[3 max]***

A2. (a) substance needed in the diet ***[1]***

(b) energy content / kJ / additives / preservatives / flavourings / colourings / allergies / % RDA; ***[1 max]***

(c) keep animals / flies away from the food;
cook food thoroughly (to kill bacteria);
refrigerate food (to prevent bacterial growth);
defrost food thoroughly;
handle cooked and uncooked food with separate tools;
store cooked and uncooked food separately;
use/consume food before the use-by date;
do not refreeze food;
good hygiene / clean hands and utensils; ***[2 max]***

A3. (a) *definition*: ***[2 max]***
some vitamins are substances that the body cannot make;
complex organic substances/molecules;

importance: ***[2 max]***
used to make substances that are essential to the body / named example with function;
deficiency diseases develop otherwise;
enzyme cofactors; ***[3 max]***

(b) tocopherol is an antioxidant;
protects membranes;
protects against oxidizing agents/hydrogen peroxide; ***[1 max]***

(c) no calciferol/vitamin D (in plant products);
but can be made in the skin / is added to margarine / added to other named vegan food;
no cyanocobalamin (in plant products);
contained in yeast/yeast extract / added to soya milk / added to other named vegan food;
vitamin supplements; ***[3 max]***

Option B — Physiology of Exercise

B1. (a) B;
longer strides;
pace greater angle / footprints in a straight-line;
smaller pace angles help balance when moving slowly; ***[2 max]***

(b) 5.6 (±0.1) m *(units are required)* ***[1]***

(c) (i) decreased because stride length reduced;
decreased because pace angle decreased; ***[1 max]***

(ii) positive correlation / the greater the stride length the greater the angle ***[1]***

(iii) greater forward distance per pace with greater pace angle;
therefore faster forward movement;

more risk of falling sideways while walking;
placing feet further from the mid-line gives more stability;

body lifts off ground during running;
feet placed alternately under the midline of body to give stability; ***[2 max]***

B2. (a) training that develops muscles needed for a particular activity/sport ***[1]***

(b) progressive overload ***[1]***

(c) duration and frequency; *(reject if answer includes intensity)*
duration develops stamina for long distance running;
the more frequent the training the greater its effect; ***[2 max]***

(d) compression / ice ***[1]***

B3. (a) increase in carbon dioxide production;
lactic acid produced by anaerobic respiration;
pH of blood reduced / more acidic;
chemosensors detect pH change in blood;
message/impulses sent to breathing centres in brain;
breathing centres / brain sends messages/impulses to diaphragm / intercostals; ***[3 max]***

(b) shaft with heads at each end;
shaft is hollow / contains bone marrow;
compact bone tissue in the shaft;
head is not hollow;
head is composed of spongy bone tissue; ***[3 max]***
Do not accept cartilage.
Accept any of the above points if clearly explained in a diagram.

Option C — Cells and Energy

C1. (a) both have two (outer) membranes;
both have cristae;
both have a matrix (with a grainy appearance) / ribosomes; ***[2 max]***

(b) shape;
arrangement of cristae;
density of cristae;
amount of matrix granules / any reference to dark dots; *(do not accept ribosomes)* ***[2 max]***

(c) A / bat's;
larger size / volume;
greater surface area of cristae / more cristae;
closeness of mitochondria in B mouse reduces rate; ***[3 max]***

C2. (a) hemoglobin / histone / immunoglobin / insulin / other named globular protein ***[1]***

(b) polar on surface of protein;
non-polar inside the protein; ***[2]***

(c) reduce/lower the activation energy;
by weakening bonds/making them easier to break in the substrate / altering shape of substrate;
correct alignment of reactants; ***[2 max]***
Do not accept reference to increase rate of reaction.

C3. (a) carbon dioxide and RuBP react/combine/fixation reaction;
catalysed by RuBP carboxylase / rubisco;
glycerate 3-phosphate produced;
reduction using ATP and NADPH;
triose phosphate produced;
some triose phosphate used to regenerate RuBP;
some triose phosphate converted to glucose (phosphate) / sucrose / starch; ***[4 max]***
Do not accept Calvin cycle or location of reactions.

(b) temperature;
carbon dioxide (concentration);
oxygen (concentration); ***[2 max]***

Option D — Evolution

D1. (a) concave region is larger/wider in knuckle-walking primates;
medial dorsal ridge in knuckle-walking primates;
an extension/bump (on right side) in non knuckle-walking primates; ***[2 max]***

(b) (i) *A. anamensis* and *A. afarensis*;
larger concave region / presence of medial dorsal ridge; ***[2]***

(ii) earliest hominids / *Australopithecus* species were knuckle-walkers;
knuckle-walking lost during *Australopithecus* evolution;
evolution from knuckle-walking to full bipedalism;
earliest *Homo* was already fully bipedal;
medial dorsal ridge lost / concave regions reduced;
knuckle-walking inherited from ape ancestors; ***[3 max]***

D2. (a) organisms can acquire/develop characteristics during their lifetime;
characteristics develop through use;
example of an acquired characteristic;
acquired characteristics can be passed on to offspring / inherited; ***[3 max]***

(b) no evidence;
no mechanism for inheritance of acquired characteristics / mutations required;
evidence for evolution by natural selection / for Darwin's theory; ***[2 max]***

D3. (a) all organisms have a common ancestor / life arose once;
genes can be transferred between species and the same protein synthesized; ***[1 max]***

(b) number of base differences can be used as an evolutionary clock;
gives estimate of how long ago two species shared an ancestor / diverged longer ago if more differences;
differences accumulate gradually by mutation;
phylogeny can be deduced;
base differences can allow way in which species diverged to be deduced;
computers work out phylogeny that would have involved fewest mutations; ***[3 max]***

(c) (i) RNA ***[1]***

(ii) RNA can self replicate;
RNA can act as a catalyst;
no DNA in early organisms; ***[1 max]***

Option E — Neurobiology and Behaviour

E1. (a) lowest (mean) amount of pollen collected on nectar visits;
highest (mean) amount on visits for both / little difference between pollen and both visits;
most variation / largest standard deviation in amount collected on visits for both; ***[2 max]***

(b) more pollen removed by bumble bees on nectar visits;
more pollen removed by honey bees on pollen and both visits;
relative mean amounts for the three types of visit are the same / numerical data; ***[2 max]***

(c) pollen most important for honey bees and nectar for bumble bees;
most honey bee visits were for both;
least honey bee visits were for nectar only;
most bumble bee visits were for nectar only;
least bumble bee visits were for pollen only; ***[3 max]***

E2. (a) (i) coughing / sneezing / blinking / any other cranial reflex ***[1]***

(ii) touch receptor in trachea / other appropriate receptor ***[1]***

(iii) diaphragm is the effector / other named effector;
contractions to force air and dust out of trachea / other role; ***[2]***

(b) allow rapid responses;
withdrawal reflex / other example of the survival value of rapid responses;
present from birth / do not need to be learned;
rooting/suckling reflex / other example of the value of having a reflex from birth;
make an animal better adapted to its environment; ***[3 max]***

E3. (a) (i) named organism (*e.g.* sparrow but not birds) ***[1]***
Accept binomial or common name.

(ii) migration from where to where ***[1]***

(b) named species showing grooming behaviour;
establishes rank within a group;
reinforces bonding within a group;
gets rid of skin parasites;
reduces conflict;
example of self-grooming (*e.g.* waterproofing feathers); ***[2 max]***
*Award **[1 max]** if no species name given.*

Option F — Applied Plant and Animal Science

F1. (a) (i) higher densities cause increased stress;
higher densities cause physical suffering as fewer birds can walk properly;
higher densities cause physical suffering as birds are pushed/knocked more;
higher densities mean they are less able to follow their natural behaviour patterns; ***[3 max]***

(ii) growth rate per bird decreases / little effect on growth rate as density increases;
but yield per square metre of house increased as density increases; ***[2 max]***

(b) diseases;
diet;
genetic factors/breed;
vaccinations;
temperature;
ventilation;
humidity; ***[2 max]***

F2. (a) (i) cotton / flax / banana / sisal ***[1]***

(ii) bamboo / palm / other named timber tree ***[1]***

(b) plants are grown without soil / in water;
roots are bathed in a nutrient solution;
nutrient solution is monitored to ensure that nutrient levels are optimum;
roots grow into matting / sand / gravel / other inert material;
(usually) in a greenhouse; ***[3 max]***

F3. (a) fertilizers are mineral nutrients needed for plant growth;
plant growth regulators are chemical (messengers) / hormones that affect plant growth; ***[2]***

(b) auxin / IAA / IEA;
produced by the shoot tip;
prevents the growth of axillary buds / side shoots; ***[2 max]***

(c) spray/apply plant growth regulators onto the weeds;
kills broadleaved weeds/dicots but not grasses/monocots; ***[2]***

Option G — Ecology and Conservation

G1. (a) area 6b / grassland with salt tolerant plants ***[1]***

(b) spent more time in marshes in summer than winter ***[1]***

(c) not positively correlated;
OFG has least area but most time / 6B has significant area / 15% but little time /
5 has most area but not most time / other valid comparison; ***[2]***

(d) overlapping niches;
as they graze the same areas in different proportions / at the same time;
may graze on different plants in the same areas;
may graze at different heights; ***[2 max]***

G2. (a) gross production is the total organic matter produced;
net production is gross production minus respiration; ***[2]***

(b) $8 - 17\,\text{kJ}\,\text{m}^{-2}\,\text{year}^{-1}$; *(units required)*
Only 10-20% passed on / lot of energy lost (by respiration *etc.*); ***[2]***

(c) loss of biomass / energy between trophic levels;
respiration;
mass lost when products of respiration are excreted;
deaths / biomass passed to decomposers instead of consumers;
some organisms / parts of organisms not eaten; ***[3 max]***

G3. (a) every species has the right to exist / other ethical reason;
rainforest are beautiful / other esthetic reasons;
tourists bring money into the country/economy;
carbon dioxide uptake / reduce greenhouse effect;
prevention of soil erosion / flooding;
source of (new) foods;
source of (new) drugs;
habitat preservation for particular species / maintain biodiversity; ***[3 max]***

(b) can spread rapidly/out of control;
can out-compete native plants;
can eat native species;
can spread diseases to native species;
can cause extinction of native species; ***[2 max]***