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

MARKSCHEME

November 2004

BIOLOGY

Standard Level

Paper 3

15 pages

General Marking Instructions

After marking a sufficient number of scripts to become familiar with the markscheme and candidates' responses to all or the majority of questions, Assistant Examiners (AEs) will be contacted by their Team Leader (TL) by telephone. The purpose of this contact is to discuss the standard of marking, the interpretation of the markscheme and any difficulties with particular questions. It may be necessary to review your initial marking after contacting your TL. **DO NOT BEGIN THE FINAL MARKING OF YOUR SCRIPTS IN RED INK UNTIL YOU RECEIVE NOTIFICATION THAT THE MARKSCHEME IS FINALIZED.** *You will be informed by e-mail, fax or post of modifications to the markscheme and should receive these about one week after the date of the examination. If you have not received them within 10 days you should contact your Team Leader by telephone. Make an allowance for any difference in time zone before calling.* **AEs WHO DO NOT COMPLY WITH THESE INSTRUCTIONS MAY NOT BE INVITED TO MARK IN FUTURE SESSIONS.**

You should contact the TL whose name appears on your "Allocation of Schools listing" sheet.

Note:
Please use a personal courier service when sending sample materials to TLs unless postal services can be guaranteed. Record the costs on your examiner claim form.

If you have any queries on **administration** please contact immediately:

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1. Follow the markscheme provided, do **not** use decimals or fractions and mark in **RED**.

2. Where a mark is awarded, a tick (✓) should be placed in the text at the **precise point** where it becomes clear that the candidate deserves the mark.

3. Sometimes, careful consideration is required to decide whether or not to award a mark. In these cases write a brief annotation in the **left hand margin** to explain your decision. You are encouraged to write comments where it helps clarity, especially for moderation and re-marking.

4. Unexplained symbols or personal codes / notations on their own are unacceptable.

5. Record subtotals (where applicable) in the right-hand margin against the part of the answer to which they refer next to the mark allocation. Do **not** circle subtotals. **Circle the total mark for the question in the right-hand margin opposite the last line of the answer.**

6. Where an answer to a part question is worth no marks, put a zero in the right-hand margin.

7. For each Option: Add the totals for each question in the Option and write it in the Examiner column on the cover sheet.
Total: Add the marks awarded and enter this in the box marked TOTAL in the Examiner column on the cover sheet.

8. After entering the marks on the cover sheet, check your addition to ensure that you have not made an error. Check also that you have transferred the marks correctly to the cover sheet. **We have script checking and a note of all clerical errors may be given in feedback to examiners.**

9. Every page and every question must have an indication that you have marked it. Do this by **writing your initials** on each page where you have made no other mark.

10. If a candidate has attempted more than the required number of Options, mark only the required number in the order in which they are presented in the paper, **unless the candidate has indicated on the cover sheet the Options to be marked**.

11. A candidate can be penalized if he/she clearly contradicts him/herself within an answer. Make a comment to this effect in the left hand margin.

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.
- Remember that many candidates are writing in a second language. 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. Indicate this with **"ECF**", error carried forward.
- Units should always be given where appropriate. Omission of units should only be penalized once. Indicate this by **"U-1"** at the first point it occurs. 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) 1977 / 1978 / 1979 ***[1]***

(b) as condensed milk importation decreases (and stops in 1987), fresh product importation increases / inversely proportional ***[1]***

(c) fresh milk ***[1]***

(d) better refrigeration;
better forms of transportation;
changes in consumer preference;
insufficient national production;
greater consumption / demand / population growth; ***[2 max]***

(e) *Any **two** of the following for **[1]**.*
proteins / amino acids;
carbohydrates / sugars;
calcium;
lipids;
vitamin D / vitamins; ***[1 max]***

A2. (a) cell respiration / source of energy;
energy storage (as glycogen or fat);
synthesis of glycoproteins / linked to proteins / glycolipids;
synthesis of nucleic acids / subunits of nucleic acids;
synthesis of some amino acids; ***[2 max]***

(b) *Response must relate environmental condition to food production or food quality.*
environmental disasters / storms destroy crops / food production;
drought / lack of rain decreases food production;
overuse of soil / deficiency of minerals decreases food production / quality; ***[2 max]***

A3. (a) (i) liver ***[1]***

(ii) formation of bile;
component of cell membrane;
necessary for the synthesis of some hormones;
named example: testosterone / estrogen / progesterone / other named steroid hormone / vitamin D; ***[2 max]***

(b) (i) an unbalanced diet / unbalanced intake of essential nutrients ***[1]***
Do not award "lack of nutrients" or "excess of nutrients" as this is not a sufficient response.

(ii) *Responses must include reference to deficiencies in vegan diet to receive full marks. Award* ***[2 max]*** *for general comments.*
each has a specific function;
cannot be synthesized by the body;
example of mineral and importance *e.g.* calcium needed for bone formation;
example of vitamin and importance *e.g.* vitamin B12 / cyanocobalamin for coenzyme synthesis;
vegans do not eat animal products which have essential minerals / vitamins not found (sufficiently / easily) in plant products;
example of mineral possibly missing in vegan diet and alternative source *e.g.* zinc from yeast;
example of vitamin possibly missing in vegan diet and alternative source *e.g.* vitamin D / calciferol from soya;
example of deficiency disease *e.g.* anemia – lack of vitamin B12;
vegans may get vitamins and minerals from supplements; ***[4 max]***

Option B – Physiology of Exercise

B1. (a) (i) Tokyo to Mexico: faster/increased by 2.9 (± 0.1) % / Mexico to Tokyo: slower/decreased by 3.0 (± 0.1) % ***[1]***
Accept just the percentage, as the idea of increase/decrease is asked in (b).

(ii) Tokyo to Mexico: slower/decreased by 6.2 (± 0.1) % / Mexico to Tokyo: faster/increased by 5.9 (± 0.1) % ***[1]***
Accept just the percentage, as the idea of increase/decrease is asked in (b).

(b) short races were faster in Mexico **and** long races were slower / short races were slower in Tokyo and long races faster ***[1]***

(c) aerobic respiration ***[1]***

(d) lower air density so less resistance to movement;
short races were faster as largely anaerobic;
long races slower as mainly aerobic / less oxygen at high altitudes;
insufficient acclimatization (for more red blood cells to form); ***[2 max]***

B2. (a) rest prevents further injury / allows healing;
ice relieves pain / prevents swelling;
compression relieves pain / prevents swelling;
elevation prevents swelling;
or other brief account; ***[2 max]***

(b) *Award **[1]** for each of the following structures clearly drawn and correctly labelled.*
sarcomeres;
actin filaments;
myosin filaments;
sarcoplasmic reticulum;
mitochondria; ***[3 max]***

B3. (a) rate of quickness of movement of limb / fitter then faster you run;
not a complete measure as other factors not included;
e.g. flexibility / stamina / agility / strength; ***[2 max]***

(b) (i) motor (neuron) ***[1]***

(ii) controlled by the cerebral cortex;
motor areas of the cerebral cortex each control one muscle;
impulse transmitted over synapse to muscle fibre;
muscle fibres contract when impulse / stimulus received;
propioreceptors / cells detect how stretched the muscle is;
feedback to brain;
by sensory neurons; ***[4 max]***

Option C – Cells and Energy

C1. (a) (i) 07:30 / 7.30 am / 7.5 hours *(accept answers in range up to 07.45)* ***[1]***

(ii) 17:00 / 5.00 pm (± ½ hour) ***[1]***

(b) 250 ppm (± 30 ppm) *(unit required)* ***[1]***

(c) at night / darkness / no light only respiration occurs so CO_2 increases;
in day / with light both respiration and photosynthesis occur / photosynthesis exceeds respiration in day;
CO_2 is used by photosynthesis and level decreases;
when sun sets, CO_2 again increases as only respiration occurs; ***[2 max]***

C2. (a) *Award **[1]** for any two correct examples.*
hormones *e.g.* insulin;
enzymes *e.g.* amylase;
structural *e.g.* collagen;
movement *e.g.* myosin / actin;
transport *e.g.* hemoglobin;
defence *e.g.* antibodies / immunoglobin; ***[2 max]***

(b) ATP synthesis is coupled to electron transport / H^+ movement;
occurs over the (inner) mitochondrial membrane;
electrons are transported through carriers;
energy released by electron transport;
protons / H^+ pumped across the membrane;
ATP synthetase transports H^+;
uses energy to make ATP; ***[2 max]***

C3. (a) substrate binds / approaches active site;
shape of active site changes;
bonds in substrate weaken;
activation energy decreases;
explains broad specificity of some enzymes;
e.g. proteases; ***[3 max]***

(b) (i) oxygen;
$NADPH / NADPH + H^+ / NADPH_2$;
ATP; ***[2 max]***

(ii) occurs in stroma of chloroplast;
ribulose disphosphate / RuBP / 5-C sugar combines with CO_2;
catalyzed by rubisco / ribulose biphosphate carboxylase;
splits into two 3-C sugars / glycerate 3-phosphate;
ATP and NADPH supply energy and H;
3-C sugars join to form glucose / 6-C sugar;
RuBP regenerated (with use of ATP); ***[4 max]***

Option D – Evolution

D1. (a) cytochrome C ***[1]***

(b) hemoglobin β-chain : fibrinopeptides = 2.8 (± 0.2) % : 12.3 (± 0.2) % / fibrinopeptides have (about) four times more substitutions / (about) 10 % more in fibrinopeptides ***[1]***

(c) sheep because fewer differences in base substitutions ***[1]***

(d) mutations occur randomly;
amino acid sequences change;
differences accumulate gradually over a long time;
the differences accumulate at a (roughly) constant rate;
can be used as an evolutionary clock; ***[2 max]***

D2. (a) (i) genetic evolution through variation and reproduction / inheritance of genes;
cultural evolution through customs / languages, *etc*. taught/learned; ***[2]***

(ii) the time taken for the radioactivity to fall to half of the original level / the time for half the atoms in a radioactive sample to decay ***[1]***

(b) vertebrates (nearly all) have pentadactyl limbs / homologous structures;
the structure in all is very similar (in spite of different uses);
likely to have evolved from a common ancestor; ***[2]***

D3. (a) (i) (theory of) natural selection ***[1]***

(ii) more offspring are produced than can be supported (in the environment);
variation amongst the offspring;
competition for survival / resources / struggle for existence;
best adapted survive and reproduce;
genes are passed on to the offspring;
characteristics of a species gradually change over generations / species evolve; ***[4 max]***

(b) membranes were necessary for cells;
phospholipids (naturally) form bilayers;
these membranes form spheres with liquid inside;
RNA (may have been) the first genetic material;
RNA replicates and is also a catalyst;
clay minerals may have acted as first catalysts; ***[3 max]***

Option E – Neurobiology and Behaviour

E1. (a) positive / direct correlation; ***[1]***

(b) any value between 413 nm and 428 nm *(units must be given)* ***[1]***

(c) the percentage correct choices at 322 nm is greater than 494 nm ***[1]***
Accept any answer where the 322 nm value is higher than the 494 nm value, even if the values given are not correct.

(d) repeat experiment after a period of time / with longer time between trials;
if number of correct choices falls they are not stored in long-term memory / if number of correct choices remains high they are in long-term memory;
if number of correct choices the same repeat with longer time interval; ***[2 max]***

E2. (a)

Rod cells	Cones cells
dim light	bright light;
one type	three types;
sensitive to all wavelengths	each sensitive to one colour / to red, blue or green light;
impulse from group of rod cells to single neurone of optic nerve	single cone cell to single neurone;
distributed around retina	concentrated at fovea;
draw rod showing shape	draw cone showing shape;

[3 max]

(b) (i) *e.g.* worker bees may die protecting the hive ***[1]***

(ii) description of behaviour in social organization;
importance in social organization;
e.g. bees sting invader and die to protect the hive / queen bee;
ensures survival of rest of population; ***[2 max]***

E3. (a) (definition of taxis) movement to or away from a directional stimulus;
e.g. movement of fly larva away from light;
name of movement *e.g.* negative phototaxis;
advantage of movement *e.g.* protected from predators;
second advantage of movement *e.g.* stay in carcass / source of food;
natural selection favours this response / larvae with this response survive; ***[4 max]***

(b) *e.g.* Pavlov's dog;
unconditioned response *e.g.* dog salivates when sees food;
conditioned stimulus *e.g.* bell rung when food given;

association of two external stimuli *e.g.* of bell and food;
conditioned response *e.g.* salivates when hears bell; ***[3 max]***

Option F – Applied Plant and Animal Science

F1. (a) (i) greenhouse / T ***[1]***

(ii) shaded / reduced light / L ***[1]***

(b) adding nutrients / raising temperature increased biomass (compared to control);
more shading decreased biomass (compared to control);
nutrients cause greatest increase in biomass; ***[2 max]***
Accept numerical answers.

(c) adding nutrients increase deciduous biomass so soil deficient in nutrients / nutrients were limiting factor (for deciduous plants);
shading decreases biomass as light is a limiting factor for all plants (except lichens);
nutrients and increased temperature increase deciduous plants which out-compete the others;
increased temperature decreases overall biomass / plants are adapted to arctic temperatures;
mosses are best adapted to control / arctic conditions; ***[2 max]***
Any other valid reasons.

F2. (a) important source of genetic diversity;
future value / as reservoir of alleles / in medicine / other;
many better adapted to local / changing conditions; ***[2 max]***

(b) *Responses must give one technique and state how it improves health to receive full marks.*
e.g. vaccinations;
to prevent disease;
e.g. nutrient supplements;
to prevent nutritional deficiencies / to promote better growth; ***[2 max]***

F3. (a) a plant growth promotor / regulator / hormone;
act in phototropism;
causes cell elongation / bending on side away from light;
produced in shoot tips / apical dominance;
prevents lateral growth;
cutting / pruning shoot tips causes bushy growth; ***[3 max]***

(b) (i) nutrients depletion;
pest invasions; ***[1 max]***

(ii) *organic:* ***[2 max]***
avoids artificial / synthetic fertilizer / pesticides / growth regulators / feed additives;
uses crop rotation / mechanical cultivation;
crop residues / animal manure / natural minerals as fertilizers;
biological pest control;

non-organic: ***[2 max]***
uses artificial / synthetic fertilizer / pesticides / growth regulators / feed additives;
more efficient for use of pesticides / synthetic fertilizers specific to conditions;
may cause environmental pollution;
often monocultures that deplete soil nutrients; ***[4 max]***
Award ***[0]*** *for ethical issues.*

Option G – Ecology and Conservation

G1. (a) (i) (increased by) one species / from six to seven species ***[1]***

(ii) (increased by) four species / from one to five species ***[1]***

(b) in Chile there were more rodents at low levels of rainfall / up to 50 mm than in the USA;
the numbers in the USA were higher than in Chile at 100 to 110 mm rainfall;
the numbers in the USA have a greater range;
>200 mm there were more species in Chile; ***[2 max]***

(c) plants in Chile grow better with less rain and provide more food in drier conditions than in the USA;
rodents in Chile have a broader diet of organisms that survive drought/dry conditions;
rodents in Chile more mobile to search for food outside area studied;
more varied food chains in the USA / longer food chains are involved; ***[2 max]***

G2. (a) decrease / lack of sufficient reproduction in overfished populations / extinction of fish;
decrease in predators of specific fish;
increase in prey numbers of specific fish; ***[2 max]***

(b) loss of energy / biomass at each stage of a food chain;
energy lost due to respiration / excretion;
a smaller amount of total biomass of food available;
cannot support large numbers of organisms; ***[2 max]***

G3. (a) done outside of the natural habitat of the organisms;
captive breeding of animals;
e.g. panda bears, *etc*.;
botanic gardens;
seed banks;
to protect the genetic pools / biodiversity; ***[3 max]***

(b) (i) the habitat of an organism, its nutrition / feeding habits and interactions / relationships with other organisms / other organisms / the role of an organism in a habitat / ecosystem ***[1]***
*Award **[0]** for habitat alone.*

(ii) localization of named animal in its habitat;
description of spatial habitat;
description of feeding habitat: type of food;
time of day;
interactions with other organisms: prey;
predators;
competition;
reproductive strategies;
breeding sites; ***[4 max]***