International Baccalaureate®
Baccalauréat International
Bachillerato Internacional

MARKSCHEME

May 2008

BIOLOGY

Higher Level

Paper 3

14 pages

Subject Details: Biology HL Paper 3 Markscheme

Mark Allocation

Candidates are required to answer questions from **TWO** of the Options **[2 × 20 marks]**.
Maximum total = **[40 marks]**

1. A markscheme often has more marking points than the total allows. This is intentional. Do **not** award more than the maximum marks allowed for part of a question.

2. Each marking point has a separate line and the end is signified by means of a semicolon (;).

3. An alternative answer or wording is indicated in the markscheme by a slash (/) – either wording can be accepted.

4. Words in brackets ( ) in the markscheme are not necessary to gain the mark.

5. Words that are <u>underlined</u> are essential for the mark.

6. The order of marking points does not have to be as in the markscheme, unless stated otherwise.

7. If the candidate's answer has the same "meaning" or can be clearly interpreted as being of equivalent significance, detail and validity as that in the markscheme then award the mark. Where this point is considered to be particularly relevant in a question it is emphasized by writing ***OWTTE*** (or words to that effect).

8. Remember that many candidates are writing in a second language. Effective communication is more important than grammatical accuracy.

9. Occasionally, a part of a question may require an answer that is required for subsequent marking points. If an error is made in the first marking point then it should be penalized. However, if the incorrect answer is used correctly in subsequent marking points then **follow through** marks should be awarded. Indicate this with **ECF** (error carried forward).

10. Only consider units at the end of a calculation. Unless directed otherwise in the markscheme, unit errors should only be penalized once in the paper. Indicate this by writing **–1(U)** at the first point it occurs and **U** on the cover sheet.

Option D — Evolution

D1. (a) trend lines have same slopes / similar pattern;
when comparing same body mass bird brains tend to be bigger;
for both, brain mass increases with body mass;
for both, each body mass has a range of brain masses / range in brain mass larger for flightless reptiles / *vice versa*;
both have similar maximum brain mass; ***[3 max]***
Accept equivalent statements using the specific values.

(b) insufficient brain mass per body mass to support flight / lack complexity for more advanced flight / could not compete with birds with larger brains / brain complexity capable of more advanced flight / not as adapted as birds for flight ***[1]***

(c) birds have larger/heavier brains per body mass than flying/flightless reptiles;
larger brains per body mass (may be) necessary for control of complexities of flight;
both flying reptiles had smaller brain mass per body mass than birds and are extinct / bird best adapted for flight / flying reptiles poorly adapted;
could be correlation rather than cause and effect / could be result of other adaptations than for flight;
only two skulls for flying reptiles / limited data; ***[2 max]***

D2. (a) simple organic compounds could have been formed from inorganic compounds (in conditions similar to pre-biotic Earth) / spontaneous generation of organic matter/molecules/compounds from inorganic / *OWTTE* ***[1]***

(b) polar lipids/phospholipids spontaneously associate into bi-layers;
form micelles when dispersed in water;
creates compartmentalization;
difficult to falsify/prove; ***[2 max]***

(c) the frequency/probability of the heterozygous phenotype / $2\times$the frequency/probability of the two alleles of a gene ***[1]***
Do not accept references to <u>number</u> of heterozygous.

D3. (a) *From Homo habilis to Homo sapiens, the following fossil trends are seen*:
intermediates were *H. erectus* and *H. neanderthalensis*;
increased cranial capacity / more brain size related to body size;
bipedalism / changes in articulations/trunk/pelvis/femur;
smaller jaws / smaller jaw angle;
smaller molars / dentition to support more varied diet;
skull of *H. erectus* suggested ability to talk;
fossils increasingly accompanied by more sophisticated tools / evidence of cultural evolution;
higher forehead / reduction in brow ridges / flatter face; ***[4 max]***

(b) speciation is the formation of new species / splitting of existing species;
involves the separation of a population from another population;
so that gene pools are isolated;
different mutations occur in separate groups;
differences in allele frequency develop / different action of natural selection on allele frequency in different groups;
new species cannot interbreed (to produce fertile offspring) with the species it evolved from;
allopatric / geographic isolation;
ecological isolation / non-geographic barriers to reproduction;
reproductive / behavioural isolation occurs;
sympatric speciation / polyploidy in plants;
can occur through migration;
Galapagos finches / other examples; ***[6 max]***

Option E — Neurobiology and Behaviour

E1. (a) ***Marking point for English, French and German papers only.***
$9.5\,(\pm 0.5)$ days ***[1]***

Marking points for Spanish paper only.
$9.5\,(\pm 0.5)$ days;
range of shortened tails approximately 19 days, range of elongated tails 5 days / shortened with greater range of about 14 (± 1) days; ***[1 max]***

(b) the longer the tail the more fledglings ***[1]***

(c) the elongated tailed birds take less time to attract a mate / more attractive to females;
more time to mate / less energy required in mate search;
allows more time to rear multiple batches of chicks / for chicks to develop;
longer tailed males attract fitter females / better providers / protectors / stronger / fitter; ***[2 max]***

(d) control I was designed to determine the effect of trimming tail feathers on reproduction;
trimming has no effect/slightly positive effect in mating time;
both control groups/trimmed and non-trimmed have similar reproductive success / means about the same;
control II supports that length has (small) effect / wider range/variability of reproductive success; ***[3 max]***

E2. (a) *Award **[1]** for every two correct labels.*
I. cerebrum / cerebral hemisphere
II. hypothalamus
III. pituitary
IV. cerebellum
V. spinal cord / medulla oblongata ***[2 max]***

(b) presynaptic neuron releases neurotransmitter / neurotransmitter binds to the postsynaptic membrane;
causing hyperpolarization (of postsynaptic membrane) / negatively charged chloride ions to move in / potassium (K^+) ions out;
making it more difficult to cause depolarization (of postsynaptic neuron)/nerve impulse transmission/action potential; ***[2 max]***

E3. (a) (most) autonomic reflexes under unconscious control / controlling autonomic reflexes can be learned;
e.g. bladder / anal sphincter muscles are under autonomic control;
(young children learn) feces/urine can be released under conscious control;
e.g. partial control of heart rate might be achieved;
through meditation/yoga; ***[3 max]***
*Award **[2 max]** if only one example given.*

(b) altruistic behaviour involves a benefit to another;
at the expense of the individual displaying the behaviour;
<u>example</u> of behaviour in a <u>named</u> species;
statement of how it harms individuals and helps another;
<u>another example</u> of behaviour in a <u>different named</u> species;
statement of how it harms individuals and helps another;

e.g. Vervet monkeys give alarm calls;
alarm calls attract attention of predator and others have more time to escape;
closer the genetic relationship the less altruism involved;
(others argue) benefits increase over time through survival of genes shared with recipient;
behaviour might lead to an advantage for the individual displaying behaviour in the future; ***[6 max]***
*Award **[5 max]** if an example of behaviour is given in only one named species.*

Option F — Applied Plant and Animal Science

F1. (a) $4.1(\pm 0.5)\%$ ***[1]***

(b) $6.6 - 4.9 = 1.7\,(\pm 0.5)$ tonnes; *(unit not required)*
increase of $35(\pm 3)\%$; *(unit required)* ***[2]***

(c) genetic engineering / genetically engineered crops;
selectively bred higher yield varieties / better barley strains;
biological pest control;
manure / humus / organic matter; ***[2 max]***
Award any other reasonable suggestion.

(d) *arguments against sustainability*:
continued loss of farmland under production may put greater pressure to achieve higher yields per hectare;
will be difficult without the return to pesticides / fertilizers / agrochemicals;
from graph improvements in yield are slowing;

arguments for sustainability:
from graph improvements in yield have been sustained with less land;
avoiding the use of pesticides / fertilizers aids sustainability in other areas;
loss of 4% of arable land has been matched by a 32% growth in yield;
yield improvements/better technology can make up for loss of land (in short-term); ***[2 max]***

F2. (a) artificial insemination / vaccination / nutrient supplementation / any other reasonable suggestion ***[1]***
*Award **[1]** for any two correct answers.*

(b) spray (unpollinated) flowers with growth regulator;
e.g. auxin in the case of tomatoes / gibberellin in the case of grapes;
stimulates fruit development without pollination; ***[2 max]***

F3. (a) Flavr-Savr™ tomatoes have delayed ripening;
polygalacturonase promotes ripening;
anti-sense DNA sequence/gene has the same orientation as the functional mRNA / reverse orientation to the sense/normal gene (coding for polygalacturonase);
artificially sequenced;
anti-sense gene transferred to tomatoes;
both anti-sense and sense gene expressed;
two kinds of mRNAs are complementary/bind to one another;
polygalacturonase not produced; ***[4 max]***

(b) photoperiod/flowering controlled by relative length of light and dark;
adaptation for flowering at different times of year;
short day plants need a critical night length/minimum night length;
long day plants cannot exceed a certain night length;
length of dark period is most important in determining flowering;
phytochrome helps plants to determine photoperiod conditions;
phytochrome exists in active and inactive forms;
active (Pfr) form degraded to inactive (Pr) form in darkness / is slow;
inactive (Pr) form converted to active (Pfr) form in the light / is fast; ***[6 max]***

Option G — Ecology and Conservation

G1. (a) higher the discard the lower the proportion of birds in the great skua diet *[1]*

(b) the more sand eel available/eaten, the less birds are eaten by the great skua;
proportion of birds (in diet) stable between 50 and approximately 125 sand eel biomass, drops drastically after 125, stabilizes around 150; *[2]*

(c) ***Marking point for English, French and German papers only.***
changes to fishing practice / markets for discarded fish / decreasing quantities of fish available / over-fishing / better technology filters out fish size more efficiently *[1]*

Marking point for Spanish paper only.
stricter control/international legislation over fishing/legal fish size / fishing methods more efficient/sophisticated / any other reasonable suggestion *[1]*

(d) increase in predation by great skua on other birds/other food sources / decrease in population of other birds/other food sources;
increase in predation on sand eel / decrease in population of sand eels;
decrease in the number of great skua (because of competition for food);
decreased quantities of detritus (from discarded fish) / decrease in other detritus feeders in the community; *[2 max]*

G2. (a) mutualism is a close association between two organisms/species <u>where both benefit</u>;
names of two organisms/species involved; *(common names acceptable)*
description of the manner in which both species/organisms benefit;
e.g. microorganisms in gut of ruminants;
e.g. microorganisms gets nutrients / habitat <u>and</u> host gets assistance with digestion; *[2 max]*
To award full marks an example is needed.

(b) plowing soils aerates the soil / provides oxygen;
bacterial denitrification is an anaerobic process, decreased in aerobic conditions;
leading *Pseudomonas* to use oxygen as a substrate / will not use nitrates as substrate;
plowing increase drainage decreasing denitrification; *[2 max]*

G3. (a) use of living organisms that are sensitive to specific conditions to detect environmental change;
name of indicator species; *(common name accepted)*
description of what it monitors;
consists of index of indicator species;
their relative numbers;
and the variety of indicator species found;
allows for quantitative comparison / measure of environmental change; ***[4 max]***

(b) CFCs/chlorofluorocarbons enjoy wide industrial application / manufactured by humans / used as solvents / propellants / refrigerants / gas blown plastics / other example;
carried by weather patterns to polar/Antarctic regions;
ozone is produced in the upper atmosphere;
ozone absorbs (solar) ultraviolet radiation;
UV causes CFCs to dissociate, releasing Cl atoms/radicals;
Cl atom/radical reacts (repeatedly) with ozone to form O_2;
chemical reaction between CFCs and ozone lead to ozone destruction;
allowing UV light to penetrate the upper atmosphere;
and cause damage within ecosystems / to biological molecules / cancer;
$O_3 + Cl \rightarrow O_2 + ClO$ ***or*** $ClO + O \rightarrow O_2 + Cl$ ***or*** $ClO + O_3 \rightarrow 2O_2 + Cl$; ***[6 max]***

Option H — Further Human Physiology

H1. (a) Na^+ concentration is lower in saliva;
Cl^- concentration is lower in saliva;
HCO_3^- concentration is higher in saliva;
K^+ concentration is higher in saliva; ***[2 max]***
Accept any correct numerical comparisons.
*Award **[2]** if all correct and **[1 max]** if two or three are correct.*

(b) as the flow rate of saliva increases the amount of Na^+ in saliva increases;
the increase is largest initially but then levels off as flow rates increase; ***[2]***

(c) Na^+ concentration (always) higher in blood plasma / moves against concentration gradient so active transport must be used ***[1]***

(d) higher flow rate means Na^+ flows past without being re-absorbed / more difficult to be absorbed / less time of contact with cells;
pumping activity/transport of Na^+ can only occur at a fixed rate;
numbers of pumps limiting / reach saturation level; ***[2 max]***

H2. (a) monitor concentration of blood plasma / regulate water levels in blood/osmotic conditions/solutes / send signal to release ADH if blood plasma too concentrated / homeostasis of blood plasma solutes ***[1]***

(b) pH/CO_2 concentration in blood plasma monitored by chemoreceptors;
found in the aorta / carotid artery/body / walls of arteries;
chemoreceptors send signal to breathing centre in brain/medulla oblongata;
to modify/increase/decrease breathing rate; ***[2 max]***
Do not accept chemorecptors send signal to diaphragm or intercostal muscles.

H3. (a) (oxygenated) blood from heart to liver via hepatic artery;
(nutrient laden) blood carried from intestines through hepatic portal vein;
artery/hepatic portal vein divide (eventually) into sinusoids;
sinusoids drain into (branches of) hepatic vein;
blood leaving the liver departs through the hepatic vein; ***[4 max]***
Accept a clearly drawn correctly annotated diagram.

(b) at high altitudes partial pressure of oxygen is lower;
as air is exchanged in lungs hemoglobin does not become fully saturated;
oxygen deprivation of tissues / Monge disease;
mountain sickness may develop;
ventilation rate/depth increases;
extra red blood cells are produced / more hemoglobin in red blood cells;
extra myoglobin produced by muscles / more capillaries develop in muscles;
hemoglobin with a decreased affinity for oxygen / releases oxygen more readily;
behavioural accommodations including reduced activity / climbing slowly; ***[6 max]***