MARKSCHEME

MAY 2006

BIOLOGY

Higher Level

Paper 3

General Marking Instructions

Subject Details: Biology HL Paper 3 Markscheme

Mark Allocation
Candidates are required to answer **ALL** questions in each of **TWO** Options (total *[20 marks]*).
Maximum total = *[40 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 D — Evolution

D1. (a) ipsenol and ipsdienol *[1]*

(b) all have frontalin;
all have seudenol;
two of three have 1-methyl-2-cyclohexen-1-ol (which suggests closer relationship between the two / *D. pseudotsugae* and *D. rufipennis*);
no other group has seudenol;
do not have most common pheromones (ipsenol and ipsdienol) / absence of majority pheromones; *[3 max]*

(c) blends of pheromone components vary greatly between adjacent species;
example of an adjacent pair is *D. adjunctus* and *D. brevicomis* where *D. brevicomis* has four components not found in *D. adjunctus* / other examples;
Do not accept examples which are not adjacent pairs connected by a bracket.

large differences between blends of adjacent species do not suggest gradual change / pheromone is either present or absent suggesting major/sudden shift;
some species have asterisk meaning additional chemical unique to them only;
cis and *trans* -verbenol / *endo* and *exo* -brevicomin / ipsenol and ipsedienol, can point at gradual changes; *[2 max]*

D2. (a) reducing atmosphere / no free oxygen;
a lot of hydrogen and ammonia;
water vapour present;
(carbon present as) methane;
solar / high energy radiation;
lightning;
high temperatures;
intense volcanic activity;
radioactive elements present; *[1 max]*

(b) large beaks for cracking seeds (large ground finch);
small beak for small seeds (ground finch);
small beak for grasping insects (small tree finch);
increased beak depth under drought conditions for cracking harder seeds; *[1 max]*
Must refer to size and not shape.

(c) frequency of phenotype A is 96 % / 0.96;
frequency of phenotype a is 4 % / 0.04; *[2]*

D3. (a) gene mutations involve changes at specific positions (loci) along chromosomes / gene mutations affect sequences of bases, whereas chromosome mutations involve changes in whole sets of chromosomes / large proportions of individual chromosomes;
gene mutations occur during replication (of DNA) while chromosome mutations occur during meiosis;
gene mutations can occur through addition (insertion) / deletion / (base) substitution (point mutation) / increase in repetitive sequences/repeats;
example of gene mutation is sickle cell anemia / PKU / cystic fibrosis;
sickle cell anemia has a point mutation / nucleotide substitution of CTT to CAT;
chromosomal mutations occur during mitosis / meiosis / formation of chiasmata, whereas gene mutations occur during interphase (replication of DNA);
example of chromosomal mutation is Klinefelter's syndrome / Down's syndrome;
chromosomal mutations can occur through non-junction / deletion / inversion / translocation / duplication; *[4 max]*
For full marks, answer must include a distinguishing characteristic of both gene and chromosome mutations and give an example of each.
Award [2 max] if answer only addresses one type of mutation.

(b) (i) species is a (potentially) interbreeding population having a common gene pool / a group of organisms that (potentially) interbreed to produce fertile offspring *[1]*

(ii) new species develop when a pre-existing species splits;
(initial separation) to produce isolated populations;
leads to separation of genetic pools in a species;
mutations / recombination / cause differences / increase the variation in different gene pools / gene frequencies;
natural selection favours the survival of different gene pools / individuals;
offspring from migrated individuals become genetically / geographically isolated from original species / allopatric speciation;
different forces of natural selection act on isolated populations;
habitat isolation can occur within same area;
variation in time of breeding can lead to seasonal isolation in same area;
courtship and mating variation can lead to behavioural isolation in same area;
ecological isolation (differences in habitat / time of breeding/courtship and mating) leads to reproductive isolation and new species (sympatric speciation);
new species can no longer interbreed with individuals in the original population to produce fertile offspring; *[5 max]*

Option E — Neurobiology and Behaviour

E1.　(a)　　(crowned) eagle shrieks　　　　　　　　　　　　　　　　　　　　　　*[1]*

　　　(b)　(i)　hornbills do approach (crowned) eagle shrieks but not leopard growls;
　　　　　　　hornbills are more likely to remain motionless in response to leopard growls
　　　　　　　than (crowned) eagle shrieks;
　　　　　　　hornbills are more likely to move away in response to (crowned) eagle shrieks
　　　　　　　than leopard growls;
　　　　　　　more variation in response to (crowned) eagle shrieks / show all three
　　　　　　　behaviors in response to (crowned) eagle shrieks whereas only two behaviors
　　　　　　　to leopard growls;　　　　　　　　　　　　　　　　　　　　　*[2 max]*

　　　　　(ii)　hornbills will not be surprised by an (crowned) eagle attack;
　　　　　　　the (crowned) eagle may lose interest in attacking if there is no surprise;
　　　　　　　hornbills may gather and challenge a (crowned) eagle;
　　　　　　　approach to investigate / altruistic behaviour;
　　　　　　　approach as larger numbers with monkeys make attack less likely;　　*[1 max]*

　　　(c)　hornbills can distinguish between Diana monkey alarm calls;
　　　　　Diana monkey calls in response to leopard growls have limited importance for
　　　　　hornbills because leopards don't prey on hornbills;
　　　　　hornbills use Diana monkey alarm calls to avoid/prevent attacks from (crowned)
　　　　　eagles;
　　　　　no controlled data showing hornbill responses to other sounds (forest) / extent of
　　　　　sampling not known;
　　　　　Diana monkey calls allow hornbills to feed without having to be "completely" on
　　　　　guard;　　　　　　　　　　　　　　　　　　　　　　　　　　　*[3 max]*

E2.　(a)　*Award [1] for any two of the following.*
　　　　　mechanoreceptors / chemoreceptors (taste/smell) / thermoreceptors / photoreceptors /
　　　　　baroreceptors　　　　　　　　　　　　　　　　　　　　　　　　*[1 max]*

　　　(b)　*Award [1] for every two of the following accurately drawn and correctly labelled.*
　　　　　medulla oblongata;
　　　　　cerebellum;
　　　　　hypothalamus;
　　　　　pituitary gland;
　　　　　cerebral hemispheres / cerebral cortex / left and right hemispheres / frontal, parietal,
　　　　　frontal lobes;
　　　　　corpus callosum and lateral ventricle;　　　　　　　　　　　　　　*[2 max]*

E3. (a)   are organized in a caste system / division of labour / queen, drone, worker;
cooperate to regulate the internal temperature of the hive;
share information about food / waggle dance;
queen lays eggs/reproduces;
workers gather food / clean the colony / defend the colony / feed larvae;
drones can mate with queens (to provide genetic variety);   *[3 max]*

(b)   presynaptic neurons pass stimulus / potential to postsynaptic neurons;
presynaptic neuron releases neurotransmitter into synaptic cleft;
process involves exocytosis;
exocytosis requires Ca^{2+} entry into presynaptic neuron;
neurotransmitter binds with postsynaptic membrane receptor;
neurotransmitter binding can cause postsynaptic membrane ion channel to open/
increase/change permeability of post-synaptic membrane;
open channel allows specific ions to enter/exit postsynaptic neuron;
depolarization/hyperpolarization can result in/initiate action potenial;
outcome depends on type of postsynaptic receptor and type of channel opened /
reference to excitatory and inhibitory synapses;
Na^+ passing to the inside of the postsynaptic neuron (usually) causes depolarization;
Cl^- passing to the inside of the postsynatic neuron (usually) causes hyperpolarization;
(some) neurotransmitters are destroyed by enzymes;   *[7 max]*
Accept any of the above points if accurately illustrated in a diagram.

Option F — Applied Plant and Animal Science

F1. (a) the total soil water content is diminishing *[1]*

(b) day 180 (± 4) *[1]*

(c) grazing increases water content;
leaf area reduced;
transpiration from leaves reduced;
(fewer plants so) water uptake from soil reduced;
some roots destroyed by grazing so more soil water;
trampling compacts the soil so less evaporation and maintains total soil water;
fluctuations in patterns of total soil water are similar;
other factors affect total soil water;
examples are rainfall/temperature; *[4 max]*

F2. (a) both contain phytochrome / photoreceptors necessary for flowering;
flowering in both plants depends on a required length of darkness/daylight;
short-day (long-night) plants flower only after reaching/exceeding a required length of darkness, whereas long-day (short-night) plants flower only when exposed to a period of light which is longer than the critical length of darkness; *[2 max]*

(b) plant growth regulators are plant growth hormones / auxins / cytokinin / gibberellin / IBA / other synthetic auxins;
promote rooting;
kill weeds;
induce ripening at desired time;
produce fruits without seeds; *[2 max]*

F3. (a) *disadvantages*: *[3 max]*
intensive livestock rearing involves overcrowding of animals;
overcrowding causes disease;
potential of disease leads to use of antibiotics;
overcrowding creates stress among animals / inhuman treatment;
overcrowded animals cannot follow natural behaviour patterns;
overcrowded animals live amid excessive animal waste which causes odours and needs to be regularly removed;
intensive rearing of animals requires greater energy input causing additional expenses;
use of hormones / antibiotics may affect human health;

advantages: *[3 max]*
higher yields (per area of land);
greater efficiency reduces cost of production;
less land requirements for grazing could mean more wildlife;
health of intensively reared animals can be more easily managed; *[6 max]*

(b) breeding programs lead to specialized plants;
highly bred plants are dependent on specific sets of conditions;
small changes in their living requirements can result in their loss;
alleles of wild plants may be more adaptable to changes in their living requirements;
greater adaptability comes from greater genetic diversity;
wild plants are more likely to survive change than highly bred plants;
wild plants species can serve as crops of future / new uses / medicines;
genes may be of use in genetic engineering;
part of food chains / ecological balance; *[4 max]*

Option G — Ecology and Conservation

G1. (a) peaks/troughs of flowering and fruiting trees occur at different times;
the fruiting pattern occurs after the flowering pattern;
more fruiting trees than are flowering (throughout the year);
more flowering in spring / summer and more fruiting during fall/winter;   *[2 max]*

(b) maximum solar radiation (April <u>or</u> September) correlates (approximately) to highest levels of flowering (during each year of four-year period);
maximum solar radiation in April in 1996 and 1997 correlates (approximately) with highest levels of flowering;
maximum solar radiation in September correlates (approximately) with highest levels of flowering in 1998 and 1999;
pattern varies from year to year so some other factors / temperature/rainfall must influence it;   *[2 max]*
insufficient evidence of the influence of solar radiation on flowering patterns;

(c) both occur at similar time of year (July to September) / both start to increase in June/July during typhoon season (until October/November);
typhoon/<u>intense</u> winds blow fruits/seeds;
torrential rain will contribute to seed dispersal
timing corresponds to ripeness of fruit;   *[2 max]*

G2. (a) *Award [1] for any two of the following.*
monitor population changes in commercial species / monitor size / maturity of fish caught;
set catch quotas for species in decline / set specific periods for fishing;
prohibit catching of endangered species;
regulate use of drift nets/fine mesh nets;
promote (commercial) breeding / fish farms of certain species;   *[1 max]*

(b) *I:* feeding/consumption/assimilation/digestion;
II: nitrogen fixing / nitrification;
III: denitrification;   *[3]*

G3. (a) fluorocarbons/CFCs have lowered atmospheric ozone levels;
fluorocarbons are very stable;
will continue to break down ozone for many decades into the future / one CFC molecules destroy thousands of ozone molecules;
fluorocarbons are used to make brown gas blown plastifics / as refrigerants / as propellants in spray cans / solvents;
(industrialized) countries are reducing their use of CFCs;
examples are reducing gas blown plastic production / using CFC-free propellants / recycling plastics;
careful disposal of refrigerators and collection of CFCs;
such efforts have reduced the rate of fluorocarbon release;
international efforts to eliminate/reduce production of CFCs have been initiated / Montreal protocol;   *[6 max]*

  (b) (i) herbivory is when a primary consumer feeds on a plant/other producers;
e.g. a beaver feeding on trees;   *[2]*
Accept other appropriate examples.

   (ii) mutualism is where the direct contact between two members of different species benefits each member;
e.g. the presence of microorganisms in the alimentary canals of cattle and sheep;   *[2]*
Accept other appropriate examples.

Option H — Further Human Physiology

H1. (a) (i) medial forefoot   *[1]*

(ii) 148($\pm$1)%   *[1]*

(b) lateral toes   *[1]*

(c) distribution becomes more uneven;
(great) increase in force on medial forefoot;
more/considerable force on hallux/toes;
force reduces on heels;
decreased force on lateral/medial midfoot;   *[3 max]*

H2. (a) cellulose is a different structure from starch;
beta glucose monomers / beta-glycosidic linkages;
no enzymes to break the (beta-glycosidic) linkages / no gene for cellulase;
no mutualistic microorganisms (in fore-gut);   *[2 max]*

(b) microvilli/brush border give high surface area (to volume ratio);
microfilaments;
numerous mitochondria provide ATP for active transport;
pinocytotic vesicles from endocytosis;
presence of specific carrier proteins in membrane;   *[2 max]*

H3. (a) exercise increases the level of cellular respiration in muscle cells;
a byproduct of cellular respiration is carbon dioxide;
(most) carbon dioxide is carried as dissolved gas / is very soluble in the blood;
some carbon dioxide reacts with water in the blood to form H^+ and bicarbonate ions;
bicarbonate concentration in blood increases / carbon dioxide raises blood acidity;
cells in brain (medulla) / carotid arteries detect lower blood ph / increased blood acidity;
increased blood acidity stimulates breathing centre;
breathing centre stimulates faster breathing / increased ventilation;
faster breathing allows for quicker release/removal of carbon dioxide;   *[7 max]*

(b) SA node called the pacemaker;
SA node originates heartbeat;
SA node stimulates AV node to fire / AV node relays electrical signal to ventricles;
AV node controls contraction of ventricles / is connected to the bundle of His and Purkinje fibres;
AV node in septum <u>and</u> SA node in right atrium;   *[3 max]*