MARKSCHEME

November 2006

BIOLOGY

Higher Level

Paper 3

11 pages

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.

- Words that are <u>underlined</u> 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 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) $(100\% - 60\% =) 40 (\pm 4)$ *(units not required)*   *[1]*

(b) no reaction immediately after injection;
decreases then remains steady / constant / plateaus / between 1 hour and 2 hours;
rises again at 3 hours;   *[2 max]*

(c) all doses reduce amount of phenylalanine / positive correlation;
100 units reduce it the most / 2 units reduce it the least;
at 2 hours level remains lower except for the 2 units of PAL / rise at 2 hours for 2 units of PAL;
2 units of PAL will be the most appropriate as less enzyme needed / 2 units of PAL reacts the fastest (0 hour);
effect of 100 units lasts longer;
no knowledge of possible side effects / more data on time / units/dosage required;   *[3 max]*

(d) (PKU is a gene mutation while) Klinefelter's is a chromosome mutation   *[1]*

D2. (a) definition of balanced polymorphism;
example;   *[2]*

e.g.
two or more forms / alleles that are maintained in a population/natural selection tends to maintain a mutated allele and a normal allele (in a genetic pool);
heterozygous organisms do not develop sickle cell anemia and are resistant to malaria / in the case of cystic fibrosis heterozygous organisms may increase resistance to typhoid fever;
any other valid example;

(b) endosymbiotic theory / endocytosis of one prokaryotic cell by another forming/evolving into chloroplasts and mitochondria   *[1]*

D3. (a)   grasping limbs / opposable thumb/ flexible digits;
rotating forelimb/hand / mobile arms / shoulder with free movement;
stereoscopic vision / eyes on front;
skull modified for upright posture;
large brain / enlarged skull;
smaller jaw/molars;
nails instead of claws;   *[4 max]*
Only accept answers referring to physical features. Do not accept bipedalism.

(b)   comparing structure of protein / other biochemicals / DNA nucleotide sequences (in many groups of organisms);
differences in molecule accumulate over long periods of time;
differences accumulate at constant rate;
can be used as evolutionary clock;
number of differences can be used to deduce how long ago a species split from a common ancestor;
e.g. hemoglobin / myoglobin / cytochrome c / hormones / ribosomal RNA;
studied by electrophoresis;
the number of differences in an amino acid sequence is measured;
immunological research;
antigen/antibody complex measured;
amount of precipitate directly proportional to foreign protein;   *[6 max]*

Option E — Neurobiology and Behaviour

E1. (a) strong stimulant / excitatory psychoactive drug;
appetite suppression;
increases alertness / energy levels / talkativeness;
euphoria / exaggerated sense of confidence;
sensation of force and power so reckless behaviour / irritability;
sense of anxiety / hallucination / panic resulting in dangerous behaviour;
bad judgment so quick changes of perception / reckless driving;
when effect over may feel suicidal;
fatigue / depression / causes psychological dependency/addiction;
leads to work absenteeism / stealing;
reduces the effects of altitude sickness;   *[6 max]*

 (b) *withdrawl reflex*: *[1 max]*
e.g. a hot/sharp object is touched and the hand withdrawn;
protects body from harm;
reflex arc: *[3 max]*
<u>pain</u> receptor/nociceptor in skin is stimulated;
impulse passed to sensory neuron;
passes impulse on to association neuron in spinal cord / grey matter;
motor neuron carries impulse to muscle/ effector which contracts;
Accept any of the above if clearly explained in a labelled diagram.   *[4 max]*

E2. (a) group 1   *[1]*

 (b) sodium causes a greater (overall) response than non-sodium;
group 1 has a greater response to sodium than to non-sodium;
group 2 has the greatest response to sodium / the lowest response to non-sodium;
group 3 has the greatest response of the three groups to non-sodium;
group 3 responds the same to both sodium and non-sodium;   *[2 max]*

 (c) all groups of neurons respond to both stimuli;
group 1 respond more to fructose and group 3 to citric;
group 2 response is the same to both stimuli;
response of each group could be the total/sum of the combined number of impulses
generated (*e.g.* group 1 with total of 145 (±2) impulses);
response could be to the strongest stimulus / *e.g.* citric 100 impulses to group 3;
response could be intermediate between the two;   *[3 max]*

 (d) chemoreceptor   *[1]*

E3. (a) learning/alteration in the behaviour of an animal as a result of the association of
external stimuli / pairing of a conditioned stimulus with an unconditioned one   *[1]*

 (b) <u>positive</u> phototaxis;
positive as it moves towards the stimulus;
photo as the stimulus is light;
taxis as it is a directional response;   *[2 max]*

Option F — Applied Plant and Animal Science

F1. (a)   4.5 (±1) arbitrary units *(units needed)*   *[1]*

(b)   C maintains more taste than P / 3.3 (±2) units more taste in C;
P maintains more juice than C / 2.5 (±1) units more of juice in P than C;   *[2]*

(c)   in the first 16/17 days P maintains more juice (more efficient) than PVC;
after 16/17 days PVC maintains more juice (is more efficient) than P;
in both cases they maintain more juice than the control;   *[2 max]*

(d)   taste is similar in the three conditions up to 14 days and P is more efficient up to 16/17 days as it maintains more juice;
from 21 days onwards PVC is the most efficient as it maintains most taste and amount of juice;
(in the long-term) with P cherries lose a lot of taste and with C they lose a lot of juice;   *[2 max]*

F2. *Award [1] for each structure clearly drawn and correctly labelled.*
stigma shown as feathery and protruding from the flower;
anther shown large and protruding from the flower;
elongated filament;
perianth / bracts reduced with leaf-like structures/no colours;
pollen grains shown as small and many of them;   *[3 max]*

F3. (a)   *biological issues*: *[4 max]*
the organism used may damage the ecosystem / get out of control;
may alter the food web;
do not often function outside greenhouses;
cannot be introduced until there is a pest infestation / when too late;
allergies caused by organisms;
safer for the health and environment than chemical controls;
very specific for the pest;

ethical issues: *[2 max]*
suffering of pests;
disruption of the natural world;
e.g. myxomatosis in rabbits / larvae in ants / any other valid example;   *[6 max]*

(b)   name of example;
animal used to produce substance;
how substance is produced;
use of the substance;   *[4]*

e.g. human growth hormone / somatotrophin / any other valid example;
expressed in mammary gland of cows;
secreted in cow's milk;
induce growth in (pituitary of) dwarfs;

Option G — Ecology and Conservation

G1. (a) indicator species can be used to monitor air/water/terrestrial pollution / can indicate short/long-term pollution changes;
indicator species need a particular environmental condition/set of conditions to live;
some indicators only grow in unpolluted areas / in polluted areas;
changes in quality of the ecosystem can lead to the disappearance/occurrence of species;
named example (*e.g.* (fruticose) lichen);
tolerance of example (*e.g.* intolerant to air pollution);
how example gives idea of pollution (*e.g.* presence implies lack of pollution / good air quality);
multiply number of indicator species by pollution tolerance rating;
abundance of tolerant species gives low overall score / abundance of intolerant species gives higher overall score;
changes can be monitored over a longer period / can lead to adequate measures to protect the environment;   *[6 max]*

(b) measures species richness in an ecosystem;
allows monitoring of ecosystem;
high value indicates a stable/ancient site;
low value suggests pollution / recent colonization / agricultural management / environmental stress;
random sampling of organisms from a variety of species;
identification and count of organisms;
$$D = \frac{N(N-1)}{\sum n(n-1)};$$
N = total number of organisms and n = number of individuals of each species;   *[4 max]*

G2. (a) 1986   *[1]*

(b) no change / same values in both   *[1]*

(c) Asia   *[1]*

(d) increased population (particularly in Asia) leads to greater need of food;
increase in use of fertilizers in (intensive) agriculture;
use of genetically modified plants that require more fertilizers/nitrogen;
more land used for farming;
increased industrialization/transportation increase more burning of fossil fuels/more nitrogen oxides;
increased global temperature liberates more nitrogen from polluted water/soil;   *[2 max]*

(e) denitrification (by *Pseudomonas denitrificans*);
run-off;   *[1 max]*

G3. (a)   gross primary production – respiration   *[1]*

    (b)   named factor (*e.g.* breeding site / territory / food supply / predators / light / human
        intervention / altitude / natural disasters);
        how factor affects;
        example;   *[3]*

        e.g.
        light;
        nocturnal animals avoid light;
        bats live in caves in the day and hunt at night;

        e.g.
        food supply;
        animals require food to reproduce/ live where readily available;
        blue whales congregate where krill is found;

Option H — Further Human Physiology

H1. (a)   6   *[1]*

   (b)   0.75;
          $\dfrac{3}{4}$ *or* $\dfrac{9}{12}$ *or* $3:1$ *or* 75% ;   *[1 max]*

   (c)   before pregnancy much lower with maximum $6\,(\pm1)$ mUl^{-1} than during pregnancy
          with maximum $37\,(\pm1)$ mUl^{-1} / $31\,(\pm2)$ mUl^{-1} increase during pregnancy;
          before pregnancy six women within safe limits while during pregnancy only three
          women within safe limits;
          before pregnancy five women below the safe limits while during pregnancy none
          were;
          before pregnancy one woman was above the safe limit while during pregnancy nine
          were;   *[2 max]*

   (d)   in a normal person high TSH implies high thyroxin / TSH induces thyroid gland to
          produce thyroxin;
          thyroxin controls production of TSH by negative feedback (keeping it in narrow limits);
          in this case high TSH does not imply high thyroxin (as protein binds to it);
          only twelve women were tested / more data needed as to the exact time during
          pregnancy when the women were tested;
          no identification of the individuals concerned before and during pregnancy;   *[3 max]*

H2. (a)   increase of carbon dioxide (partial pressure) results in a decreased affinity of
          hemoglobin for oxygen;
          in respiring tissues carbon dioxide levels rise causing more oxygen to be released
          from hemoglobin;
          oxygen dissociation curve is shifted to the right;
          so more oxygen available for respiring tissues;   *[2 max]*

   (b)   pacemaker / impulses initiated here   *[1]*

H3.   (a)   hepatic artery supplies oxygenated blood (from aorta);
blood enters through hepatic portal vein (from digestive system);
it divides into sinusoids / blood spaces / open channels;
in close contact with hepatocytes / Kupffer cells / phagocytes;
drain into branches of hepatic vein;
hepatic vein takes blood to heart (through vena cava)
Accept any of the above if clearly explained in a labelled diagram.   *[4 max]*

(b)   lipids form droplets;
insoluble in water;
lipase is water soluble (so does not enter lipid droplets);
its active site is hydrophobic (site normally covered by hydrophilic areas);
hydrolyses lipids on surface of droplets;
liver produces bile salts / stored in gall bladder;
bile salt molecules have both hydrophilic and hydrophobic ends;
bile emulsifies lipids / breaks them into droplets;
speeding up digestion / increasing surface area (for digestion);   *[6 max]*