

MARKSCHEME

November 2007

BIOLOGY

Higher Level

Paper 3

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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 underlined 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 penalizing 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 D — Evolution

- D1.** (a) 5 *[1]*
- (b) $(1 + 5 + 4 + 17) = 27$ *[1]*
- (c) $\left(\frac{304}{460} \times 100\right) = 66(.1)\%$ *[1]*
- (d) plant kingdom shares 52 (LCC protein) groups with animal kingdom but only 9 groups with prokaryote kingdom;
 plant kingdom shares 47 groups with animal kingdom that are not found in prokaryote kingdom but only four groups with prokaryotes that are not found in animals;
 insufficient data for prokaryotes to be conclusive; *[2 max]*
- (e) comparing amino acid sequences of (a protein from) several species can help determine evolutionary history;
 the more similar the sequence of amino acids the more closely related (the protein);
 differences in amino acid sequences accumulate over time / number of differences used to determine how long ago two species split from common ancestor;
 low percentage difference means more recent split;
 rate at which differences accumulate is constant and used as evolutionary clock; *[2 max]*
- D2.** (a) population is large;
 mating is random;
 no mutations occur;
 no immigration/emigration / stable populations;
 no gene flow between populations / constant allele frequency over time;
 all genotypes are equally fertile; *[2 max]*
- (b) I: Chordata;
 II: Order;
 III: Primate(s);
 IV: Hominid(ae); *[2]*
Award [2] if four are correct, [1] if two or three are correct and [0] if one is correct.

D3. (a) process by which one/more species arise from previously existing species;
populations become genetically isolated;
natural selection acts independently on each population;
results in changes in allele/genotype frequencies;
inability of organisms/gametes to meet leads to reproductive isolation;
ecological isolation occurs when two species inhabit similar ranges but have different habitat preferences (*e.g.* two species of plants grow on different types of soil) / courtship/feeding differences;
geographical barriers (such as mountain ranges, seas, rivers) produce barrier to gene flow due to spatial separation;
after prolonged separation / genetic isolation over long period of time no longer able to interbreed and speciation has occurred;

[5 max]

(b) comparative anatomy provides evidence for evolution;
pentadactyl limb is limb-bone pattern found in vertebrates;
adapted to different functions/mode of locomotion (in a particular environment);
organs/structures/anatomical features having similar basic structure/similar embryonic development as structures in other species said to be homologous;
homologous anatomical structures derived from a common ancestor;
are examples of adaptive radiation;
examples comparing two named organisms:
e.g. seal's forelimbs adapted for swimming, human's for manipulating;

[4 max]

Option E — Neurobiology and Behaviour

- E1.** (a) in both species, females spend less time away from the nest than males;
female kestrels spend less time away from nest than female red-footed falcons / male
kestrels spend more time away from nest than male red-footed falcons; **[2]**
- (b) $2 \times (11 - 6)$;
10 minutes (more) per hour ± 2 minutes; **[2]**
- (c) red-footed falcons spend less time together than kestrels;
red-footed falcon females spend more time away from the nest alone than kestrel
females;
however, male kestrel spends large amount of time away from nest alone leaving
female kestrel unguarded;
amount of time female kestrel spends alone is almost 50% (approximately 15 minutes
in a 30-minute interval);
data incomplete to support the hypothesis / mating behaviour too incomplete to
support the hypothesis **[2 max]**
Accept specific data describing each point.
- E2.** (a) (i) regulation of hunger/thirst/sleep/temperature / control of endocrine secretion /
release of hormones **[1]**
- (ii) reflex centres / regulation of heart rate/blood pressure/ventilation rate/
swallowing/salivation/sneezing/vomiting/coughing **[1]**
- (b) (unconditioned) stimulus of food/sight of food accompanied by bell ringing;
caused (unconditioned) response of salivation;
(conditioned stimulus) sound of bell given before/without unconditioned stimulus/
sight of food;
caused conditioned response to salivation to sound (without any food);
old behaviour caused by new stimulus therefore behaviour has been changed and
learning has occurred / repeated association of two stimuli (meat and sound) lead to
type of learning; **[3 max]**

E3. (a) *general points: [2 max]*

controlled by involuntary/autonomic nervous system;
reflex activity;
control has to be learnt;
higher centres involved in learning;
sphincter involved;

points for the bladder/anus: [2 max]

sympathetic inhibits urination/defecation;
parasympathetic allows for urination/defecation;
distension/stretching brings about urination/defecation;

[4 max]

- (b) neurotransmitters released by pre-synaptic neurons;
neurotransmitter substance diffuses across synaptic cleft;
attaches to specific receptor sites on postsynaptic membrane;
change in configuration of receptor sites effects postsynaptic membrane's ion gates/channels;
cause (sodium) ion channels to open allowing sodium ions to diffuse in;
leads to depolarization which encourages postsynaptic transmission / excitatory synapse;
e.g. acetylcholine;
can inhibit postsynaptic transmission by hyper-polarization at postsynaptic membrane;
potassium ions move out of the post-synaptic cell / chloride ions move across the post-synaptic membrane into the cell;
increase polarization / increase membrane potential / makes inside membrane more negative making generation of impulse more difficult;
e.g. GABA;

[5 max]

Option F — Applied Plant and Animal Science

- F1.** (a) reproduction between closely related organisms / between offspring produced by same parents (in order to propagate particularly desirable characteristics) [1]
- (b) $11900 - 10300 = 1600 (\pm 200) \text{ kg ha}^{-1}$ (*unit needed*) [1]
- (c) in all hybrids increasing inbreeding decreases yield / negative correlation / pure bred have higher yields;
Dias with lower yield for all percentage inbreeding / Aris hybrid line with higher yield for all percentage inbreeding;
less difference in yield of hybrids at 40% inbreeding than in pure lines (0% inbreeding);
rate of decrease in yield in Aria is greatest of the three as inbreeding increases;
for inbreeding percentages no standard error/s.d. so unable to compare; [3 max]
- (d) $42 (\pm 1)\%$ (*units needed*) [1]
- F2.** (a) by forming tubers/runners/bulbs/cutting/callus [1]
- (b) variety is transgenic/uses antisense technology;
enzyme breaks down pectin in cell walls and causes ripe tomatoes to soften;
gene/enzyme expression blocked by reverse copy/anti-sense mRNA strand;
anti-sense mRNA strand complementary to sense strand;
mRNA can no longer be translated;
mRNA that produces enzyme (polygalacturonase/PG) / causes over-ripening/
softening blocked; [3 max]

- F3.** (a) *for named example include:*
name of organism and what is being improved;
Award [3 max] for no named example.
- choose breeding stock with desirable qualities/traits;
genetically determined traits passed to next generation;
results in (slow) change in phenotype / characteristic of group;
use of artificial insemination;
use of reproductive technologies such as embryo multiplication/transgenic techniques; **[4 max]**
- (b) flowering controlled by phytochromes/light produces far red phytochrome;
short-day plants far red inhibits flowering / long-day plants far red stimulates flowering;
short-day plants flower when night/dark is sufficiently long / long-day plants flower when night/dark is sufficiently short;
length of night/dark is critical in control of flowering / *OWTTE*;
commercially important short-day plants *e.g.* poinsettias/chrysanthemums/holiday cactus/other acceptable example / commercially important long-day plants such as petunia/baby's breath (*Gypsophila*);
in fields, short-day plants induced to flower by covering to create artificial long nights;
in greenhouses plant induced to flower out of season/all year round by altering length of dark periods;
e.g. covering windows, lights left on; **[6 max]**

Option G — Ecology and Conservation

- G1.** (a) $146 - 117 = 29 (\pm 2)$ kg **[1]**
- (b) weaning mass decreases during sardine regime (1975 to 1998) and increases during anchovy regime (1998 to 2004) **[1]**
- (c) colder water (may) lead to more anchovies;
 colder temperature waters lead to more successful foraging by female seals / increase weaning mass with anchovy regimes;
 before 1985 sardine the weaning mass is higher than at any other time;
 sardines come with warmer water / before 1985 warmer waters (may have) led to more successful foraging by female seals;
 inconclusive set of data / anchovy fat content may be higher thus foraging success has less impact;
 anchovies still present in large numbers at the beginning of the sardine regime;
 other foods available / other factors may influence decline; **[3 max]**
- G2.** (a) use energy from chemical reactions (rather than sunlight);
 oxidize inorganic compounds/hydrogen sulphide/ammonia/nitrite/iron-containing compounds;
 oxygen required;
 produce proton/voltage gradient across membrane which is used to generate ATP;
specific example: e.g. nitrifying bacteria (obtain energy to synthesize ATP by oxidizing ammonia/nitrite; **[3 max]**
- (b) chlorine/chlorine radical released from breakdown of CFCs by UV light (in the stratosphere);
 causes ozone to break down to oxygen (and ClO) / $O_3 + Cl \rightarrow O_2 + ClO$;
 cycled reactions / use of correct equations to illustrate this *e.g.* $ClO + O_3 \rightarrow 2O_2 + Cl$
or $ClO + O \rightarrow O_2 + Cl$;
 each chlorine atom/radical catalyses breakdown of 10^5 / reduces ozone; **[2 max]**

- G3.** (a) *definition:* replacement of some species by others through time;
named example;

type of succession:

(primary succession) on surface lacking organic soil (bare rock / recently created volcanic island / glaciated surface);

(secondary succession) on surface stripped of plants but already has an organic component (cleared forest/burned area/farmed area);

description:

pioneer community made of initial organisms to colonize area and identified for named example;

climax community is the final stable/mature/self-perpetuating community and dominant species identified;

describe changes that occur to soil;

describe changes to plant communities;

[5 max]

- (b) *in situ* conservation means preserving biological diversity in the wild (rather than in human controlled settings);

endangered species=one whose numbers are so reduced that is in danger of becoming extinct;

includes setting up parks and nature reserves;

preserve and protect important habitats;

species interact with each other, helping to conserve entire ecosystem;

animals maintain natural behaviour patterns / avoid stress of captivity;

species remain adapted to natural habitat;

have multiple uses including recreation (tourism)/education / logging / grazing / farming / mineral development in controlled manner;

easier to count numbers;

give a specific example of reserve set up to protect specific endangered species (e.g. Pelican Island in Florida to protect brown pelican);

[5 max]

Option H — Further Human Physiology

- H1.** (a) *patients: 42 (± 2) ml*
control group: 73 (± 2) ml **[1]**
Both answers must be correct to receive [1].
- (b) both show increase in ventricular pressure as volume increases / positive correlation;
in DHF patients as diastolic volume increases diastolic pressure increases more rapidly than in the control group / the control group shows a gradual/almost linear increase while patients with DHF show very rapid/exponential increase in pressure;
controls have relatively low pressure at large volumes whereas the DHF patients have higher pressure with a lower maximum volume; **[2]**
- (c) DHF patients all (but one) have stiffer left ventricles;
control all have stiffness constant below 0.015 while patients with DHF all have stiffness constant above 0.014;
DHF patients show wider range of stiffness; **[1 max]**
- (d) (i) stiff ventricle unable to stretch/increase in volume and fill optimally **[1]**
- (ii) insufficient (oxygenated) blood would reach the tissues;
heart rate increases due to increase carbon dioxide/decrease blood pH;
cramp due to lactic acid build up;
fatigue due to insufficient oxygenated blood reaching the tissues; **[1 max]**
- H2.** (a) water;
bile salts/sodium glycocholate/sodium taurocholate;
bile pigments/bilirubin;
cholesterol;
hydrogen carbonate (ions)/ HCO_3^- /inorganic salts; **[1 max]**
Award [1] for any two of the above.
- (b) erythrocytes/red blood cells (rbc) have lifespan of about 120 days;
old erythrocytes/rbcs engulfed and broken down by Kupffer cells / Kupffer cells are phagocytic;
Kupffer cells found lining sinusoids in liver;
hemoglobin broken down to heme/haem (group) and globin;
globins are hydrolyzed to amino acids;
iron is removed from heme/haem group / stored in the liver (and blood as ferritins);
leaving bilirubin (bile pigment);
amino acid deaminated / ammonia converted to urea / carbohydrate respired; **[3 max]**

H3. (a) osmoreceptors in hypothalamus sensitive to osmotic changes in blood / change in solute concentration;
osmoreceptors stimulated by increased solute concentration of blood / low fluid intake / low blood volume / reduced blood pressure;
ADH made in hypothalamus / neurosecretory cells synthesize (and release) ADH (anti diuretic hormone);
secreted from posterior pituitary;
ADH travels in blood to kidney (tubules)/nephrons;
causes collecting ducts to be made more permeable / water is then reabsorbed;
reabsorption causes (decrease in urine production) increase volume of blood/
decrease solute concentration of blood/increased blood pressure;
ADH secretion inhibited by high volume blood / high blood pressure / high fluid intake / low solute concentration;
definition of negative feedback as a control mechanism to return a factor/condition to optimum/normal level;

[5 max]

(b) microvilli increase surface area of plasma membrane exposed for absorption;
channel proteins for (facilitated) diffusion;
tight junctions act as barriers / keep digestive fluids in intestine separate from tissue fluid / maintain concentration gradients / ensure one way flow of absorbed materials;
large numbers of mitochondria provide ATP/energy for active uptake/transport/ processes;
large amount of rER/sER/Golgi Apparatus for secretion of enzymes;
pinocytotic vesicles (near microvilli) take in/contain fluid from lumen of small intestine/ileum;

[5 max]

Answers must state structure and function for the mark.
