



# **MARKSCHEME**

**November 2009**

**BIOLOGY**

**Higher Level**

**Paper 3**

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## General Marking Instructions

### 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 underlined 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. 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.
9. 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.

**Option D — Evolution**

- D1.** (a) (i) proboscis length has decreased;  
proboscis length has become less variable; [2]
- (ii) variation in proboscis length in original population;  
the short proboscis can feed more easily on the introduced species;  
takes less resources to make short proboscis;  
soapberry bugs with a short proboscis are more likely to survive to reproductive age;  
the short proboscis is selected for / genes passed on to the next generation;  
increased frequency of introduced species/*Koelreuteria elegans*; [3 max]
- (b) introduced fruit has a thicker flesh;  
expect proboscis to get longer; [2]
- D2.** (a) both involve reproductive isolation / separation of gene pools;  
sympatric is speciation due to isolation of populations living in the same geographic area whereas allopatric is speciation due to geographic isolation; [2]
- (b) analogous structure similar in appearance/function but with different evolutionary history *e.g.* wing of bat and wing of bird; [1]
- (c) smaller/70S ribosomes in mitochondria/chloroplasts (as in prokaryotes);  
circular DNA in mitochondria/chloroplasts (as in prokaryotes);  
mitochondria/chloroplasts have double membrane;  
similar size/shape of mitochondria/chloroplasts to prokaryotes; [2 max]
- (d) opposable thumb;  
large range of shoulder movement;  
good vision / stereoscopic vision / overlapping field view;  
large brain relative to body size;  
tailless primate;  
Y-5 cusps of molars; [2 max]
- D3.** DNA/RNA found in all living organisms/genetic code is universal;  
amino acids all L- not D- isomers  
same 20 amino acids/proteins found in all living organisms;  
involves comparing similarities and differences in the amino acid sequence of the same molecule;  
*e.g.* hemoglobin;  
involves comparing base sequences of variable regions of DNA;  
*e.g.* mitochondrial DNA;  
the more similar the base/amino acid sequence, the more closely related;  
comparing amino acid sequences that result in the phenotype/comparing DNA sequences that result in the genotype;  
evidence for molecular evolution in drug resistance; [6 max]

**Option E — Neurobiology and behaviour**

- E1.** (a) (i) (mean) chick mass increases in presence of helpers [1]  
(ii) female survival probability increases in presence of helpers [1]
- (b)  $\frac{1300-1225}{1300} \times 100\%$  *or* other correct calculation; 5.8%; [2]  
*Accept the correct answer if it is not rounded up to 5.8% or if it is rounded up to 6%.*
- (c) with helper, smaller egg volume;  
less resources from mother to produce egg/rear young;  
more resources toward survival of mother; [2 max]
- (d) (altruistic) behaviour is inherited;  
adaptations/behaviours that help the colony survive at expense of individual;  
selected for (natural selection);  
will be more likely to be passed on; [2 max]
- E2.** (a) sensory neurons receive information from receptors;  
transmit nervous impulses to the central nervous system;  
relay neurons in the central nervous system transmit the information from  
sensory neurons to motor neurons;  
motor neurons send impulse to effector; [3 max]
- (b) taxis is (directional) movement towards/away from a stimulus whereas kinesis is  
more movement in unfavourable conditions and less movement in favourable  
conditions;  
example; (*e.g. Planaria moving towards food / Euglena moving towards light is  
taxis and woodlice moving more in (unfavourable) dry conditions is  
kinesis*) [2]
- (c) inhibition of nervous impulses / binding to cannabinoid receptors / blocking of  
release of excitatory neurotransmitter [1]
- E3.** whole brain death is brain stem and cerebrum;  
failure of pupil to respond to light indicates brain stem death;  
without brain stem function, life cannot continue;  
cerebrum involves higher order brain function;  
non-functioning cerebrum with functioning brain stem is vegetative state;  
some would argue this is the death of the person;  
though brain stem function alone may be able to maintain homeostasis; [6 max]

**Option F — Microbes and biotechnology**

**F1.** (a) 1.05 kg (*units needed*) [1]  
 Accept answer in the range of 1.03 kg to 1.07 kg.

(b) 5 piglets [1]

(c) improvement in survival;  
 improvement in body mass gain;  
 sample size for survivorship data is very small;  
 possibly no benefit after day 20 as control group survive anyway;  
 study was only undertaken over four weeks;  
 other possible reasons for survivorship; [3 max]

(d) probiotics may multiply in gut / less possibility of multiplication of disease-causing pathogens;  
 antibiotics leave residues in meat;  
 antibiotic resistance develops;  
 release of antibiotics into environment;  
 antibiotics do not control viruses (but probiotics may limit); [1 max]

(e) antibiotics inhibit biochemical pathways in bacterial cells but not in human/ animal cells;  
 inhibition of the synthesis of cell walls (peptidoglycans) / inhibition of protein synthesis; [2]

**F2.** (a)

<i>Bacteria</i>	<i>Peptidoglycan content</i>
<i>Gram-positive</i>	thick wall / high content / 95 % ;
<i>Gram-negative</i>	thin wall / low content / 5 % ;

[2]

(b) *Nitrosomonas*;  
*Nitrobacter*;  
*Nitrococcus*;  
 Allow any other confirmed example. [1 max]

(c) Award [1] for each structure clearly drawn and correctly labelled.  
 cell wall – shown with some thickness;  
 membrane containing chlorophyll/thylakoids/photosynthetic membrane;  
 heterocyst/nitrogen fixing cell – shown as larger than other cells in filament;  
 DNA – not enclosed in nucleus;  
 cytoplasm – running from cell to cell;  
 70S/small ribosomes; [3 max]

**F3.** *definition:*

insertion of genes / replacement of defective genes using a vector into non-germ line cells;

*safety:*

the DNA/viral vector may integrate into other parts of the genome;

causing problems of gene expression;

possibly cancer;

example of SCID treatment/leukemia;

the vector may trigger an immune response;

viral vectors may recombine with other viruses;

inadvertent modification of germ line cells;

*conflict of interest:*

the producers of gene vectors gain financially;

clinical trials must be free of bias from commercial sponsors;

*ethics:*

the vectors are tested on animals and may behave differently in humans;

unethical to use healthy humans in trials;

no gene therapy has been commercialized / no valuable results as yet;

**[6 max]**

*Award [4 max] if responses do not address safety, conflict of interest and ethics.*

**Option G — Ecology and conservation**

- G1.** (a) (i) downward trend / decreasing slightly;  
the data show much variability/fluctuates; [2]
- (ii) warmer air/atmosphere/water temperatures/global warming (bringing about more ice melt) [1]
- (b) (i) increase in summer ice cover has a positive effect on mass increase;  
high proportion of ice cover has little effect / (slightly) negative effect on chick mass/growth; [2]
- (ii) changes in (water) temperature/climate change influence fish populations/ food available for chick growth;  
changes in habitat affect chick growth / rearing of chicks; [2 max]
- (c) mass may go down as proportion of ice cover has decreased;  
mass may increase as most recent data shown in (bar) graph shows increasing proportion of ice area; [1 max]
- G2.** (a) (i) biomagnification is a process in which chemical substances become more concentrated at each trophic level [1]
- (ii) toxins/substances enter the body in water or food;  
heavy metals are water soluble / synthetic organic compounds are fat soluble;  
heavy metals bind to enzymes / synthetic organic compounds stored in fat;  
no removal mechanism for heavy metals / synthetic organic compounds cannot be metabolized;  
example of chemical/mercury (*e.g.* DDT/organophosphorus/ TBT/PCB);  
example of affect on top carnivore in food chain (*e.g.* thin egg shells for birds of prey); [2 max]  
*Award [1 max] if no named example given.*
- (b) *The description should be limited to moisture, temperature and characteristics of vegetation.*  
lush vegetation;  
great diversity of animals/plants;  
*e.g.* forests of equatorial Africa;  
evergreen;  
high insolation;  
high precipitation;  
high temperature;  
increased productivity;  
high level of competition;  
adaptations of leaves; [3 max]

**G3.** *measures to promote conservation: [3 max]*

- reduce total allowable catch below maximum sustainable yield/MSY;
- limit areas where fishing can take place;
- decrease total net size;
- increase mesh size to let immature fish through / set minimum landing sizes for fish;
- reduce fishing effort;
- reduce/stop subsidies for increasing size of fleet;

*methods used to measure conservation: [3 max]*

- monitor fish catches;
- calculate the mass of fish that can be removed annually / maximum sustainable yield;
- required knowledge of birth rate, growth rate of fish and mortality rates;
- can be estimated by looking at age structure of landed fish;
- can be estimated by catch per fishing effort;

**[6 max]**

**Option H — Further human physiology**

- H1.** (a)  $\frac{20}{29} \times 100$ ;  
 = 69% ; (accept correct answer that is not rounded up to 69%) [2]
- (b) higher percentage of those with stomach cancer have *H. pylori* infection;  
 higher median of those with stomach cancer have *H. pylori* infection;  
 infection/high level antibodies does not mean that gastric cancer will always result  
 / many infected did not develop gastric cancer;  
 not all of those with stomach cancer had *H. pylori* infection; [3 max]
- (c) pepsinogen would not be broken down to pepsin;  
 pepsin would not work as well due to incorrect pH;  
 it is not known if humans would respond in the same way as gerbils; [2 max]
- H2.** (a) (i) microvilli/microvillus [1]
- (ii) epithelial cell/enterocyte [1]
- (b) chemical (messengers) secreted by (endocrine) glands;  
 into the blood / transported by the blood;  
 act on target organs/cells; [2 max]
- (c) hepatic artery carries oxygenated blood;  
 hepatic portal vein carries blood from gut/deoxygenated blood;  
 blood from hepatic portal vein and hepatic artery mix;  
 flows through sinusoids;  
 hepatic vein carries blood away from liver; [3 max]
- H3.** during exercise the rate of tissue respiration increases/more carbon dioxide produced;  
 carbon dioxide production in the tissues exceeds the rate of breathing it out;  
 increase in carbonic acid / increase in H<sup>+</sup> ions / pH drops in the blood plasma;  
 lactic acid (in strenuous exercise) reduces pH;  
 chemoreceptors/chemosensors detect change in pH/increase in carbon dioxide/ decrease  
 in oxygen;  
 receptors in the carotid/aortic bodies;  
 nerve impulses sent to the breathing centres of the brain;  
 nerve impulses then sent to diaphragm/intercostal muscles;  
 negative feedback control; [6 max]
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