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M02/410/H(3)M+

# **MARKSCHEME**

**May 2002**

**BIOLOGY**

**Higher Level**

**Paper 3**

## 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.
- ◆ 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) any value from 3.25 to 3.49 kg (*could be U – 1, see page 5*) (*range not required*) [1]
- (b) any value from 3.50 to 3.74 kg (*could be U – 1*) (*range not required*) [1]
- (c) initially as birth mass increases / up to 3.5 kg, survival increases / mortality decreases; then, as birth mass further increases / beyond 3.5 kg, survival decreases / mortality increases;  
further from mode the higher the mortality / highest survival / lowest mortality nearest to mode value; [2 max]
- (d) birth mass shows variation;  
selection against very low / very high birth weights; [2 max]
- (e) mother's diet / smoking / pollution / mother's alcohol consumption / mother's health / mother's blood pressure (*not inherited*) / disease (*not inherited*) [1]  
*Only one answer is acceptable. If several answers are given, mark the first one.*
- D2.** (a) 0.6 / 60 % [1]
- (b) *Apply error carried forward - indicate by ECF (see page 5 of markscheme).*  
dominant allele is 0.4 /  $p^2$  represents the number /  $p^2 = 0.16$ ;  
160; [2]
- D3.** (a) named radioisotope –  $^{14}\text{C}$  or  $^{40}\text{K}$  / other radioisotope;  
fossil accumulated radioisotope before fossilization (when living) / upon death no further radioisotope accumulates / radioisotope held in sediments/rock when fossilization occurs;  
definition of half-life / radioisotopes decay at a known rate;  
 $^{14}\text{C}$  decays to  $^{14}\text{N}$  /  $^{40}\text{K}$  decays to  $^{40}\text{Ar}$  / other decay;  
amount of radioactive material in fossil/in rock near fossil allows age to be determined (from decay curve);  
ratio of  $^{14}\text{C}$  to  $^{12}\text{C}$  /  $^{40}\text{K}$  to  $^{40}\text{Ar}$  used to determine age of fossil; [4 max]
- (b) only part of organisms found / fossils are rare;  
some parts do not fossilize / DNA for analysis only extracted from recent fossils;  
fossilization is rare / fossilization requires certain conditions;  
dating only approximate;  
opinions between scientists differ;  
male and female differ / fossils may not be representative of the species;  
rarity of fossils lead to missing links in the fossil record;  
quoting of accepted dates;  
naming of one or more species (*accept Genus only or anglicised name, but not "Lucy"*);  
many aspects of human evolution (e.g. language) are not represented in fossil record; [6 max]

**Option E – Neurobiology and behaviour**

- E1.** (a) Parkinson's caused by deficiency in dopamine;  
dopamine is a neurotransmitter / intermediate of noradrenaline;  
acts between nerve cells in brain / dopamine produced by substantia nigra;  
affects motor transmission / muscle control / uncontrollable shaking; **[3 max]**
- (b) controls involuntary functions of the body / smooth muscle / cardiac muscle / glands;  
contains sympathetic and parasympathetic systems;  
which are antagonistic;  
sympathetic usually excitatory / prepare for emergency;  
parasympathetic usually inhibitory / parasympathetic returns system to normal;  
sympathetic increases heart beat, parasympathetic slows;  
sympathetic inhibits saliva production, parasympathetic stimulates;  
sympathetic neurotransmitter is noradrenaline;  
parasympathetic neurotransmitter is acetylcholine; **[7 max]**
- E2.** (a) 18 / Group I = 4, Group II = 0, Group III = 14 **[1]**
- (b) most birds flew North in both / in the right direction in both (other similarity);  
more birds flew South in I than II / flew the wrong way in II (other difference); **[2]**
- (c) within southern quadrant;  
shorter arrow (within southern quadrant) / arrow (within southern quadrant) slightly more to the East; **[2]**
- (d) the behaviour is innate;  
behaviour is present in young inexperienced birds / only young birds released / absence of parents; **[2]**
- E3.** I. hypothalamus (*accept* ventricle);  
II. cerebellum;  
III. medulla (oblongata); **[3]**

**Option F – Applied animal and plant science**

- F1.** (a) as soil nitrate increases, grain protein increases / direct relationship / positive correlation [1]
- (b) at 75 mm water there is more grain protein than at 175 mm;  
at 175 mm water there is a wider spread of values for grain protein; [2]
- (c) more nitrate at time of planting;  
less water at time of planting; [2]
- (d) mineral depletion;  
pests / diseases;  
(monoculture) leading to soil degradation;  
inbreeding if seed stock not renewed;  
change in climatic conditions; [2 max]  
(not soil nitrate or soil water)
- F2.** (a) accept any answer from 5 million to 500 000 years [1]
- (b) selective breeding / artificial selection;  
select named feature for named animal (e.g. water buffalo adapted to flooded paddy fields); [2 max]
- F3.** (a) normal tomatoes ripen because of an enzyme(s) breaking down cell walls;  
normal mRNA will translate into this enzyme / sense strand of gene's DNA expressed to produce enzyme;  
sequence of mRNA used to produce antisense gene;  
using reverse transcriptase;  
this gene is placed in tomatoes genome / DNA / chromosomes;  
this gene transcribes / produces antisense RNA;  
antisense is complementary to sense;  
antisense (mRNA) joins together with sense (mRNA);  
stops sense / normal gene from being expressed;  
tomatoes do not over-ripen; [6 max]
- (b) *Award [2 max] for and [2 max] against.*  
against: cause pain to animals / some animals are rare/close to extinction;  
no right to play God / religious beliefs / cultural beliefs;  
animals have rights;  
animals do not make good research models for humans / pathogens jump species barrier more easily;  
for: may save human life / develop vaccines / drugs;  
animals bred specially for research / animals can be good models for research;  
religious beliefs / man has dominion over animals; [4 max]

**Option G – Ecology and conservation**

- G1.** (a) define parasitism / one benefits one suffers;  
define mutualism / both benefit (neither suffer);  
example of parasite and host (*e.g.* tapeworm and human);  
what the parasite gains from host specific to example given (*e.g.* obtains digested food);  
what the host suffers specific to example given (*e.g.* cysticercosis / weight loss);  
example of two organisms in mutualistic interaction (*e.g.* sea anemone and hermit crab);  
what one gains (*e.g.* protection and camouflage);  
what the other gains (*e.g.* mobility); **[6 max]**
- (b) name of one organisation (*e.g.* WWF);  
gathering information / global view of the biosphere;  
protect genetic / species / ecosystem diversity;  
recognises damage to environment / recognises waste of non-renewable resources;  
co-ordinates action (internationally and locally);  
raise money (in rich nations);  
stimulate / finance research;  
publicise / educate;  
lobby (governments/companies); **[4 max]**
- G2.** (a) 08.00 and 23.00 **[1]**
- (b) Eskdalemuir showed greater variations over the 24 hour period;  
Strath Vaich always had greater ozone content;  
both had least during early morning hours (or numerical);  
both had most in early afternoon (or numerical); **[3 max]**
- (c) sunlight / higher temperature **[1]**
- (d) Strath Vaich;  
as less ozone was absorbed (due to windy conditions); **[2]**
- G3.** increase in N or P / eutrophication / algal bloom;  
increase in bacteria / microbes;  
increased BOD / reduced dissolved oxygen;  
oxygen sensitive organisms in river die/emigrate / pollution sensitive organisms increase /  
diversity decreases;  
increased levels of toxins / hormones / heavy metals; **[3 max]**

**Option H – Further human physiology**

- H1.** (a) 225 ( $\pm 5$ ) **[1]**
- (b) decreased for the first four/five months / up to June/July / initially;  
 increased in September / October;  
 decline in November;  
 showed day to day fluctuation;  
 slight increase in May and June / April and May;  
 less variation / plateaus July to August / September; **[3 max]**
- (c) *Simple “yes/no” not acceptable.*  
 the data does not support the hypothesis;  
 the increase in asthma admissions does not immediately follow a rise in pollen /  
 hospital admissions fall whilst pollen levels remain constant in March to August;  
*or*  
 the data does support the hypothesis;  
 the main increase in asthma admissions follows a short time after a rise in pollen; **[2]**
- (d) inflammation of airways / bronchioconstriction / constriction of airways /  
 increased mucus secretion in airways / coughing / lack of breath **[1 max]**
- H2.** (a) liver / liver cells / hepatocytes **[1]**
- (b) acts on fats / lipids;  
 emulsifies / smaller droplets of fats;  
 greater surface area for enzymes;  
 creates alkaline conditions for duodenal enzymes; **[2 max]**
- H3.** (a) *Comparisons needed.*  
 insulin decreases blood sugar, glucagon increases blood sugar;  
 insulin promotes uptake of glucose by cells, glucagon does not have an effect on  
 glucose uptake;  
 insulin promotes change of glucose to glycogen, glucagon promotes change of  
 glycogen to glucose;  
 insulin promotes cell respiration, glucagon does not have an effect on cell  
 respiration;  
 insulin promotes change of glucose to fat, glucagon promotes breakdown of fats;  
 both are involved in the homeostatic/feedback control of blood glucose; **[4 max]**

- (b) *Diagrams are acceptable provided they are adequately annotated.*  
initial uptake of one oxygen molecule by haemoglobin facilitates the further uptake of oxygen molecules / haemoglobin has an increasing affinity for oxygen / and vice versa;  
shows how the saturation of haemoglobin with oxygen varies with partial pressure of oxygen / dissociation curve for (oxy)haemoglobin is S/sigmoid-shaped;  
low partial pressure of oxygen corresponds to the situation in the tissue;  
when partial pressure of oxygen is low, oxygen released;  
high partial pressure of oxygen corresponds to the situation in the lungs;  
when partial pressure of oxygen is high, oxygen taken up by haemoglobin;  
Bohr effect occurs when there is lower pH / increased carbon dioxide / increased lactic acid;  
shifts the curve to the right;  
oxygen more readily releases to (respiring) tissue;

**[6 max]**

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