

MARKSCHEME

May 2002

BIOLOGY

Higher Level

Paper 2

Subject Details: **Biology HL Paper 2 Markscheme**

Mark Allocation

Candidates are required to answer **ALL** questions in Section A total [*32 marks*] and **any TWO** questions in Section B [*20 marks*] each. Maximum total = [*72 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 penalised. 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 penalised 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 penalise candidates for errors in significant figures, unless it is specifically referred to in the markscheme.

Section B

Extended response questions - quality of construction

- ♦ Extended response questions for HL P2 carry a mark total of 20. Of these marks, 18 are awarded for content and 2 for the quality of construction of the answer.
- ♦ Two aspects are considered:
 - expression of relevant ideas with clarity
 - structure of the answers.
- ♦ **ONE** quality mark is to be awarded when the candidate satisfies **EACH** of the following criteria. Thus **TWO** quality marks are awarded when a candidate satisfies **BOTH** criteria.

Clarity of expression:

The candidate has made a serious and full attempt to answer all parts of the question and the answers are expressed clearly enough to be understood with little or no re-reading.

Structure of answer:

The candidate has linked relevant ideas to form a logical sequence in at least two parts [(a), (b), etc.] of the question.

- ♦ It is important to judge this on the overall answer, taking into account the answers to all parts of the question. Although, the part with the largest number of marks is likely to provide the most evidence.
- ♦ Candidates that score very highly on the content marks need not necessarily automatically gain the two points for the quality of construction (and vice versa).
- ♦ The important point is to be consistent in the awarding of the quality points. For **sample scripts for moderation** the reason why quality marks have been awarded should be stated.
- ♦ Indicate the award of quality marks by writing **Q2**, **Q1** or **Q0** in **red** at the end of the answer.

SECTION A

1. (a) 0.3 mmol dm^{-3} (*must include units for mark*) [1]
- (b) at low concentrations / below 0.03 growth increases in *A. lesbiacum* but decreases in *A. montanum*;
at higher concentrations / above 0.03 both decrease;
biomass production by *A. montanum* reaches zero but in *A. lesbiacum* does not;
A. lesbiacum grows better than *A. montanum* at all concentrations of nickel; [3]
- (c) to ensure a known / constant nickel concentration / soil nickel concentration is variable;
because soil may already contain nickel (affecting overall concentration);
other metals / ions / nutrients / substances in the soil might vary / affect growth;
nickel may bind to soil and not be available;
to ensure that nickel concentration is the only variable; [1]
- (d) $0.6 \% (\pm 0.1) / 100 \%$; [1]
- (e) *A. lesbiacum* roots have a higher nickel % than *A. montanum* roots;
A. lesbiacum shoots have a much higher nickel % than *A. montanum* shoots;
A. lesbiacum shoots contain more than roots but reverse for *A. montanum*;
no significant difference between roots at low concentrations; [2 max]
- (f) *A. lesbiacum* (roots) absorb more nickel than *A. montanum*;
membranes more permeable / pumps / channels;
faster transport of nickel in *A. lesbiacum* than *A. montanum*;
from roots to shoots / up the plant;
A. lesbiacum stores nickel in its shoots;
A. montanum stores nickel in its roots; [2 max]
- (g) *A. lesbiacum* would be most useful;
A. lesbiacum grows better in high / all nickel concentrations;
growth of *A. lesbiacum* is stimulated by moderate concentrations;
A. lesbiacum accumulates higher nickel percentages;
shoots of *A. lesbiacum* containing nickel could be removed; [2 max]
- (h) area 1: 39 (ppb) and area 2: 51 / 50.67 / 50.7 / $50\frac{2}{3}$ (ppb); (*units not needed*) [1]
- (i) in area 1, *Cyprinus* has higher PCB concentration;
in area 2 *Micropterus* has a higher PCB concentration;
Micropterus’ higher level is in area 2;
Cyprinus’ higher level is in area 1; [2 max]

- (j) PCBs are stable / cannot be broken down;
PCBs not excreted / stored in body tissues / bioaccumulation;
PCBs passed along the food chain;
biomagnification / higher concentrations in higher trophic levels;
fish are at higher trophic levels / near end of food chain;
the three species may be at different trophic levels;
the fish may have migrated from / fed in areas with higher PCB concentrations;
fish with low PCB tolerance may have died;
some fish may swim / feed close to the source of the PCBs;
fish that live for longer accumulate more PCBs;

[3 max]

2. (a) *For a diagram of the whole gas exchange system, award [1] for each of the following structures clearly drawn and labelled correctly.*
 trachea;
 lungs;
 bronchi;
 bronchioles;
- For a diagram of an alveolus only, award [1] for each of the following structures clearly drawn and labelled correctly.*
 alveolus;
 bronchiole; **[3 max]**
- (b) breathing is moving air into (and out of) the lungs **and** respiration is production of ATP / release of energy from food / named food / organic compound; **[1]**
- (c) lower blood pH / more acidic due to higher CO₂ concentration;
 action of carbonic anhydrase / release of H⁺ ions from H₂CO₃;
 detected (by chemosensors) in aorta / carotid artery;
 send signal to brain / respiratory centre;
 brain sends signals to diaphragm / intercostal muscles to increase rate;
 under involuntary control;
 rate of ventilation increases; **[3 max]**
3. (a) sex chromosomes determine gender / sex and autosomes do not;
 X and Y are sex chromosomes and all other chromosomes are autosomes;
 autosomes in homologous pairs but sex chromosomes may not be; **[1]**
- (b) (during gamete formation) the separation / inheritance of one pair of alleles / factors (for one gene / trait) is independent of the separation / inheritance of another pair of alleles / factors (for other gene / trait); **[1]**
No mark for “Law of Independent Assortment”.
- (c) F₁ all tall and yellow;
 F₂ tall and yellow, tall and green, short and yellow, short and green;
 F₂ 9:3:3:1; **[3 max]**
- (d) tall and yellow / TTY_Y, TTY_y, TtYY, TtYy;
 short and green / ttyy; **[2 max]**
Deduct [1] per incorrect answer, minimum mark [0].

SECTION B

4. (a) unicellular versus multi-cellular / cell number;
cell type / prokaryotic versus eukaryotic cell;
example of prokaryote / eukaryote difference;
mode of nutrition / autotrophic or heterotrophic / chlorophyll or not / source of energy;
cell wall presence;
composition of cell wall;
type of reproduction;
DNA sequences;
amino acid sequences of proteins;
carbohydrate storage compound;
presence of flagella / cilia; **[5 max]**
Accept any of these points if made as a comparison between two kingdoms.
- (b) gene of interest is cut out;
with restriction enzymes;
RNA used to produce DNA;
using reverse transcriptase;
plasmid cut open with same restriction enzyme;
gene inserted into plasmid;
blunt ends / sticky ends;
spliced together by DNA ligase;
recombinant plasmids are cloned / many copies produced;
recombinant plasmids are inserted into new host cells / virus / bacteriophage / yeast;
inserted by shooting / spraying / microencapsulation / by heat treatment; **[5 max]**
- (c) living organisms show genetic variation;
genetic variation needed for natural selection / evolution;
species become extinct if they cannot evolve;
more genetic disease with less genetic diversity;
more homozygosity with less genetic diversity;

may be of future value;
cultivated plants had wild relatives;
can contain genes for drought resistance;
can contain genes for pest resistance;
through breeding or genetic engineering can introduce new traits into cultivated plants;
can produce new cultivars to increase yield;
more diversity in animals can introduce genes from the wild;
can produce different breeds;
more efficient meat producers;
more efficient milk producers;
can live on marginal land;
source of medicines / painkillers / antibiotics;
source of food;
source of predators / parasites for biological control; **[8 max]**
Accept these points if given as suitable converses, e.g. more heterozygosity with more genetic diversity instead of more homozygosity with less genetic diversity.

(Plus up to [2] for quality)

5. (a) *Award [1] for each of the following structures clearly drawn and labelled correctly.*
root hair;
epidermis;
cortex;
endodermis;
xylem;
phloem; **[5 max]**
Award [4 max] if epidermis and / or endodermis is shown as a line only.
Award [2 max] if a longitudinal section of a root is drawn.
Award [2 max] if a monocotyledonous root is drawn.
Award [0] if a transverse section of a stem is drawn.
- (b) absorbed by root hairs / through epidermis;
root hairs increase the surface area for absorption;
uses active transport / uses ATP / uses energy;
use of proteins / pumps to move ions across membrane;
against concentration gradient / diffusion gradients into cell / root;
can enter cell wall space / be drawn through cell walls / apoplastic pathway;
selective / only specific ions absorbed; **[5 max]**
- (c) *Function must be given to award mark.*
cuticle (produced by epidermis) prevents water loss;
epidermis protects cells inside the leaf;
stomata (in epidermis) for gas exchange;
palisade parenchyma / mesophyll / layer for photosynthesis;
spongy parenchyma / mesophyll / layer for photosynthesis;
air spaces for diffusion of O₂ / CO₂ / gases;
spongy mesophyll for gas exchange / absorption of CO₂;
xylem transports water / mineral salts / ions to the leaves;
phloem transports products of photosynthesis / sugars (to flowers / new leaves / stem / roots / fruit);
stomata allow transpiration (which helps transport of mineral nutrients);
guard cells open and close stomata;
guard cells close stomata to reduce transpiration; **[8 max]**

(Plus up to [2] for quality)

6. (a) *Award [1] for each of the following structures clearly drawn and labelled correctly.*
outer membrane;
intermembrane space / outer compartment;
inner membrane;
matrix;
cristae;
ribosome;
naked / circular DNA;
ATP synthase;
Do not accept plasma membrane. **[5 max]**
- (b) acetyl CoA enters Krebs cycle;
glucose / carbohydrates converted to pyruvate in glycolysis;
glycerol undergoes glycolysis and is converted to pyruvate;
pyruvate enters mitochondria;
pyruvate converted to acetyl CoA;
by oxidative decarboxylation / hydrogen and CO₂ removed;
fats enter mitochondria;
fats oxidised to acetyl CoA / oxidation of fatty acids / fats converted to acetyl CoA; **[5 max]**
- (c) proteins, fats, carbohydrates, minerals and vitamins in a balanced diet;
everyone needs a balanced diet (whatever their energy needs);
relative energy content of food / fats more energy than carbohydrates;
proteins can be used as a source of energy;
input of Joules / energy must balance output of Joules / energy;
more active need more energy / less active need less energy;
obesity if energy intake is excessive;
risk of heart disease / other problems linked to obesity;
lethargy / poor growth / prone to infections with insufficient energy intake;
fats for slow release energy;
carbohydrates for rapid release energy;
young are growing and need more energy;
elderly need less energy;
pregnant need more energy;
lactating need more energy; **[8 max]**

(Plus up to [2] for quality)

7. (a) proteins are synthesised on the rER;
proteins enter the ER;
vesicles move from the ER to the Golgi apparatus;
protein is processed in Golgi apparatus;
vesicle leaves Golgi and moves to cell surface;
vesicle fuses with membrane to release the protein;
exocytosis;
active process / uses ATP;

[4 max]

- (b) mRNA with genetic code / codons;
tRNA with anticodon;
tRNA with amino acid attached;
ribosome with two sub-units;
mRNA held by ribosome;
start codon;
two tRNA molecules attached with mRNA on ribosome;
peptide bond between amino acids on tRNA;
polypeptide forms;
ribosome moves down mRNA;
continues until a stop codon is reached;
polypeptide is released;

[6 max]

- (c) variation / example of variation;
over-reproduction;
struggle for existence / competition;
better adapted survive and breed / pass on genes;
alleles conferring adaptedness increase in frequency;

[4 max on this section]

For each of two examples.

- name of organism and characteristic that has evolved;
explanation of selective advantage of the characteristic;

[8 max]

(Plus up to [2] for quality)
