

MARKSCHEME

May 2005

BIOLOGY

Higher Level

Paper 2

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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 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.
- ◆ 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.

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.
- ♦ **[1]** quality mark is to be awarded when the candidate satisfies **EACH** of the following criteria. Thus **[2]** 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 **[2]** marks 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) (i) $2.8 (\pm 0.5) \text{ g kg}^{-1} \text{ day}^{-1}$ [1]
- (ii) $2.0 (\pm 0.5) \text{ g kg}^{-1} \text{ day}^{-1}$ [1]
- Award [1 max] for (a) (i) and (ii) if units are not included or wrong units used.
It is not necessary to indicate whether the difference is positive or negative.*
- (b) NPY $-/-$ consumes more alcohol than NPY-EX (at all concentrations);
consumption increases at a (relatively) constant rate (above 6 %) with concentration for NPY-EX, but levels off at higher concentrations for NPY $-/-$;
as alcohol concentration increases both NPY $-/-$ and NPY-EX rats consume more;
NPY $-/-$ consumes more alcohol than NPY $+/+$ and NPY-EX consumes less than NPY $+/+$; (*Accept use of word control.*)
biggest difference from NPY $+/+$ for NPY-EX is at 20 %, but for NPY $-/-$ it is at 10 %; [3 max]
- (c) NPY levels are inversely related to alcohol consumption/the lower the NPY levels,
the more alcohol consumption (*Accept the converse.*) [1]
- (d) NPY $-/-$ takes least time to regain the reflex;
NPY-EX takes most time to regain the reflex;
NPY-EX is the most sensitive to effects of alcohol / NPY $-/-$ is the least sensitive
to effects of alcohol;
the higher the NPY levels the more time taken to regain the reflex;
NPY $-/-$ /under-expression has more of an effect than NPY-EX/over-expression; [3 max]
- (e) there is no difference / small difference in blood levels between groups at 1 hour
and 3 hours / decrease from 1 to 3 hours is the same for both;
therefore, the hypothesis does not appear to be justified; [2]
- (f) NPY-EX does not prefer alcohol and is sensitive to effects of alcohol / NPY $-/-$
prefers alcohol and is not sensitive to effects of alcohol;
therefore, alcohol preference is inversely related to sensitivity to effects of alcohol
/ the less sensitive the rats are to alcohol, the more they consume it; [2]
- (g) (i) having two identical alleles (of a gene) [1]
- (ii) normal preference for alcohol / moderate preference for alcohol / standard
phenotype for alcohol preference / normal levels of NPY [1]
Do not accept "normal rats" only.
- (iii) Punnett square correctly drawn;
*Can be two by two or one by one, accept +/- without NPY, square or diamond
shape acceptable but clear cells expected, male or female symbols not necessary.*
100 % / all; [2]

2. (a) growth;
(tissue) repair;
spermatogenesis / oogenesis / cloning / asexual reproduction;
maintenance; [2 max]
- (b) the rate of material / heat exchange / diffusion is proportional to surface area;
the rate of metabolism is proportional to mass/volume;
as a cell grows, the volume increases faster than the surface area / as a cell grows,
surface area to volume ratio decreases;
(without cell division) material / heat cannot be exchanged fast enough to meet
the needs of the cell; [3 max]
- (c) free ribosomes synthesize proteins for use within the cell/cytoplasm and attached
ribosomes produce proteins for export / use within lysosomes / membranes [1]
3. (a) blood carries heat;
skin arterioles carry blood to skin surface / capillary beds;
body temperature high, vasodilation occurs/arterioles dilate;
increasing heat loss to the environment / cooling blood;
body temperature low, vasoconstriction occurs/arterioles become narrower;
decreasing heat loss to the environment/conserving heat; [3 max]
- (b) transpiration is the loss of water vapour from stems and leaves/plant;
high temperature favours transpiration / low temperature decreases transpiration;
high temperature increases evaporation of water (from the surface of plant cells);
high temperature increases motion of water molecules/ rate of diffusion of water
(out of stomata);
humidity influences the effect of temperature on transpiration; [3 max]
- (c) enzymes have an optimum temperature;
increase in temperature increases motion/energy of
enzyme and substrate molecules;
increased frequency of contact between substrate and
active sites; (Accept converse i.e. effect
of lowering temperature.)
reaction rate increases;
high temperature disrupts intermolecular forces / denatures enzymes; [3 max]

SECTION B

4. (a) *Award [1] for any two of the following clearly drawn and correctly labelled.*
- vena cava;
 - inferior and superior vena cava distinguished;
 - aorta;
 - pulmonary artery;
 - pulmonary vein;
 - left ventricle;
 - right ventricle;
 - left ventricle shown with thicker walls than right ventricle;
 - septum;
 - left atrium;
 - right atrium;
 - coronary artery;
 - two semi-lunar valves;
 - AV valves;
 - bicuspid and tricuspid valves distinguished;
- [5 max]*
- (b) consists of inhaling and exhaling air / exchanging stale air with fresh air (with the environment);
- external intercostal muscles contract moving the rib cage up/out;
 - diaphragm contracts;
 - increases volume of thorax / lowers lung pressure relative to air pressure / pulls air in;
 - diaphragm relaxes;
 - abdominal muscles contract;
 - internal intercostal muscles contract moving the rib cage down/in;
 - force air out / decreases volume of thorax / raise lung pressure relative to air pressure;
- [5 max]*
- (c) roots have a large / increased surface area (in relation to their volume);
- root hairs increase the surface area;
 - water is absorbed by osmosis;
 - solute concentration inside the root is higher than in the soil / outside;
 - due to active transport of ion into the root;
 - apoplastic and symplastic transport across root;
 - apoplastic route is through the cell walls (and intercellular spaces);
 - symplastic route is through the cytoplasm (and plasmodesmata);
 - carried up stem by xylem (vessel elements/tracheids);
 - water has to pass through cytoplasm of endodermis / Casparian strip blocks water;
 - water movement in xylem due to pulling force / transpiration pull from leaves;
 - cohesion between water molecules;
- [8 max]*

(Plus up to [2] for quality)

5. (a) *Award [4 max] for method for animal species.*

Lincoln index;

capture a random sample of individuals;

example of method of capture;

(count) mark and release individuals;

recapture a random sample of individuals;

calculate $\frac{\text{number caught and marked originally} \times \text{total number in 2nd sample}}{\text{number of marked individuals in 2nd sample}}$ = population estimate;

Accept this formula using symbols with a key.

Award [4 max] for method for plant species.

(stationary) population assessed using quadrat method;

sample areas of fixed size from a larger area chosen;

samples chosen by line/belt transect / throwing frame/random number generation;

number of individuals in sample counted;

average number in all samples of same size determined;

average number multiplied by number of quadrats in entire area (gives population estimate);

[7 max]

(b) *bryophytes:*

non-vascular/no true roots/rhizoids / dominant gametophyte / dependent sporophyte;

angiospermophytes:

flowering / seeds encased in fruits;

coniferophytes:

naked seeds / cone bearing;

[3]

(c) originally advanced by Darwin/Wallace;

based on observations;

overproduction of offspring leads to struggle for survival;

variation exists;

some varieties better adapted than others;

best adapted survive / reproduce and pass on characteristics;

evolution is change in species / allele frequency with time;

evidence that species have evolved include observed evolution / multiple antibiotic resistance;

second example of evidence *e.g.* fossil record;

some claims in the study of evolution (of extinct species) are not testable/cannot be proven;

competing explanation was inheritance of acquired characteristics/Lamarck's ideas;

competing idea is that of special creation;

[8 max]

(Plus up to [2] for quality)

6. (a) Award **[1]** for each **two** of the following correct: name, source, substrate, product(s), and optimum pH.
e.g. name: amylase; (*Do not accept the general term protease.*)
 source: pancreas / salivary gland;
 substrate: starch; (*Do not accept carbohydrate.*)
 product: maltose;
 optimum pH: 7 / slightly alkaline; **[4 max]**
Similarly, for second enzyme.
- (b) the name of the enzyme and the substrate;
 the name(s) of the product(s);
 a statement as to why the application is useful commercially;
Award [3 max] for each example.
e.g. pectinase acts on soluble pectin;
 produces smaller, more soluble carbohydrates;
 used in fruit juice clarification/improving fruit juice yield;

e.g. DNA endonuclease acts on DNA;
 produces DNA fragments;
 used in genetic engineering;

e.g. protease acts on insoluble proteins;
 produces amino acids;
 washing powders – stain removal; **[6 max]**
Accept other suitable examples.
- (c) *competitive:*
 a molecule structurally similar to the substrate binds to the active site;
 preventing substrate binding;
e.g. inhibition of butanedioic acid (succinate) dehydrogenase by propanedioic acid (malonate) in the Krebs cycle / other valid example;
 competitive inhibition is reversible;

non-competitive:
 an inhibitor molecule binds to an enzyme;
 not at the active site;
 causes a conformational change in the active site;
 preventing substrate binding;
e.g. CN inhibition of cytochrome oxidase by binding to SH groups / other valid example;
Award [6 max] for explanation of competitive and non-competitive inhibition.

 most allosteric enzymes have multiple allosteric sites;
 allosteric inhibition is a form of non-competitive inhibition;
 metabolites can act as allosteric inhibitors of enzymes earlier in a metabolic pathway to regulate metabolism;
 binding (of end product) to an allosteric site changes shape of enzyme; **[8 max]**

(Plus up to **[2]** for quality)

7. (a) sun is source of energy for most ecosystems;
energy is fixed by producers / photosynthesis brings energy into the food chain;
energy passed through the food chain;
from producer to consumer;
energy transfer to next trophic level is only about 10 % efficient;
because of losses due to cellular respiration/heat/metabolic activity/undigested material;
losses limit the length of the food chain;
energy in detritus utilized by saprotrophs; **[5 max]**
- (b) lipids have more/twice the energy content per unit mass of carbohydrates;
energy stored as glycogen in animals/fungus;
glycogen/carbohydrates used for short-term energy storage;
glycogen converted to glucose when energy is required;
energy stored as starch in plants;
lipids/triglycerides used for long-term energy storage;
triglycerides converted to fatty acids and glycerol (when energy is required);
triglycerides broken down to yield acetyl CoA; **[5 max]**
- (c) glucose is broken down to pyruvate in the cytoplasm;
with a small yield of ATP/net yield of 2 ATP;
and NADH + H⁺/NADH;
aerobic respiration in the presence of oxygen;
pyruvate converted to acetyl CoA;
acetyl CoA enters Krebs cycle;
Krebs cycle yields a small amount of ATP/one ATP per cycle;
and FADH₂/FADH + H⁺ / NADH/NADH + H⁺ / reduced compounds / electron
collecting molecules;
these molecules pass electrons to electron transport chain;
oxygen is final electron acceptor/water produced;
electron transport chain linked to creation of an electrochemical gradient;
electrochemical gradient/chemiosmosis powers creation of ATP;
through ATPase; **[8 max]**

(Plus up to [2] for quality)
