

MARKSCHEME

May 2004

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 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 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.
- ◆ 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. Ignore this, if marks for units are already specified in the markscheme.
- ◆ Do not penalize 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.

SECTION A

1. (a) (i) higher mean index in 1999;
higher maximum index in 1998 / lower minimum in 1998 / wider range in 1998;
none above 55 in 1999 / none below 35 in 1999 / none classified as extremely thin in 1999; **[2 max]**
Accept converse of each of these statements.
- (ii) regrowth of algae after end of El Niño / less competition because of high mortality in 1998 **[1]**
- (b) death if index is below 20 **[1]**
- (c) *For part (i) and (ii) do not accept size, mass or condition as equivalent to body condition index.*
- (i) at low body condition index / below 35 there is a (strong) negative correlation / OWTTE;
above 35 there is no relationship / slight negative correlation;
overall negative correlation / lower corticosterone as body condition index increases; **[2 max]**
- (ii) at low body condition index / below 35 the marine iguanas are under increasing stress;
at low body condition index / below 35 body tissues have to be broken down to obtain energy; **[1 max]**
- (d) 100/99 % survival before the spill / 63 % (*accept 61-64 %*) after the spill / 100-163 %;
37 % (± 2 %) lower survival; **[2]**
- (e) originally 180 iguanas becomes $75(\pm 2)$ *or* $\frac{180 - 75\%}{180} \times 100\%$ *or* 39 mm (± 1) to 16 mm (± 1);
reduced by 58 % (± 1) / reduced to 42 % (± 1); **[2]**
Allow ECF.
- (f) food sources/algae that the marine iguanas feed on were killed / supply of food reduced;
microbes in the gut that help digestion were killed;
oil spill causes stress/lowers body condition index/impairs movement/reduces useable habitat; **[2 max]**
- (g) higher corticosterone is a predictor of drop in survival;
predicted survival was 63 % (*accept 61-64 %*) actual survival is 42 % (± 1 %) / it does not allow for accurate prediction;
some causes of mortality are not accounted for by corticosterone levels; **[2 max]**

2. (a) C c W w;
all are coloured starchy; [2]
- (b) gametes are C W, C w, c W, c w and c w;
F₂ genotypes are CcWw, Ccww, ccWw and ccww;
1 coloured starchy: 1 coloured waxy: 1 colourless starchy: 1 colourless waxy; [3]
Phenotypes must be unambiguously indicated, but not necessarily on the line.
- (c) chi squared test [1]
- (d) (autosomal) linkage (*reject sex linkage*) / genes are on the same chromosome/genes do not assort independently;
coloured starchy and colourless waxy are parentals/coloured waxy and colourless starchy are the recombinants;
recombinants produced by crossing over; [2 max]
3. (a) high pressure in afferent arterioles;
leads to ultrafiltration in the glomerulus/through fenestrated capillaries in the glomerulus;
drains through the Bowman's capsule to the proximal convoluted tubule; [2 max]
- (b) (i) glucose / amino acids [1]
- (ii) water by osmosis;
salts by active transport/facilitated diffusion; [2]
- (c) magnification = $\frac{\text{size of image}}{\text{actual size of object}}$ *or* $\frac{49000 \mu\text{m}}{10 \mu\text{m}}$ *or* 4.9 cm scale bar represents 10 μm ;

 $\times 4900 (\pm 200)$; [2]
Do not award the first mark if incorrect equations are set up such as 4.9 cm = 10 μm .
- (d) microvilli increase the surface area for absorption / active transport;
mitochondria produce ATP for active transport; [2]

SECTION B

4. (a) cell division by mitosis to form more cells / spermatogonia;
growth of cells / spermatogonia to form larger cells / primary spermatocytes;
cells / primary spermatocytes divide by meiosis;
two divisions of meiosis;
haploid cells / spermatids formed;
differentiation of haploid cells / spermatids into sperm;
growth of tail / other feature of differentiation;
FSH, testosterone and LH all needed for spermatogenesis;
sperm stored / maturation in epididymis/gain motility;
fluid added to sperm by seminal vesicle (during ejaculation);
fluid from seminal vesicle contains nutrients / mucus;
fluid added to sperm by prostate gland (during ejaculation) / fluid from prostate gland
contains alkali / minerals; **[8 max]**
- (b) FSH is secreted at the start of the cycle / early in the cycle / days 1 to 5 / when
progesterone/estrogen is low;
FSH stimulates follicle development;
FSH stimulates secretion of estrogen (by the follicle / ovary);

LH is secreted in the middle of the cycle / before ovulation / days 10 to 14;
LH stimulates ovulation;
LH stimulates the development of the corpus luteum;
LH stimulates less estrogen;
more progesterone secretion / high progesterone / estrogen inhibits FSH and LH release; **[6 max]**
- (c) *Arguments against cloning [3 max]:*
reduces the value / dignity of the individual / causes psychological problems;
high miscarriage rates / cloned individuals are likely to have developmental
disorders/health problems / cloned individuals may show premature aging;
costly process and money could be better spent on other types of healthcare;
cloning may be done for inappropriate motives/replace lost loved one/perfect race *etc.*;
- Arguments for cloning [3 max]:*
identical twins are formed by cloning so it is a natural process;
cloned embryos can be tested for genetic disease / genetic screening;
increased chance of children for infertile couples;
cloning research may lead to spin-offs for other research areas such as cancer/transplant
research/regeneration research; **[4 max]**

(Plus up to [2] for quality)

5. (a) subunits are nucleotides;
one base, one deoxyribose and one phosphate in each nucleotide;
description / diagram showing base linked to deoxyribose C¹ and phosphate to C⁵;
four different bases – adenine, cytosine, guanine and thymine;
nucleotides linked up with sugar-phosphate bonds;
covalent / phosphodiester bonds;
two strands (of nucleotides) linked together;
base to base;
A to T and G to C;
hydrogen bonds between bases;
antiparallel strands;
double helix drawn or described; **[8 max]**
Accept any of the points above if clearly explained in a diagram.
- (b) both in 5' to 3' direction;
both require ATP;
DNA is transcribed and mRNA is translated;
transcription produces RNA and translation produces polypeptides/protein;
RNA polymerase for transcription and ribosomes for translation / ribosomes in translation only;
transcription in the nucleus (of eukaryotes) and translation in the cytoplasm/at ER;
tRNA needed for translation but not transcription; **[4 max]**
- (c) sample of DNA obtained / leucocytes / from mouthwash / hair / other named source;
satellite DNA/repetitive sequences used for profiling;
amplification of DNA by polymerase chain reaction / PCR;
cutting DNA into fragments using restriction enzymes;
separation of fragments of DNA (by electrophoresis);
separation according to the length of the fragments;
pattern of bands obtained / different pattern of bands with DNA from different individuals;
used for criminal investigations / example of use in criminal investigation;
used to check paternity / who is the father / mother / parent;
used to check whether two organisms are clones; **[6 max]**

(Plus up to [2] for quality)

6. (a) skeletal muscle fibres are larger / have many nuclei / are not typical cells;
fungal hyphae are (sometimes) not divided up into individual cells;
unicellular organisms can be considered acellular;
because they are larger than a typical cell / carry out all life functions;
some tissues / organs contain large amounts of extracellular material;
e.g. vitreous humour of eye / mineral deposits in bone / xylem in trees / other example;
statement of cell theory / all living things/most tissues are composed entirely of true cells; **[4 max]**
- (b) calcium released from sarcoplasmic reticulum;
calcium binds to troponin;
troponin with calcium bound makes tropomyosin move;
movement of tropomyosin exposes binding sites (for myosin) on actin;

contraction of muscle fibres is due to the sliding of filaments (over each other);
myosin heads bind to / form cross bridges with actin;
ATP binds to the myosin heads causing them to detach from the binding sites;
hydrolysis of ATP / conversion of ATP to ADP causes myosin heads to move;
myosin heads reattach to actin further along;
myosin pushes actin / actin pushed towards the centre of the sarcomere / shortening of sarcomere; **[6 max]**
- (c) labelled diagram showing, biceps, humerus, radius and ulna;
cartilage reduces friction;
synovial fluid lubricates the joint;
synovial membrane secretes synovial fluid;
capsule / capsular ligament seals the joint;
ligaments prevent dislocation / restrict the range of movement/attach bones to one another;
motor neurones stimulate muscles to contract;
bones provide a firm anchorage for muscles;
bones act as levers/change the torque / size / direction of forces;
tendons attach muscle to bone;
biceps and triceps are antagonistic;
biceps is the flexor / bends the elbow joint **and** triceps is the extensor / straightens the elbow joint;
biceps is attached to the radius and triceps is attached to the ulna; **[8 max]**
Accept any of the above points if clearly drawn and correctly labelled in a diagram.

(Plus up to [2] for quality)

7. (a) *Award [1] for each of the following structures, shown in the correct relative position and labelled. Individual cells are not needed but do not penalize if they are shown.*
- upper epidermis;
 - palisade layer / mesophyll;
 - spongy layer / mesophyll;
 - lower epidermis;
 - xylem (in a major or minor vein);
 - phloem (in a major or minor vein);
 - collenchyma (in the midrib);
 - guard cells; *(do not accept stoma/stomata only)*
- [6 max]**
- (b) chlorophyll/photosystem absorbs light;
electron raised to higher energy level / photoactivated;
splitting of water/photolysis replaces electron;
passing of excited electrons between chlorophyll molecules in photosystems;
electron passed from photosystem II to carriers (in thylakoid membrane);
production of ATP in this way is called photophosphorylation;
electron causes pumping of protons into the thylakoid;
proton gradient used by ATPase to drive ATP production;
electron passes to photosystem I at end of carrier chain;
electron re-excited and emitted by photosystem I;
electron passed to / used to reduce NADP^+ ;
 $\text{NADPH} + \text{H}^+$ / reduced NADP produced;
cyclic photophosphorylation using photosystem I electron carriers and ATPase only;
Accept any of the above points if clearly drawn and correctly labelled in a diagram.
- [8 max]**
- (c) leaves release carbon dioxide when they respire;
when they are burned/combustion;
C passed to decomposers when they die;
C passed to detritus feeders from leaf litter;
C passed to consumers/herbivores in the food chain;
carbon removed from the carbon cycle when leaves are fossilized / turn to peat/coal;
- [4 max]**

(Plus up to [2] for quality)
