

# **MARKSCHEME**

**May 2001**

**BIOLOGY**

**Higher Level**

**Paper 2**

**SECTION A**

1. (a) (i) 1976; [1]
- (ii) 1995; [1]
- (b) hypothesis not supported / no clear trend;  
thin rings in 1995 / 1996 (but the other rings are not thin);  
thick rings in 1976 / 1984; [2 max]
- (c) 1976; [1]
- (d) (i) cycle / peak / trough (about) every ten years / peak in the middle of each decade;  
cycles are (nearly) synchronous / peaks / troughs at the same time;  
peaks are all approximately 140 %;  
troughs are all approximately 60 %;  
all have higher than average peaks in 1925 / 1945 / mid 1920s / mid 1940s;  
all show poor growth in the 1970s / poor growth in late 1880s; [2 max]
- (ii) temperature (of the growing season) rises and falls over the years;  
amount of rainfall (in the growing season) rises and falls over the years;  
amount of sunshine / light (in the growing season) rises and falls over the years;  
reference to sunspot activity cycles;  
same area so similar climate / temperature / rainfall / light intensity / day length;  
same tree species; [2 max]  
*(Reject any reference to soils or other factors that could not fluctuate.)*
- (e) (i) positive correlation / the higher the latitude the better the growth; [1]
- (ii) negative correlation / the higher the latitude the less the growth; [1]
- (f) trees of other latitudes are less well adapted / evolved to the trial site's latitude;  
different conditions / climate / temperatures at different latitudes;  
light intensity / daylengths at the trial site are different from other latitudes; [2 max]
- (g) use seed from a local source / from same latitude (north or south); [1]

2. (a) (i) gas exchange / absorption of oxygen **and** removal of carbon dioxide; [1]
- (ii) asthma / emphysema / tuberculosis / lung cancer / bronchitis / cystic fibrosis / pneumonia; [1]  
(Reject smoking.)
- (b) soluble substance that can be converted to insoluble substance;  
converted to fibrin (in cuts);  
helps to form a **clot**;  
to seal a cut / prevent more blood loss / prevent entry of infection; [2]
- (c) helper T-cells are involved in the immune response / immunity;  
helper T-cells recognise / have receptors complementary to one specific antigen;  
helper T-cells are activated by antigen-presenting cells / this antigen;  
helper T-cells stimulate B-cells (complementary to the same antigen) to divide;  
by secreting cytokines / interleukins;  
helper T-cells activate macrophages / phagocytes which engulf pathogens;  
helper T-cells activate cytotoxic T-cells (which kill cells infected with viruses);  
helper T-cells stimulate B-cells to produce antibodies; [3 max]
3. (a) (i) (base) substitution / inversion of 2 / 3 bases; [1]
- (ii) translation / protein synthesis will stop before the end of the gene;  
incomplete / shorter / truncated polypeptide produced;  
polypeptide will not function properly / harmful effect / **possibly** fatal; [2 max]
- (b) recessive because two parents without the disease can have a child with the disease;  
such parents must be acting as carriers;  
quoted example from the pedigree chart; [2 max]
- (c) only sons / males are affected (which suggests sex-linkage);  
could be due to chance that only boys in the pedigree are affected / converse for girls;  
all males marrying into the family must be carriers if non-sex-linked; [2 max]
- (d) (i)  $\frac{(6 - 2.25)^2}{2.25}$   
= 6.25; [2]
- (ii) between 7.81 and 11.34 on the 3 degrees of freedom line;  
therefore there is a significant difference with over 95 % confidence /  
probability < 5%;  
the hypothesis that the disease is sex-linked is supported; [2 max]

**SECTION B**

4. (a) acrosome contains enzymes;  
acrosome releases its contents (by exocytosis);  
hyaluronidase / other named enzyme;  
zona pellucida loosened / broken down;  
acrosome reaction;  
many sperm needed to allow one to penetrate;  
head / sperm nucleus / sperm penetrates the egg membrane;  
cortical reaction;  
cortical granules released;  
zona pellucida hardened;  
other sperm prevented from entering;  
reference to fast and slow blocks to polyspermy; **[6 max]**
- (b) test strip dipped into urine;  
embryo produces HCG;  
HCG is present in the urine if the woman is pregnant;  
(monoclonal) antibodies detect / bind to HCG;  
(monoclonal antibodies have dye attached so) a colour change if the woman is pregnant; **[4 max]**
- (c) during exponential growth the population grows at an increasing rate;  
all / most / many offspring survive / birth rate higher than death rate;  
all / most / many offspring reproduce;  
each generation produces more offspring than the last;  
plateau reached eventually / population levels off / birth rate equals death rate;  
when carrying capacity of environment is reached;  
*e.g. when no more food / nutrients / resources available\**;  
*e.g. when no more space for nesting / space for another purpose is available\**;  
*e.g. when numbers of predators have increased\**;  
*e.g. when levels of parasites / diseases have become very high\**;  
transitional phase when limits to growth are starting to act;  
(\* for exponential growth phase, accept converse examples) **[8 max]**

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

5. (a) cell wall shown clearly and labelled;  
cell surface membrane shown thinner than and adjacent to cell wall and labelled;  
cytoplasm shown with no nucleus present and labelled;  
ribosomes shown free in the cytoplasm and labelled;  
loop of DNA shown in the cytoplasm / nucleoid and labelled as DNA;  
plasmid shown as a small loop and labelled;  
slime capsule shown as a layer outside the cell wall and labelled;  
mesosome shown as a membrane invagination and labelled;  
flagellum shown and labelled (*reject if shown with microtubules*). **[6 max]**
- (b) contain histones;  
eight histone molecules form a cluster in a nucleosome;  
DNA strand is wound around the histones;  
wound around twice in each nucleosome;  
(another) histone molecule holds the nucleosome(s) together; **[4 max]**
- (c) DNA replication is semi-conservative;  
helicase causes the double helix to unwind;  
helicase separates the two strands of the DNA molecule;  
hydrogen bonds between bases broken to separate the two strands;  
DNA polymerase attaches nucleotides;  
nucleotides are in the form of deoxynucleoside triphosphates;  
complementary base pairing / A only pairs with T and C with G;  
DNA polymerase III can only work in a 5' to 3' direction;  
on the lagging / 3' to 5' strand DNA replication occurs discontinuously;  
Okazaki fragments are formed on the lagging / 3' to 5' strand;  
DNA polymerase III cannot start a new chain of nucleotides;  
RNA primase inserts a RNA primer;  
DNA polymerase I replaces the RNA primer / nucleotides with DNA;  
DNA ligase seals the nicks between the nucleotides; **[8 max]**

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

6. (a) phospholipids labelled with hydrophilic (heads) and hydrophobic (tails);  
phospholipid bilayer clearly shown and labelled;  
proteins shown in the bilayer and labelled;  
transmembrane and peripheral / extrinsic proteins both shown and labelled;  
glycoproteins shown and labelled;  
cholesterol shown and labelled;  
glycolipids shown and labelled;  
thickness shown as 10 nm /  $\pm$  2 nm; **[5 max]**
- (b) diffusion (is a method of passive transport across the membrane);  
pore / channel proteins for facilitated diffusion / to allow hydrophilic particles  
across;  
movement from high to low concentration / down the concentration gradient;  
membrane must be permeable to the substance diffusing;  
oxygen / other named example of a substance that can diffuse through membranes;  
osmosis is movement of / diffusion of water through a membrane;  
from a region of lower to a region of higher solute concentration / higher to lower  
water potential;  
membranes are (nearly) always freely permeable to water; **[5 max]**
- (c) light is absorbed by chlorophyll;  
a species shares a common gene pool;  
electron in chlorophyll (in PSII) is excited / raised to a higher energy level;  
excited electron passes along a chain of carriers / is passed to an electron acceptor;  
electron transport causes pumping of protons (across the thylakoid membrane);  
proton gradient (generated) between inside and outside of thylakoids;  
protons pass (out of the thylakoid) through (a pore in) ATP synthetase;  
(energy released by) proton is used to synthesise ATP;  
electrons re-excited (in PSI);  
re-excited electrons passed to NADP;  
photolysis of water returns electrons to PSII;  
cyclic photophosphorylation involves only PSI; **[8 max]**

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

7. (a) autotrophs use an external / non-organic energy source;  
(*reject statements suggesting that energy is made*)  
(some) autotrophs use light / (some) autotrophs use photosynthesis;  
(some) autotrophs use inorganic chemical reactions / (some) autotrophs use chemosynthesis;  
heterotrophs obtain energy from other organisms;  
heterotrophs (usually) ingest food / consume food;  
saprotrophs obtain energy from non-living matter / dead organisms;  
saprotrophs digest organic matter extracellularly; **[6 max]**
- (b) binomial system;  
devised by Linnaeus;  
the first name is the genus name;  
the second name is the species name;  
genus name can be abbreviated;  
genus consists of a group of (closely related) species;  
upper case for first letter of genus name and the rest of the binomial is lower case;  
*Sequoia sempervirens* / other example;  
first published name is the correct one;  
local / colloquial names can be very confusing / helps international communication; **[4 max]**
- (c) a species is a group of organisms;  
a species shares a common gene pool;  
showing similar morphology / characteristics;  
capable of interbreeding;  
and producing fertile offspring;  
but dissimilar organisms sometimes interbreed;  
mule formed by crossing horse and donkey / other example of interspecific hybridisation;  
interspecific hybrids are sometimes fertile;  
sometimes organisms that are very similar will not interbreed;  
*Drosophila pseudoobscura* and *persimilis* / other example of sibling species;  
reference to the problem of defining fossil species;  
reference to the problem of species that only reproduce asexually;  
reference to the problem of isolated populations gradually diverging; **[8 max]**

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

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