

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 / ± 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.)
