

MARKSCHEME

May 2000

BIOLOGY

Higher Level

Paper 3

Option D — Evolution

- D1.** (a) humans have evolved most rapidly;
because they have the highest observed number of amino acid substitutions; [2]
- (b) chimpanzee highest with 1.7 per generation;
whereas only 1.6 in humans and 1.2 in gorillas; [2]
- (c) very stable as the mutation rate per nucleotide is very low;
but genome contains much DNA so the total rate per generation is high;
but over millions of years / long time periods there will be many mutations; [2]
- D2.** (a) large population;
random mating;
constant allele frequency / no natural selection;
no mutation;
no migration; [1 max]
- (b) to calculate allele frequencies if phenotype frequencies are known;
e.g. frequency of recessive allele is square root of frequency of recessive phenotype;
to calculate phenotype frequencies if allele frequencies are known;
to calculate genotype frequencies if allele frequencies are known;
quotation and use of Hardy equation to deduce genotype / phenotype frequencies; [3 max]
- D3.** (a) apparatus constructed in which chemicals could circulate;
gases of pre-biotic Earth's atmosphere mixed inside;
methane (as carbon source);
ammonia water vapour and hydrogen;
sparks / electric discharge (to simulate lightning);
high temperatures / boiling water;
no oxygen;
amino acids spontaneously formed;
example of other organic compound formed; [6 max]
- (b) experiments can simulate pre-biotic conditions;
can show what was / was not possible;
can give an indication of the likelihood of an event;
cannot prove what happened;
impossible to be certain what happened in the past; [4 max]

Option E — Neurobiology and Behaviour

- E1.** (a) pain sensed by receptors in the skin;
impulse passed along sensory neurone;
to the spinal cord / CNS;
passage through association neurone / neurones;
in grey matter;
impulse passed along motor neurone;
to muscles;
contraction of muscle pulls limb away from source of pain; **[6 max]**
- (b) benzodiazepine / valium / diazepam / Temazepan is an inhibitory psychoactive drug;
it relaxes (skeletal) muscle;
by enhancing the action of GABA;
cannabis causes relaxation / euphoria / enhanced awareness;
inhibitory psychoactive drugs may reduce anxiety / muscle tension;
inhibitory psychoactive drugs may be addictive; **[4 max]**
- E2.** (a) chemoreceptors and photoreceptors present;
colour vision / yellow and blue distinguished;
mango and lemon smells sensed / distinguished;
otherwise equal numbers of visits / same results for both smells; **[3 max]**
- (b) smell remembered after leaving first chamber;
colour and smell association remembered (between visits to the apparatus); **[2]**
- (c) conditioning / associative recall; **[1]**
- (d) bees look for a particular colour of flower after smelling it; **[1]**
- E3.** (a) sympathetic **and** parasympathetic; (*both needed for [1 mark]*) **[1]**
- (b) heart / arteries / digestive system / smooth muscles / salivary glands / iris / bladder; **[1]**
- (c) release of urine from bladder / relaxation of anus; **[1]**

Option F — Applied plant and Animal Science

- F1.** (a) (i) rise in carbon content with all three systems;
rise is higher in organic than non-organic;
rise is higher in the organic system with cattle than with legumes; *[2 max]*
- (ii) N-O is lower than O-B because decomposition rate is higher;
N-O lower than O-L because decomposition faster though addition faster also;
O-L lower than O-B because addition rate is greater; *[2 max]*
- (b) cause more carbon to be retained in the soil;
so reducing atmospheric carbon dioxide levels;
but a maximum soil carbon level might be reached;
the amounts retained are small in comparison to the atmosphere's content;
much more carbon would be retained in biomass in woodland; *[3 max]*
- F2.** food from cattle / sheep / chickens / other domesticated livestock examples;
ploughing / traction / power using oxen / horses;
transport using oxen / horses / donkeys;
clothing (using wool or fur) from sheep;
protection using dogs;
vermin control using dogs / cats;
guide dogs for the blind; *[3 max]*
- F3.** (a) pollination is transfer of pollen from anther to stigma;
by wind or insects / outside agents;
pollination precedes fertilisation;
fertilisation is fusion of male and female gametes;
male gamete transported in the pollen tube;
female gamete in the embryo sac / ovule fertilised by male gamete from pollen; *[4 max]*
- (b) cross breeding of different varieties;
pollen transferred from one variety to another;
self pollination prevented;
details of method of crossing;
progeny tested / evaluated;
artificial selection;
seed of best varieties retained and the rest discarded;
use of wild varieties with desirable characteristics;
polyploidy; *[6 max]*

Option G — Ecology and Conservation

- G1.** (a) oxygen is converted to water in respiration;
water to oxygen in photosynthesis;
oxygen from carbon dioxide converted to water in photosynthesis;
oxygen from water converted to carbon dioxide in respiration;
oxygen to ozone;
at lower levels due to car engines;
due to lightning / electrical discharge;
ozone formed spontaneously at high levels; *[6 max]*
- (b) chlorine causes conversion of ozone to oxygen;
CFCs cause ozone depletion;
use alternative to CFC for gas-blown plastics / refrigerator coolant;
collect CFCs from old refrigerators;
use fewer aerosols / alternative propellant;
ban manufacture of CFCs; *[4 max]*
- G2.** (a) positive correlation / more fruits with more insects; *[1]*
- (b) (i) fruit eating insects attracted to the fruits; *[1]*
- (ii) predatory insects attracted to attack fruit eaters; *[1]*
- (c) mutualism; *[1]*
- (d) ants prevent leaf damage;
more photosynthesis;
more materials available for fruit growth;
less damage to flowers / developing fruits;
ants might carry out some (self) pollination; *[3 max]*
- G3.** (a) 3 million to 50 million; *[1]*
- (b) tropical rainforest has more than tundra;
temperate forest has more than tundra but less than tropical rainforest; *[2]*

Option H — Further Human Physiology

- H1.** (a) (i) rate of bile flow increased by bile salt secretion; [1]
(ii) because bile salts draw water from liver cells by osmosis so increasing bile volume; [1]
- (b) after eating fatty foods; [1]
- (c) increases the rate of bile flow;
by the same amount whatever the rate of bile salt secretion; [2]
- (d) some bile flow even without secretin and with zero bile salt secretion;
extrapolated ‘without secretin’ line cuts the y-axis above zero;
some other solute must be drawing water into bile by osmosis; [2 max]
- H2.** (a) helps inflate the lungs when it contracts / increases thorax volume; [1]
- (b) stores oxygen in the muscles; [1]
- (c) causes more oxygen to be released in tissues with high CO₂ levels; [1]
- H3.** (a) microvilli in the part of the cell membrane exposed to the foods;
microvilli create large surface area;
many mitochondria to produce ATP;
ATP needed for active transport;
carriers in the cell surface membrane for active transport;
pinocytic vesicles for bulk uptake / endocytosis;
membrane-bound enzymes for completion of digestion before uptake; [6 max]
- (b) transport of fats;
from the digestive system;
to join the blood system in the vena cavae;
drainage of fluid from tissues;
removes excess fluid not reabsorbed into capillaries;
reference to the role in immunity; [4 max]
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