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MARKSCHEME

May 2001

BIOLOGY

Higher Level

Paper 3

14 pages

Option D – Evolution

D1. (a) 10.9 ± 0.1 cm / 4.33 ± 0.08 inches (*do not award the mark if size units are not given*); ***[1 max]***

(b) Similarity: both have jagged edges / rough edges / bits chopped off;
both about hand size (or slightly larger);
both have more rounded ends for holding;

Difference: Oldowan are (slightly) shorter;
Oldowan have a smooth unchipped end;
Acheulian are more pointed;
Acheulian have a bigger cutting edge / more carefully worked; ***[2 max]***

(c) (i) Acheulian because they appear more sophisticated / developed / finely worked;
(Award no marks just for 'Acheulian'.) ***[1 max]***

(ii) *Homo erectus* because they required more skill / intelligence to make / more complex brain; ***[1 max]***
(Award no marks just for 'Homo erectus' and no marks for arguing that Homo erectus was 'bigger brained', 'more evolved' or 'more recent'.)

(d) cultural *(do not accept 'non-genetic')*; ***[1 max]***

D2. (a) long periods where there was no (apparent) change / stasis;
short periods of rapid evolution;
periods of mass extinctions leading to opportunities / caused by environmental disruption / rapid environmental change in short periods;
supported by lack of fossils showing gradual changes;
an example of such environmental disruption (meteors, earthquakes, volcanoes, *etc.*);
alternative theory is gradualism;
punctuated equilibrium is based on fossil evidence rather than biochemical evidence; ***[3 max]***

(b) Herring gull – lesser black-backed gull / reindeer-caribou / plethodontid salamanders – California / great tit (in Eurasia); ***[1 max]***
(Check authenticity of other answers where possible – www.cs.colorado.edu has useful information.)

D3. (a) black variety of moth arose as a result of a mutation (in the light form);
called (balanced / transient) polymorphism;
black form caused by a dominant allele / frequency of black allele increases or decreases quickly (with environmental change);
black caused by production of melanin;
industrial pollution caused death of lichens on trees and rocks;
many buildings, rocks and trees became (about 150 years ago) blackened (by soot);
melanic variety became better camouflaged than light form / light form was originally better camouflaged;
resulted in less predation by birds;
black variety increased at the expense of the light variety / selection advantage;
as pollution decreased the lichens recovered and conditions favoured the light form;
light variety increased at the expense of the dark variety; ***[6 max]***

(b) proposed by Lamark;
no real substantial evidence;
example: if tail cut off rat – offspring still have tails;
relies on phenotypic inheritance not genotypic inheritance / somatic changes cannot be passed on / changes had to occur in sex cells, not the somatic cells;
cannot be repeated experimentally since very many generations would be necessary;
also mutations would have to be eliminated in such an experiment – impossible; ***[4 max]***

Option E – Neurobiology and behaviour

E1. (a) *(Note US names for transmitters, e.g. norepinephrine for noradrenaline.)*
pre-synaptic neurons are excitatory or inhibitory;
cholinergic neurons release acetylcholine;
found in neuromuscular junctions / most synapses in voluntary NS / many synapses in autonomic NS;
adrenergic neurons release noradrenaline;
found in sympathetic synapses (of ANS);
both types of neuron can be excitatory;
attach to postsynaptic receptors;
make membrane permeable to Na^+ which moves through / into / across postsynaptic membrane;
causes depolarisation;
monoamine oxidase 'destroys' noradrenaline and acetylcholine esterase 'destroys' acetylcholine;
other excitatory transmitters in brain – serotonin / dopamine / glutamic acid;
inhibitory neurons release transmitters that make postsynaptic membrane less permeable to Na^+;
cause hyperpolarisation of the membrane;
by allowing K^+ to diffuse out of postsynaptic membrane;
examples include glycine / gamma-aminobutyric acid / acetylcholine; ***[7 max]***

(b) light received by retinal cells / neurons / bipolar neurons / photoreceptor;
passed to optic nerve / cranial nerve II;
to visual cortex / relay neurons / internuncial neurons / intermediary neurons;
out via motor neurons / cranial nerve III / effector neurons / oculomotor nerve;
sympathetic neurons cause radial muscles to contract / pupil to enlarge;
parasympathetic neurons cause circular muscles to contract / pupil to reduce; ***[3 max]***

E2. (a) Group A because both (large and small) crabs have the opportunity to gain (from exchanging shells); ***[1 max]***

(b) (i) the greater the relative difference (in mass) the more knocks per fight; ***[1 max]***

(ii) the smaller crab could hide more easily in the large shell and so require more knocks; there is greater motivation for the larger crab to keep trying to get the smaller one out; ***[1 max]***

(c) relative mass difference;
time each fight took;
difference in strength of each crab;
difference in the sorts of shell occupied by the crabs;
whether the 'point' represented Group A or Group B; ***[2 max]***

(d) the advantage to be gained was low;
weaker crabs and so could only knock a few times; ***[1 max]***

E3. (a) (type of learning) where young form an attachment / association to an object / parent shortly after birth; ***[1 max]***

(b) investigated by (Konrad) Lorenz;
used (greylag) goose *(awarded if some indication of an imprinting experiment is given)*;
divided eggs into two batches / groups (A) on hatching saw mother first, group (B) on hatching saw Lorenz first;
group (A) goslings always followed mother, group (B) goslings always followed Lorenz; ***[3 max]***

Option F – Applied plant and animal science

F1. (a) too small to support many fleas / too young to have acquired many fleas;
do not produce reproductive hormones; ***[1 max]***

(b) fertile females have the greatest number of fleas;
more fleas in winter than summer;
males have fewer fleas than females; ***[2 max]***

(c) the hypothesis is supported;
rabbits in the 80 % sterile females group had fewer fleas;
young in the 80 % sterile females group had fewer fleas;
males in the 80 % sterile females group had fewer fleas;
needs testing to find out if it is statistically significant; ***[3 max]***

F2. (a) (i) the ratio between the total area of leaves of a plant and the area of soil available to it; ***[1 max]***

(ii) the (dry) mass of (part of) a plant that has commercial value; ***[1 max]***

(b) used to prevent infection of sperm used for artificial insemination;
added to feed to promote feed conversion;
added to feed to prevent certain diseases;
example of such a disease – mastitis;
can lead to development of resistant strains (that may also infect people); ***[2 max]***

F3. (a) raise levels of carbon dioxide in the atmosphere thereby increasing carbon fixation / photosynthesis;
raise temperature (where appropriate) to increase rates of carbon fixation / photosynthesis / reduce temperature fluctuations;
ensure sufficient levels of water are available;
control fertilisation / pollination;
decrease rates of infection / pests;
decrease competition from weeds;
can administer locally exact amounts of inorganic nutrients;
control light conditions; ***[4 max]***

(b) *(Award no more than **[4]** for responses all in favour or all against.)*
killing animals is wrong / killing causes pain and suffering in animals;
eggs from animals involve killing embryos (sometimes);
milk does not involve killing directly but cows must be made pregnant to get milk (– bull calves are killed);
religious reasons for not eating such products;
animals kept in captivity can suffer cruelties / normal behaviour of animals kept in captivity is prevented;
catching fish involves slow death of fish by suffocation;
but it keeps people in employment;
it is natural to eat animals and so it is OK;
religious reasons to eat such products;
some nutrients are necessary for children to grow and certain animal products are rich in them;
fishing causes incidental death of other animals / animal farming causes incidental extermination of other species;
certain cultures are traditionally reliant on animals as their only food source (*e.g.* Masai and Netsilic);
[6 max]

Option G – Ecology and conservation

G1. (a) indicator species are key organisms that can indicate the (abiotic) characteristics of an environment;
disappearance or appearance of an indicator species in a community signals environmental change;
example of indicator organism;
biotic index is relative or absolute scale of numbers / species;
species chosen for different tolerance levels;
example of biotic index and its use (*e.g.* water invertebrates and water pollution, lichen for air pollution, foraminifers for climatic change) *(N.B. do not allow Simpson's Index)*;
uses the presence or absence of indicator species;
uses the numbers of different species / diversity / species richness;
ecosystems under stress / polluted ecosystems have reduced diversity;
gender ratios / malformations of some species (*e.g.* amphibians) can indicate presence of toxic products;
these methods can be rapid but not precise;
they can be used to detect rapid changes;
but generally used to detect gradual changes / changes over time; ***[7 max]***

(b) *(Other legitimate answers are acceptable. The factor must be accompanied by a correct statement; a list of factors alone is not acceptable.)*
temperature;
water / freshwater / sea water / salinity / pH of water;
breeding sites / territory;
food supply; ***[3 max]***

G2. (a) Savanna; ***[1 max]***

(b) Desert; ***[1 max]***

(c) precipitation / rainfall since even at high temperatures where precipitation / rainfall is low productivity is low;
example: prairie / steppe or prairie / steppe versus tropical rainforest;
even when temperature low productivity can be relatively high;
example: temperate forest versus savannah; ***[2 max]***

(d) the higher the precipitation the more forest;
generally high precipitation is needed when the temperature is high / or reverse point;
forest is not found when the precipitation is very low (– whatever the temperature);
forest formation needs a mean annual temperature > -5 to 2 ºC;
forest formation needs a mean annual rainfall > about 250 mm. ***[2 max]***

G3. (a) very low concentrations / no oxygen / anaerobic conditions;
suitable humid conditions;
suitable temperatures to enable sufficient metabolism;
appropriate organic food source;
example: animal waste, plant material, organic acids;
Methanococcus / *Methanobacterium* / *Methanosarcina* / *Methanospirillum*;
(Reject 'suitable bacteria or bacteria or suitable organisms' – must be ***named*** *species.)* ***[3 max]***

(b) organic material → methanol + formic acid + carbon dioxide + hydrogen;
glucose → methane + carbon dioxide
$CO_2 + 4H_2 \rightarrow CH_4 + 2H_2O$;
$CH_3CH_2OH + H_2O \rightarrow CH_3COOH + 2H_2$;
$CO_2 + 3H_2 \rightarrow CH_4 + 2H_2O$;
(accept word equations) ***[1 max]***

Option H – Further human physiology

H1. (a) (i) 7.3 ± 0.3 MJ m^{-2} h^{-1}; ***[1 max]***

(ii) cool; ***[1 max]***

(b) *(Award **[2]** for a correct answer or correct calculation; deduct **[1]** if units incorrect.)*
1.8 ± 0.2 MJ; ***[2 max]***
(Do not award unit mark if MJ m^{-2} or MJ h^{-1} or MJ m^{-2} h^{-1} are stated.)

(c) *accept either:*
the higher the temperature the less the effects of wind speed;
the lower the temperature the greater the effects of wind speed;

or:
the higher the wind speed the greater the effect of temperature;
the lower the wind speed the lower the effect of temperature;
the effect of raising/lowering wind speed on wind chill is the inverse of the effect of raising/lowering temperature on wind chill. ***[2 max]***

H2. (a) lipid-soluble vitamins / A, D, E and K / retinol, calciferol, α-tocopherol, phylloquinone *(accept one of the four vitamins listed)*;
carbohydrate / glycogen;
vitamins B_{12} (cyanocobalamin) and folic acid;
iron (attached to protein / transferrin);
potassium and several trace elements as ions; ***[3 max]***

(b) negative feedback; ***[1 max]***
(Reject 'feedback' on its own.)

H3. (a) (in the mouth) salivary amylase breaks down starch into (polysaccharides and) maltose;
process called hydrolysis;
conditions slightly alkaline / neutral usually (pH 7.5);
in duodenum pancreatic juice secreted containing amylase;
conditions more alkaline (pH 7.5–8.8);
continues hydrolysis of starch / polysaccharides into maltose;
wall of the small intestine / duodenum / ileum / jejenum secretes more enzymes;
from tips of the microvilli;
including maltase which hydrolyses maltose to glucose; ***[6 max]***

(b) *(Award **[2]** each for outline of atherosclerosis -lines 1,2 and 3- and causes of coronary thrombosis -lines 4,5,6,7 and 8.)*
atherosclerosis – progressive degeneration of artery walls;
atheroma / lipids / cholesterol deposited on endothelium / wall;
fibrous tissue may also be laid down;
blood flow is impeded causing platelets to stick;
clotting factors may then be released;
a clot or thrombus may form;
if in coronary artery / arteriole flow of blood to part of heart muscle is reduced / stopped;
myocardial infarction / heart attack / cardiac arrest / heart failure; ***[4 max]***