

MARKSCHEME

May 2001

BIOLOGY

Higher Level

Paper 3

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 Lamarck;
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 °C;
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
 $\text{CO}_2 + 4\text{H}_2 \rightarrow \text{CH}_4 + 2\text{H}_2\text{O}$;
 $\text{CH}_3\text{CH}_2\text{OH} + \text{H}_2\text{O} \rightarrow \text{CH}_3\text{COOH} + 2\text{H}_2$;
 $\text{CO}_2 + 3\text{H}_2 \rightarrow \text{CH}_4 + 2\text{H}_2\text{O}$;
(accept word equations) [1 max]

Option H – Further human physiology

- H1.** (a) (i) $7.3 \pm 0.3 \text{ MJ m}^{-2} \text{ h}^{-1}$; [1 max]
(ii) cool; [1 max]
(b) (Award [2] for a correct answer or correct calculation; deduct [1] if units incorrect.)
 $1.8 \pm 0.2 \text{ MJ}$; [2 max]
(Do not award unit mark if MJ m^{-2} or MJ h^{-1} or $\text{MJ m}^{-2} \text{ h}^{-1}$ 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 B₁₂ (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 / jejunum 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]