



MARKSCHEME

May 2014

BIOLOGY

Higher Level

Paper 3

9 pages

Option D — Evolution

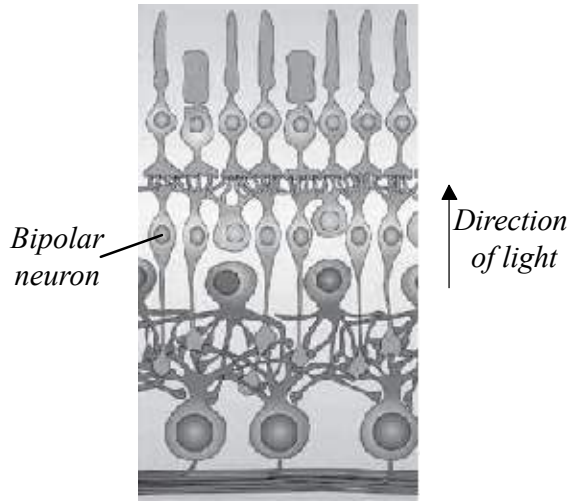
1. (a) Carboniferous [1]
- (b) 125 (families) (*accept answers in the range of 115 to 135 families*) [1]
- (c) reptiles, as mammals appeared before birds [1]
- (d) examined/compared fossils [1]
- (e) *punctuated equilibrium*
 evolution occurs in rapid bursts / interspersed by long periods of stability;
 very little change in number of mammal/bird families occurred during Cretaceous period;
 but large increase during the Tertiary period;
- gradualism*
 evolution occurs gradually;
 the number of amphibian/reptile families did not change much;
 number of families do not reflect what happens at species level / *OWTTE*; [3 max]
2. (a) comets / meteorites/meteors [1]
Do not accept asteroids.
- (b) self replicating;
 can act as catalysts;
 (store) genetic information; [2 max]
- (c) convergent as wings in both have similar function but different ancestral origin /
 are analogous structures [1]
- (d) constant ratio of ^{14}C to ^{12}C in organism's cells when alive;
 when they die this radioactive ^{14}C is converted to ^{12}C ;
 time for half the ^{14}C to decay is the half-life/5730 years;
 ratio of ^{14}C to ^{12}C allows calculation to be made of when organism died; [3 max]
3. (speciation is) the process by which new species arise;
 chromosome pairs fail to separate during meiosis;
 can lead to individuals/gametes with double/multiples of the normal chromosome number;
 polyploids may be well adapted to their environment;
 common in plants / named example of speciation by polyploidy;
 polyploidy is a form of sympatric speciation;
 leading to reproductive isolation from parent species;
 polyploid individuals can interbreed with one another;
 breeding with diploids/original species leads to infertile hybrids/individuals; [6 max]

Option E — Neurobiology and behaviour

4. (a) 350 seconds / 5 mins 50 seconds (*units required*) [1]
- (b) 50 cm (*units required*) (*accept answers between 47 cm and 53 cm*) [1]
- (c) the ant travelled further from nest to the food (than food to nest);
from nest to food took more time / ant travelled slower (than from food to nest);
journey from nest to food less direct/more changes of direction than from food
to nest; [2 max]
*Do not accept answers stating only numerical values without comparative
wording.*
- (d) (i) memorized direction / magnetic direction / sight/smell of nest [1]
Accept other valid suggestion.
Do not accept left a trail or scent.
- (ii) retrieved a (chemical) trail/scent / communicate with touch/smell [1]
Accept other valid suggestion.
- (e) can share work / division of tasks / become specialists / increased protection
(because of large numbers) [1]

- 5. (a) (i) correctly identified bipolar neuron [1]
- (ii) arrow pointing upwards [1]

eg.:



- (b) (i) amplify the sound (waves)/vibrations;
transmit sound across the middle ear; [1 max]
- (ii) sound/vibration/hair movement converted to nerve impulse [1]

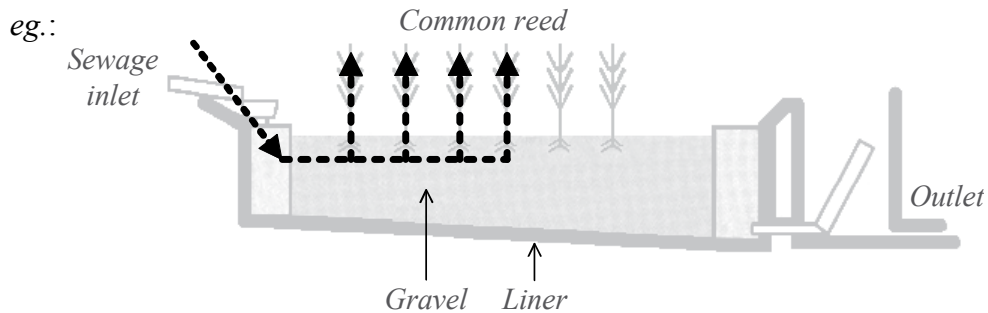
- (c) *innate behaviour*
innate behaviour present at birth/genetic;
young birds born with a crude template of songs (for their species) / *OWTTE*;
young birds kept in isolation from other birds do not develop proper songs;
- learned behaviour*
learned behaviour occurs after birth due to experiences/environment / *OWTTE*;
song refinement is learned from other birds / *OWTTE*;
during a sensitive period; [3 max]
- Award [2 max] if only one type of learning is mentioned.*

- 6. observe patients/animals with injuries/lesions to a specific part of the brain;
abnormal behaviour linked to lesion/specific brain stimulation;
eg. damage to the occipital lobes affects patients vision / other valid example;
neuroimaging tools/fMRI/EEG;
measures blood flow/glucose uptake/electrical activity in parts of brain during certain activities;
has advantage that studies are carried out on healthy individuals;
experiments may not be carried out on the brains of humans/are unethical;
experiments may be carried on animals but are unethical;
what applies to animals may not be applicable to humans; [6 max]

Option F — Microbes and biotechnology

7. (a) 87°C (units required) (accept answers in the range of 86°C to 88°C) [1]
- (b) as pH increases optimum growth temperature increases / directly proportional / positive correlation [1]
- (c) Archaea survive at a greater range of pH than the bacteria;
Archaea can survive at higher temperatures than the bacteria;
Archaea can survive at lower values of pH than the bacteria;
overlap in (optimum) temperature (for the two groups) between pH 5 to 7; [2 max]
- (d) there is some overlap between the values;
(overlap) occurs at approximate pH 5 to 7 / temperature about 75 to 88°C;
classification based on other features/DNA/metabolism not considered by the data; [2 max]
- (e) anaerobic environments / appropriate example [1]

8. (a) (i) clear annotation indicating movement from (inlet to) gravel bed to reed [1]



- (ii) decompose organic matter / release nitrates [1]

(b)

| | <i>photoautotroph</i> | <i>photoheterotroph</i> |
|----------------------|---------------------------------------|-------------------------|
| <i>energy source</i> | light | light; |
| <i>carbon source</i> | inorganic compounds / CO ₂ | organic compounds; |

[2]

Award [1] for a correct row or column.

- (c) methane / ethanol [1]
- (d) by means of a virus/vector the normal gene is injected/inserted into a cell/chromosome;
to replace the effect of a defective gene;
example of viral vector in gene } (treatment of SCID allowing the therapy;
production of enzyme ADA) [2 max]

9. *irradiation: [3 max]*

involves exposing microorganisms/bacteria to radiation/UV light which damages DNA;
kills bacteria / prevents growth of microorganisms/reproduction (depending on dosage);
may cause changes in taste/chemical composition of food;
can be used on both food and non biotic material (eg. glass, hospital equipment);
expensive / people may be reluctant to eat treated food;

pasteurization: [3 max]

involves heating (certain) food to a certain temperature for a specific amount of time /
example of temperature and time;
considered safer than irradiation;
kills most but not all bacteria / does not sterilize / slows down the decay of milk/food by
killing (some) bacteria;
heat resistant bacteria not killed;

[6 max]

Option G — Ecology and conservation

10. (a) decreased [1]
- (b) 64 (%) (*units not required*) (*accept answers in the range of 63 to 65 %*) [1]
- (c) there were more chicks/greater density of chicks as more eggs had hatched;
parasite also fed on rats but as there were fewer rats they fed more on chicks;
parasites could have been introduced after rat control / unknown whether there
were parasites before rat control; [1 max]
- (d) successful as more chicks survived compared with the previous year;
fewer eggs and chicks were eaten by predators;
parasites may cause more harm (than rats);
one year is a short time to predict whether the study was successful; [2 max]
- (e) loss of habitat;
loss of their food source/resources;
disease;
competition from other species;
change in climate patterns / other abiotic factor; [2 max]
11. (a) (total) dry mass of organisms;
(total) dry mass of organic matter in ecosystem(s); [1 max]
- (b) net production + respiration = gross production [1]
- (c) the quadrat positions are determined randomly within the area of the field;
the number of plantain plants in the quadrat is counted each time;
the area of the quadrat and the field are measured; (*both needed*)
apply a formula; [2 max]
- (d) species are living in their natural habitat;
they can receive sufficient resources/space;
relatively cheap to set up / easy monitoring / ecotourism / low maintenance;
bigger populations can be conserved / greater gene pool / more genetic diversity;
natural selection occurs normally;
other species are benefitted / no disruption of food chains/webs; [3 max]

12. provide habitat for other organisms / humans live in the rainforests;
absorb a lot of carbon dioxide from the atmosphere / produce oxygen;
rainforests are aesthetically pleasing to visit/inspirational;
provide food as part of food chain/web;
many humans rely on products of rainforests for survival;
may contain chemicals which will prove useful in the future (*eg.* medicines);
allows ecotourism which is of economic importance;
humans have the ethical responsibility to preserve all natural aspects of the planet;
all species have the right to live;

[6 max]

Option H — Further human physiology

13. (a) 50 minutes (*units required*) [1]
- (b) $4.7 \text{ mmol litre}^{-1}$ (*units required*) [1]
 Accept answers ranging between $4.6 \text{ mmol litre}^{-1}$ and $4.8 \text{ mmol litre}^{-1}$.
- (c) in the first 10 minutes/immediately after the meal they both have a significant drop;
 concentration of those fed human milk is normally less (than those fed cow milk);
 those fed human milk value never goes above normal but it does for those fed cow milk / *OWTTE*;
 rises in those fed cow milk in last 30 minutes but drops in those fed human milk;
 from 60 to 120 minutes those fed cow milk closer to normal; [2]
- (d) emulsifies fat / makes fats more soluble / allows fats to be digested [1]
- (e) human milk causes lower/more stable bile salt concentrations (than cow milk);
 could mean that fewer bile salts necessary to digest human milk;
 more fat is absorbed with human milk;
 suggests babies digest/absorb human milk better than cow milk; [2 max]
14. (a) initiate heart beat / (acts as) pacemaker [1]
- (b) enteropeptidase / enterokinase [1]
- (c) (initially) under nervous control due to the sight/smell of food;
 (later) presence of food stimulates hormone gastrin;
 gastrin stimulates production of acid/gastric juice; [2 max]
- (d) ADH is hormone responsible for regulating water content/osmoregulation;
 low water content/concentrated blood detected by osmoregulatory cells in the hypothalamus;
 this stimulates the release of ADH from the posterior pituitary gland;
 ADH increases the permeability of the collecting duct so more water reabsorbed;
 high water content/dilute blood stops/reduces secretion of ADH; [3 max]
15. (statement that) oxygen dissociation curve shows % saturation hemoglobin at different partial O_2 pressures;
 annotated diagram of shape of curve;
 (in respiring tissues) increase in CO_2 concentration lowers blood pH;
 shifts the oxygen dissociation curve to the right (is Bohr shift);
 lowers the affinity of hemoglobin for oxygen;
 means less oxygen can be carried for same partial O_2 pressure;
 oxygen dissociation curve steeper at lower P_{O_2} corresponding to respiring tissues;
 providing even more oxygen to (respiring) tissues;
 lungs have high P_{O_2} and hemoglobin is (almost) saturated / *OWTTE*; [6 max]