



MARKSCHEME

November 2014

BIOLOGY

Higher Level

Paper 3

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Option D — Evolution

1. (a) as nitrogen levels increase so does epidemic size / positive correlation /relationship [1]
- (b) increases in nitrogen means more food/phytoplankton (for *D. dentifera/Daphnia*); more food means a bigger *D. dentifera/Daphnia* population; a bigger *D. dentifera/Daphnia* population leads to more infection (by the parasite); [2 max]
- (c) high epidemic sizes associated with higher populations of *D. dentifera/Daphnia*; the greater the population of *D. dentifera/Daphnia*, the greater the possibility of variation/mutations in population; some of the variations may include greater resistance to the parasite; (resistant strains) have a greater chance of reproducing/produce more offspring; (leads to) selection in favour of resistant strains / death of non resistant strains; [2 max]
- (d) the resistant strains of *D. dentifera/Daphnia* will increase; predators eating the infected *D. dentifera/Daphnia* reduce the epidemic; the resistant strains of *D. Daphnia* lose their adaptive advantage; [2 max]
2. (a) fossils are rare / fossilization is rare; fossil record is incomplete / fossils may not be representative of the species; some parts of organisms do not fossilize / only part of organisms found; dating of fossils is only approximate / *OWTTE*; [2 max]
- (b) the half-life is the time taken for half the parent atoms to decay to the daughter atoms / *OWTTE* [1]
- (c) (i) 18 000 (y) (*allow answers in the range of 17 500 (y) and 18 500 (y)*) [1]
- (ii) there is very little carbon-14 left after 50 000 years / *OWTTE* [1]
- (d)
- | genetic | cultural |
|---|--|
| concerns genetic make up/DNA/genes /physical characteristics / <i>OWTTE</i> | concerns customs/language/tools /thinking / <i>OWTTE</i> ; |
| modified through natural selection/ transmitted through heredity/“nature” | modified/transmitted through learning/“nurture”; |
| passed to offspring | passed to kin (family)/social group/ population; |
| slow change | fast change; |
- [2 max]**

Award [1] for each valid distinction between genetic and cultural evolution.

3. a cladogram is (often) a tree-like diagram;
nodes/branches represent the splitting of (two) new groups
from a common ancestor/ nodes represent common ancestor;
members of a clade (above a node) evolved from a common
ancestor;
members of a clade share a set of features not found in more
distantly related species;
- (accept these
marking points on a
clearly annotated
diagram)
- classification was traditionally based on morphology;
morphology is still important in cladistics for fossil species;
cladistics is also based on molecular differences/base sequences/amino acid sequences;
cladistics is based on probability/the Principle of Parsimony/Occam's razor;
but improbable events do occur, so relationships can be wrong;
cladistics allow predictions to be made;
but a common ancestor may not have existed/diverging species may hybridize;
classification based on cladograms often give the same result as traditional classification;
in some groups cladograms have led to revised classification;

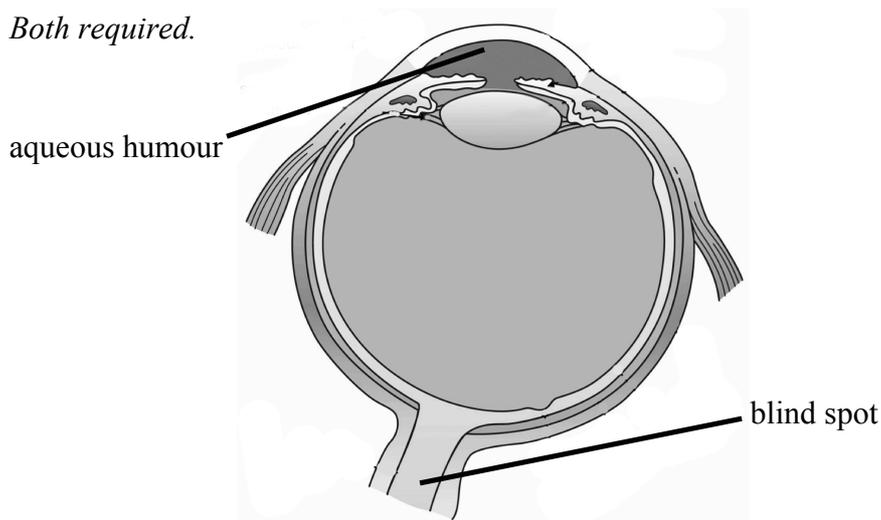
[6 max]

Option E — Neurobiology and behaviour

4. (a) using the waggle dance / *OWTTE*;
intensity of (waggle) dance indicates the distance of the food source;
the orientation of the (waggle) dance on the hive indicates the direction
relative to the position of the Sun; **[2 max]**
- (b) the expression of the gene in the scouts and the non-scouts is the same **[1]**
- (c) *Eaat-2* **[1]**
- (d) *GLT*: $(0.13 - 0.08 =) 0.05$;
OA: $(0.10 - 0.08 =) 0.02$; **[2]**
- (e) the expression of (neurotransmitter) genes that encourage scouting in bees vary;
those bees showing scouting behaviour will find more food sources;
the hive/bees will receive more food;
more offspring carrying the genes/alleles for scouting will survive;
the genes/alleles for scouting will increase in the population; **[3 max]**

5. (a) *Award [1] for each two correct and [1] for a correct sequence of three answers.*
receptor (cell) / named receptor cell;
sensory neuron;
relay neuron / interneuron;
motor neuron;
effector/appropriate example; (*eg: muscle*) **[3 max]**
Marks can be awarded for a clearly drawn correctly labelled diagram.

(b) *Both required.*



[1 max]

- (c) endorphins block the transmission of impulses at synapses involved in pain perception **[1]**

6.

<i>kinesis</i>	<i>taxis</i>
degree of movement (in no particular direction) / <i>OWTTE</i>	displacement towards/away from a stimulus / <i>OWTTE</i>
named invertebrate appropriate for the stated behaviour; (common names eg: meal worm, blow fly larva, accepted but must be precise eg: bug, maggot, insect are unacceptable)	
identify environmental condition/stimulus; (eg: light)	
identify <u>independent</u> and <u>dependent</u> variables as such;	
describe controlled variables; (eg: temperature or pH)	
appropriate apparatus providing necessary contrasting conditions;	
method to determine the <u>rate of movement/displacement</u> ;	method to determine the <u>direction of movement</u> ;
repeated method/measurements / sample size considered;	
control experiment / control group;	

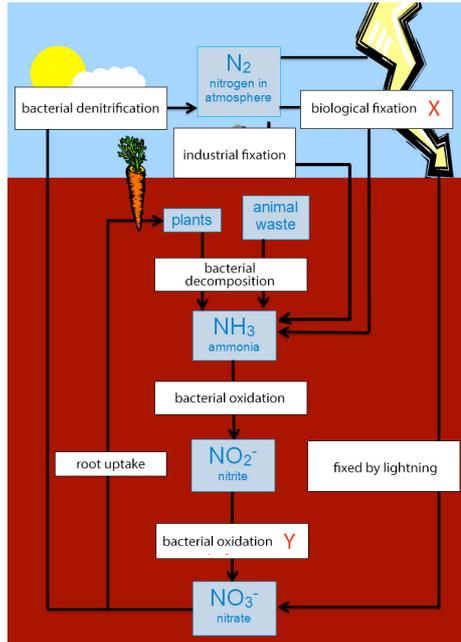
[6 max]

Award [5 max] if the behaviour being investigated is wrongly identified as taxis/kinesis or the organism is not an invertebrate.

Option F — Microbes and biotechnology

7. (a) 35 (*allow answers in the range of 30 to 40*) **[1]**
- (b) both diminish with (increased) depth;
the oxygen concentration shows less variation/has a clearer trend;
the oxygen consumption is lowest (on average) at 15 m but the oxygen concentration is lowest at 28 m;
both are exponential; **[2 max]**
- (c) (i) aerobic respiration;
chemoautotrophy; **[1 max]**
Do not accept photosynthesis.
- (ii) organic matter / organic carbon / dead organic matter/detritus falling from the surface waters;
mineral rich deposits available to chemoautotrophs; **[1 max]**
- (d) less diffusion of oxygen from water above sediments with depth/at 22 m / consumption proportional to oxygen available;
different species may have different consumption rates / swap between aerobic and anaerobic respiration / *OWTTE*;
more compact sediments at 22 m so less space for microbes; **[2 max]**
Accept converse arguments for conditions at 2 m.
Do not accept less microbes as it is oxygen consumption per cell.

8. (a)



(i) *X*: Accept answer on the line between N_2 and plant protein. [1]

(ii) *Y*: Accept answer on the line between NO_2^- and NO_3^- . [1]

(b) starch (must be) first hydrolysed (to sugar/maltose) by amylase;
Saccharomyces/yeast then (breaks down) sugars to ethanol/
 alcohol and CO_2 ; } (both needed)
 by fermentation / anaerobic cell respiration; [2 max]

(c) (i) catalyses the production of (single-stranded) DNA from RNA [1]

(ii) retrovirus / HIV / RNA virus [1]
 Accept the first answer given by the candidate.

(d) lipopolysaccharides causing fever and aches;
 found in walls/outer membrane of Gram-negative bacteria; [1 max]

9. methane gas is produced by methanogens/*Methanococcus*/*Methanobacterium*;
 (methanogens are) chemoautotrophs;
 biomass/sewage/wood pulp/manure added to the fermenter/digester;
 anaerobic conditions/absence of oxygen required;
 require warm conditions to work best/an optimum temperature of $35^\circ C$ /
 (methanogens) are thermophiles;
 optimum pH of 6.5 to 8/neutral/slightly alkaline pH needs to be maintained;
 methanogens need to be associated with decomposers/heterotrophic bacteria;
 some bacteria digest/ferment organic waste (biomass) into organic acids and alcohol;
 other bacteria convert organic acids/alcohol into acetate, carbon dioxide and hydrogen;
 (methanogens) produce methane from CO_2 and H_2 /the breakdown of acetate /
 $CH_3COO^- + H^+ \rightarrow CH_4 + CO_2$ *or* $4H_2 + CO_2 \rightarrow CH_4 + 2H_2O$;
 the biogas produced consists of about 60% CH_4 ; [6 max]

Option G — Ecology and conservation

10. (a) 48 (%) (*allow answer in the range of 40 (%) to 49 (%)*) [1]
- (b) Greenland chicks are fed more *C. hyperboreus* (than the Spitzbergen chicks);
 Spitzbergen chicks are fed more *C. glacialis* (than Greenland chicks);
 more “other prey” for Greenland chicks and more *C. finmarchicus* for
 Spitzbergen chicks; [2 max]
*Do not accept answers quoting only numerical values from graphs without any
 other statement.*
- (c) 155 individuals m⁻³ (*allow answers in the range of 150 to 155 individuals m⁻³*) [1]
- (d) there is very little *C. hyperboreus* so they choose to feed on the next highest
 energy source/*C. glacialis* / *OWTTE*; [1]
- (e) in cold waters (off Greenland) *C. hyperboreus* is more abundant;
 in warmer waters (off Spitzbergen) *C. hyperboreus* is rare but *C. finmarchicus*
 is very abundant;
C. hyperboreus provides more energy than *C. finmarchicus*/*C. glacialis* / chicks
 fed on *C. hyperboreus* receive more energy than those fed on *C. finmarchicus*/
C. glacialis;
 (therefore) in cold waters chicks receive more energy in their food;
 (therefore) in areas where there is cold water the chicks will/should grow more
 quickly; [3 max]
11. (a) captive breeding/zoos/aquariums;
 botanical gardens;
 seed banks; [2 max]
- (b) maximum sustainable yield is the largest yield that could be taken without
 harming the population size / *OWTTE*;
 aims to target the exponential phase of the population growth curve / half of
 the carrying capacity;
 harvesting/fishing should balance recruitment/survival/natality/birth rate;
 used to establish quotas/regulation; [2 max]
- (c) pioneer community/early stages has low diversity;
 as the community develops the diversity will increase;
 competitor community/intermediary stage has higher diversity;
 climax community/late stages has highest diversity; [2 max]
12. valid name of species; (*eg: rabbits*) (*accept common names*)
 location/statement of the problem; (*eg: Australia or devastation of farmland*)
 type of release; (*deliberate/controlled release/originally farmed*)
 increases stress on the environment / upsets the food chains/webs;
 no natural limiting factors of the species / predators/diseases absent;
 alien species population increases exponentially;
 competes with local species for resources;
 valid example of affected species;
 method to control invader; (*eg: rabbits in Australia by myxomatosis*)
 may lead to extinction of local species / reduces species diversity; [6 max]
*If more than one example given, mark all and annotate the example gaining the
 most marks.*
Award [3 max] if no specific example is given.

Option H — Further human physiology

13. (a) platelets stick together/stick to blood vessel walls during a thrombosis;
platelets release clotting factors; **[1 max]**
- (b) BMI;
genetic risk;
non-smokers;
sex;
age;
other relevant factor; **[2 max]**
- (c) -34 (%) (*minus required*) (*allow answers in the range of -32 (%) to -36 (%)*) **[1]**
- (d) both decrease in the period from before to during the games } (*both needed*)
and rise again afterwards; }
sCD62P falls and rises more than sCD40L / mean change higher for sCD62P
than sCD40L;
sCD40L has proportionally greater error bars/shows more variation than sCD62P; **[2 max]**
- (e) *hypothesis supported: [2 max]*
three of the markers / sCD62P, sCD40L and von Willebrand factor decrease as
the air pollution decreases;
three of the markers/sCD62P, sCD40L and fibrinogen increased as air pollution
increased after the games;
- hypothesis not supported: [2 max]*
fibrinogen levels did not change with decreased air pollution;
von Willebrand factor remained low after the games;
uncertainty in the data shown by error bars;
the study is not a controlled experiment / the changes could be influenced by
other factors; **[3 max]**

14. (a) *II.* (branch of) hepatic artery;
III. (branch of) hepatic portal vein; } *(both needed)* *[1]*
- (b) CO₂ reacts with water in red blood cells/erythrocytes to form H⁺ and HCO₃⁻/
 bicarbonate/hydrogen carbonate ions;
 HCO₃⁻/bicarbonate/hydrogen carbonate ions diffuse/move out of red blood
 cells/ erythrocytes;
 Cl⁻/chloride ions diffuse/move from plasma into red blood cells/erythrocytes; *[2 max]*
Do not accept mechanisms other than diffusion.
- (c) diffusion through cell membrane of fat soluble molecules (*eg:* vitamin A)/
 fatty acids/monoglycerides;
 absorption of lipids/triglycerides by pinocytosis/micelles binding with lipid
 bilayer of the cell membrane;
 facilitated diffusion of water/minerals/fructose through pore channels;
 active transport linked to (Na⁺/K⁺) pump protein of amino acids/glucose/
 galactose/certain minerals/water soluble vitamins;
 endocytosis of vitamins (*eg:* vitamin B₁₂)/hemoglobin; *[2 max]*
15. both/pepsin and trypsin are proteases/proteolytic enzymes;
 both/pepsin and trypsin are synthesized as inactive pro-enzymes/precursors to prevent
 auto-digestion;
 both/pepsin and trypsin hydrolyse peptide bonds of proteins/peptides in food to form
 shorter chains of amino acids/peptides;
- pepsin: [3 max]*
 pepsin is synthesized as inactive (pro-enzyme) pepsinogen;
 in the chief cells of (the gastric pits of) the stomach;
 pepsinogen is secreted into the stomach lumen (where the food is);
 it is transformed into active pepsin by freeing the active site;
 activation is brought about by HCl (and pepsin itself);
- trypsin: [3 max]*
 trypsin is synthesized as inactive (pro-enzyme) trypsinogen;
 in the pancreas exocrine cells/acini;
 trypsinogen travels to the small intestine/duodenum lumen (where the food is);
 trypsinogen is activated by enteropeptidase/enterokinase (and active trypsin itself in the
 duodenum); *[6 max]*
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