



# **MARKSCHEME**

**November 2014**

**BIOLOGY**

**Higher Level**

**Paper 3**

11 pages

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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;

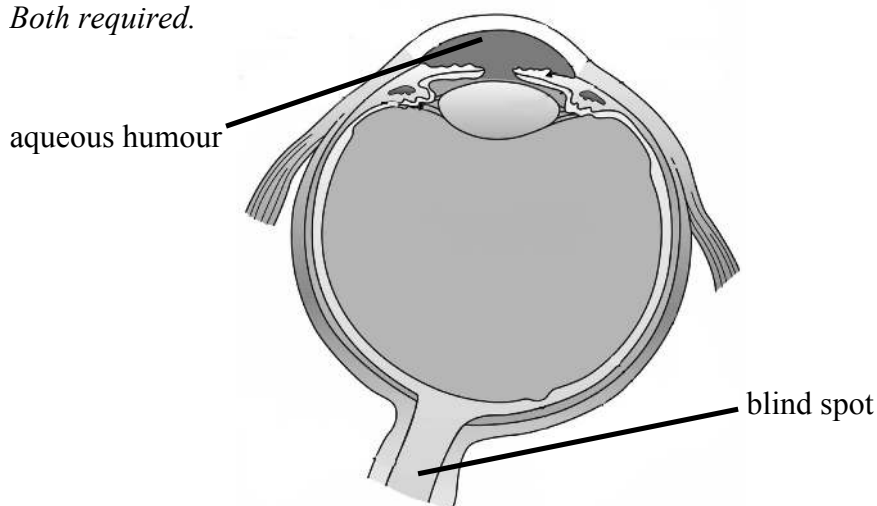
[6 max]

**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;	

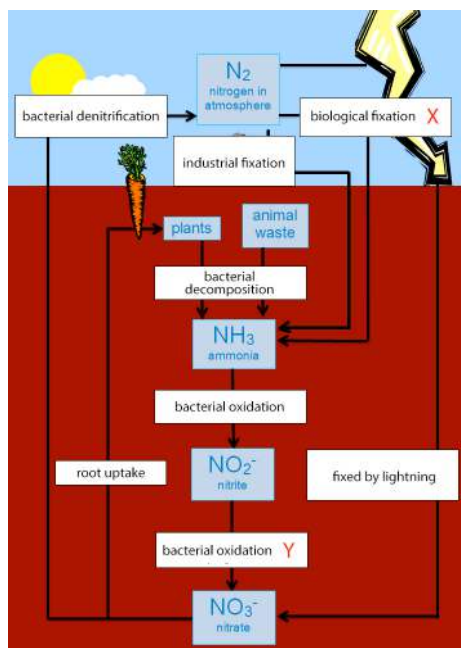
[6 max]

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<sup>-3</sup> (*allow answers in the range of 150 to 155 individuals m<sup>-3</sup>*) [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) CO<sub>2</sub> reacts with water in red blood cells/erythrocytes to form H<sup>+</sup> and HCO<sub>3</sub><sup>-</sup>/  
 bicarbonate/hydrogen carbonate ions;  
 HCO<sub>3</sub><sup>-</sup>/bicarbonate/hydrogen carbonate ions diffuse/move out of red blood  
 cells/ erythrocytes;  
 Cl<sup>-</sup>/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<sup>+</sup>/K<sup>+</sup>) pump protein of amino acids/glucose/  
 galactose/certain minerals/water soluble vitamins;  
 endocytosis of vitamins (*eg:* vitamin B<sub>12</sub>)/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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