



MARKSCHEME

November 2013

BIOLOGY

Higher Level

Paper 3

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Subject Details: Biology HL Paper 3 Markscheme

Mark Allocation

Candidates are required to answer questions from **TWO** of the Options [**2 x 20 marks**].

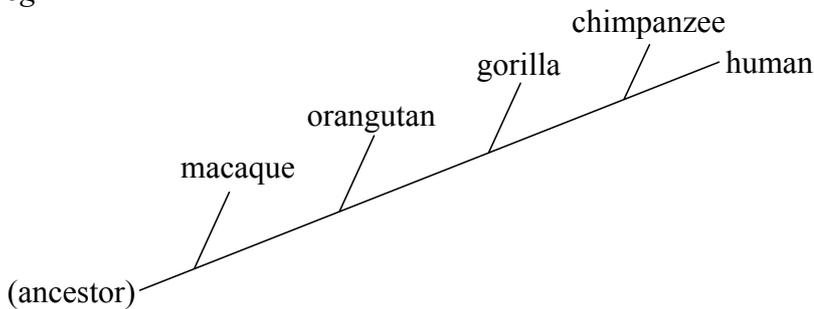
Maximum total = [**40 marks**]

1. A markscheme often has more marking points than the total allows. This is intentional.
2. Each marking point has a separate line and the end is shown by means of a semicolon (;).
3. An alternative answer or wording is indicated in the markscheme by a slash (/). Either wording can be accepted.
4. Words in brackets () in the markscheme are not necessary to gain the mark.
5. Words that are underlined are essential for the mark.
6. The order of marking points does not have to be as in the markscheme, unless stated otherwise.
7. If the candidate's answer has the same "meaning" or can be clearly interpreted as being of equivalent significance, detail and validity as that in the markscheme then award the mark. Where this point is considered to be particularly relevant in a question it is emphasized by **OWTTE** (or words to that effect).
8. Remember that many candidates are writing in a second language. Effective communication is more important than grammatical accuracy.
9. Occasionally, a part of a question may require an answer that is required for subsequent marking points. If an error is made in the first marking point then it should be penalized. However, if the incorrect answer is used correctly in subsequent marking points then **follow through** marks should be awarded. When marking indicate this by adding **ECF** (error carried forward) on the script.
10. Do **not** penalize candidates for errors in units or significant figures, **unless** it is specifically referred to in the markscheme.

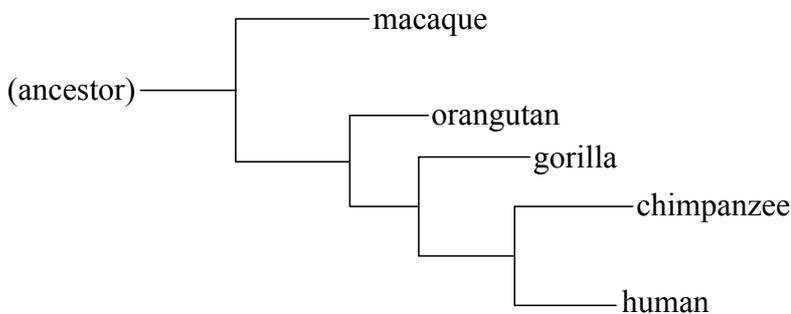
Option D — Evolution

- 1. (a) (i) 133 *(accept answers in the range of 132 to 134)* **[1]**
- (ii) 18 SDs per Myr *(accept answers in the range of 17 to 19 SDs per Myr)*
(units required.) **[1]**
- (b) increase after divergence (from 18 to 55 SDs per Myr);
further increase when diverged from gorilla;
decrease when diverged from chimps; **[2 max]**
- (c) these SDs occurred between the divergence of gorillas and the divergence of
chimpanzees;
this period was a shorter time than the others;
some SDs lost again/deleted (after split from gorilla); **[2 max]**
- (d) same SDs occurred (independently) in both humans and gorillas;
deletion of the SDs in chimpanzees; **[1 max]**
- (e) correct sequence of divergence must be shown **[1 max]**
(Distance between boundaries is not relevant. Accept straight line diagram or u-shaped cladogram.)

eg



or



2. (a) balanced polymorphism [1]
- (b) $2pq = (2)(0.98)(0.02) = 0.039$; [2]
 3.9 %;
Award [1] for working and [1] for correct answer.
- (c) gene pool is all of the genetic information/genes/alleles present (in an interbreeding population);
 allele frequency is the proportion of one allele of one/CF gene in a population; [2]
- (d) large population size;
 no immigration or emigration;
 no mutation(s);
 random mating;
 no selective advantage/disadvantage from gene; [1 max]
Mark only the first answer if more than one provided.
3. all organisms use DNA as genetic material;
 same four (nucleotide) bases makes up DNA in all organisms;
 number of mutations reflect differences between organisms;
 all organisms use the same genetic code / minor differences;
 genetic code is degenerate/*OWTTE*;
 all organisms use the same 20 amino acids;
 function of proteins constant between species;
 protein/molecule examples; (*eg hemoglobin, cytochrome, chlorophyll*)
 only left-handed amino acids have been observed in living organisms;
 although right-handed amino acids will have been available;
 only right-handed glucose/carbohydrates used in organisms;
 similarities in glycolysis/metabolic pathways;
 all use RNA/same enzymes in transcription/translation; [6 max]

Option E — Neurobiology and behaviour

4. (a) occasional [1]
- (b) both (identical and non-identical twins) show lower percentages going from occasional to abuse to dependence;
 at every stage, the percentage is higher for identical twins;
 non-identical twins percentage drops to zero for dependence (but identical twins does not);
 difference is similar for both groups between abuse and dependence;
 sharper decrease between occasional and abuse for non-identical twins than identical twins/*OWTTE*; [3 max]
Do not accept answers stating numerical values only
- (c) hypothesis supported as identical twins are more likely to behave the same for abuse and dependence than non-identical twins;
 identical twins have the same genotype / *OWTTE*;
 hypothesis not supported as environment is the major factor for trying cocaine;
 not known if similar results may be due to similar environment;
 not enough data for valid statistical analysis/*OWTTE*; [3 max]
5. (a) X: cerebellum;
 Y: medulla oblongata; } *(both needed)* [1]
Accept pons/brain stem in place of medulla oblongata
- (b) functional magnetic resonance imaging / fMRI [1]
Accept FMRI.
- (c)
- | <i>characteristic</i> | <i>rod cells</i> | <i>cone cells</i> |
|----------------------------------|--|------------------------------------|
| <i>location</i> | (all along the) retina | in fovea; |
| <i>light intensity detected</i> | dim | bright; |
| <i>connection to optic nerve</i> | group of rod cells to single nerve fibre | single cone to single nerve fibre; |
- [3]
- Award [1] for each correct row.*
- (d) conditioned reflexes in humans;
 variations between humans;
 need large numbers of subjects;
 ethical/legal considerations; [2 max]

6. plays a (major) role in mate selection / select male based on exaggerated trait;
can be hindrance to survival;
development of exaggerated traits represents expenditure of time/energy;
trait represents reproductive fitness / shows that the male is well-adapted;
more likely to mate and produce offspring;
trait is genetic / passed on to offspring;
trait is subject to natural selection / leads to greater exaggeration of trait;
example of species with exaggerated trait;
description of the trait in the example given;

[6 max]

Option F — Microbes and biotechnology

7. (a) 12 (*accept (day) 13, 7th May or 8th May as alternatives.*) [1]
- (b) 280 (*accept answers in the range of 270 to 290*) [1]
- (c) (31-25=) 6 (*accept answers in the range of 5 to 7*) [1]
- (d) (i) first incidence of locally infected cases before day 14/on day 12;
progression irregular/correct example given;
rapid increase after 42 days; (*accept 40 to 46 days.*) [2 max]
- (ii) misdiagnosis / non-symptomatic / isolation / longer incubation period [1]
Accept any other logical response.
- (e) starts in one country / spreads from country to country;
one person required to start cycle (in one country);
takes time to diagnose/recognize;
spreads rapidly/exponentially / requires early medical intervention;
international travel increases spreading to multiple countries / *OWTTE*;
need for international cooperation; [3 max]
8. (a) acid/lemon/vinegar lowers pH (thus) inactivating enzyme activity;
inhibit growth of microorganisms/bacteria; [2]
- (b)

<i>process</i>	<i>organism</i>
<i>wine production</i>	<i>Saccharomyces</i> ;
<i>nitrogen fixation</i>	<i>Azotobacter / Rhizobium</i> ;

 [2]
- Award [1] for each correct row.*
- (c) an organism that uses energy from chemical reactions to generate ATP and obtain organic compounds from other organisms [1]
9. (it catalyses) the production of DNA from RNA;
transcribes single stranded RNA into single-stranded DNA/cDNA;
make DNA/cDNA from mature mRNA/mRNA without introns;
found in retroviruses;
example of retrovirus; (*eg HIV / polio*)
used to isolate and identify genes;
used to analyse gene expression;
used in production of proteins;
RNA and reverse transcriptase enter the host cell, injected by the virus;
RNA of virus integrates into nuclear DNA of the host cell via transcribed DNA; [6]

Option G — Ecology and conservation

10. (a) (i) 9.85°C (*accept answers in the range of 9.75° C to 9.95° C units required*) [1]
- (ii) 152 000 tonnes } (*accept answers in the range of 150 000 tonnes to 155 000 tonnes units required*) [1]
- (b) (rapid) increase between 1960 and 1970;
decrease from 1970 to beyond 2000/2002;
brief reversal/slight increase between 1981 and 1982; [2 max]
- (c) *Evidence supporting the prediction*
biomass trend declines as temperature trend increases / negative correlation from mid-'80s;
- Evidence not supporting the prediction*
no correlation between (finer) fluctuations in sea temperature and biomass between 1960 and mid-'80s;
peaks in sea temperature in 1960, 1990 and 2000 at same level with different biomass;
dip in both curves at the end of '70s;
significance hard to demonstrate without statistical tools/*OWTTE*; [3 max]
- (d) overfishing / predation / availability of the food / pollution / disease [1]
Mark only the first answer if more than one provided
11. (a) the total (dry) mass of living organisms/organic material in a given area/ecosystem [1]
- (b) (i) primary succession [1]
- (ii) soil develops as lava/rock weathers/breaks down/erodes;
organic material/soil accumulates from (autotrophic) bacteria/ lichens/mosses;
(gross productivity/biomass increases as) small plants are replaced by larger plants;
development of plant communities support higher trophic levels;
more soil allows for detritivores;
succession increases species diversity / climax community established; [4 max]

12. Award [1] for one argument for each of the following aspects:
- identification/monitoring of tiger populations;
 - creation of *in situ*/nature reserves;
 - provision of corridors between nature reserves;
 - hunting/poaching;
 - development of ecotourism;
 - impact on local economy;
 - ban on tiger products trade / development of synthetic alternatives;
 - increase of public awareness;
 - need for international cooperation/funds to implement measures;
 - ex situ*/captive breeding programs;
 - extraction of DNA for gene bank;

Option H — Further human physiology

13. (a) $\left. \begin{array}{l} \text{concentration of cholesterol: } 11 \text{ mg g}^{-1}; \\ \text{mass of bile salts: } 12 \text{ mg day}^{-1}; \end{array} \right\} \begin{array}{l} \text{(accept answer in the range of } 10.5 \text{ mg g}^{-1} \\ \text{to } 11.5 \text{ mg g}^{-1}) \\ \text{(accept answers in the range of } 11.5 \text{ mg day}^{-1} \text{ to} \\ 12.5 \text{ mg day}^{-1}) \end{array} \quad [2]$
Units are required.

(b) $19 - 11 = \frac{8}{11} = 73(\%) \quad \text{(accept answers in the range of } 72.7(\%) \text{ to } 81.0(\%)) \quad [1]$

- (c) supplementation decreases liver cholesterol in high cholesterol diet;
 not enough to bring it to the level of a normal diet;
 no difference between *L. plantarum* and *L. fermentum* in the decrease of liver cholesterol;
 supplementation increases bile salts levels;
 greater increase in bile salts levels with *L. plantarum* / lesser/(perhaps)
 non-significant increase with *L. fermentum*; [2 max]

- (d) *Evidence for hypothesis:*
Lactobacillus/supplements lower liver cholesterol (in high cholesterol diet) which is a risk factor for CHD;
Lactobacillus/supplements increase bile salts in feces which implies some cholesterol may be eliminated;

- Evidence against hypothesis:*
 not known if cholesterol ends up in blood instead thus increasing risk for CHD;
 no data about benefit for normal diet/actual decrease of incidence of CHD;
 data/results based on rat experiments / may not apply to humans;
 WTTE of taking into account difference in bile salt level between *L. fermentum* and *L. plantarum*; [3 max]

14. (a) I. villus;
 II. longitudinal (smooth) muscle; } *(both needed do not accept microvilli)* [1]

(b) facilitated diffusion;
 substance moves from high to low concentration/ down concentration gradient;
 protein channels needed;
 does not require ATP/energy / passive;
 valid example; *(eg amino acids / glucose / fructose / water soluble vitamins)* [3 max]

or

active transport;
 substance moves from low to high concentration / against concentration gradient;
 membrane pumps needed / Na/K pump, Ca⁺⁺;
 ATP/energy required;
 valid example; *(eg amino acids / glucose / mineral irons / iron)*

or

endocytosis/pinocytosis;
 droplets of intestinal fluid surrounded by membrane;
 forms vesicle;
 vesicles are released inside villus cell;
 valid example; *(eg fat soluble vitamins)*
Accept appropriate diagram.

(c) finalize digestion *(eg disaccharides to monosaccharides)*;
 enzymes immobilized in plasma membrane of epithelial cells / on surface of villi/microvilli;
 remain functional for longer time than free floating enzymes / *OWTTE*;
 product in right place for absorption / absorbed immediately;
 valid example of enzyme; *(eg maltase, lactase, sucrase)*; [2 max]

15. control of ADH secretion by negative feedback;
 ADH controls water reabsorption in kidney;
 osmoreceptors in hypothalamus monitor water content (in blood);
 ADH produced by neurosecretory cells in the hypothalamus;
 transported (down axons of these cells) to the posterior pituitary;
 low water content/high solute concentration in blood ((usually) causes action potential to be sent to posterior pituitary);
 posterior pituitary releases ADH which travels to collecting ducts of kidney;
 more water reabsorbed (by collecting ducts) making water content (of blood) higher/solute concentration lower;
 less ADH released; [6 max]