



MARKSCHEME

November 2013

BIOLOGY

Standard Level

Paper 3

15 pages

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Subject Details: Biology SL Paper 3 Markscheme

Mark Allocation

Candidates are required to answer questions from **TWO** of the Options [**2 x 18 marks**].
Maximum total = [**36 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 A — Human nutrition and health

1. (a) (i) Asian [1]
- (ii) 11.5 (%) (*allow answers in the range of 11 (%) to 12 (%)*) [1]
(NOTE: question is worded awkwardly but if students give both 24.5 % and 11.5 % do not give credit)
- (b) all ethnic groups show range (very high, high and normal) of albumin levels;
 greatest frequency of very high levels of albumin found in Pacific Islander patients/
 European ancestry patients have lowest frequency of very high levels of albumin;
 greatest frequency of high levels of albumin in Indigenous Australian/European ancestry patients /
 lowest frequency of high levels of albumin in Pacific Islander patients;
 European ancestry patients have highest frequency of normal levels of albumin /
 Indigenous Australian/Pacific Islander patients have lowest frequency of normal levels of albumin; [3 max]
- (c) European ancestry patients have highest/higher frequency of kidney failure but more than half/a large percentage have a normal level of albumin;
 Indigenous Australian patients have lower frequency of kidney failure but higher levels of albumin;
 it would be better to test for both kidney failure and albumin levels; [2 max]
2. (a) (i) synthesized/made in the body (from other nutrients) [1]
- (ii) *Award [1] for any two consequences.*
 weight loss;
 anemia;
 depression/anxiety disorders;
 abdominal distension;
 hair loss/thinning;
 flaky skin;
 cessation of menstrual cycle / other hormonal imbalance;
 death; [1 max]
- (b) *causes:* genetic/inherited (homozygous recessive) disorder / mutation in (gene for) enzyme that converts phenylalanine into tyrosine / lack of phenylalanine hydrolase/PAH;
consequences: phenylalanine converted to phenylketone / mental retardation / brain damage / seizures;
treatment: low-phenylalanine diet / example of substances that cannot be eaten;
(eg any food containing protein / aspartame) [3 max]

3. (a) fatty acids share a common structure but differ in the total number of carbon atoms in the chain;
saturated fatty acids have no double bonds between carbon atoms;
unsaturated have double bond(s);
monounsaturated have one double bond / polyunsaturated have more than one double bond;
cis fatty acids have adjacent hydrogen atoms on same side of double bond and *trans* have them on opposite side;
(accept annotated diagrams)

[3]

- (b) cholesterol is a steroid found mainly in animal products;
it builds up in the walls of arteries / causes clogging/narrowing/blockage of artery / atherosclerosis;
lowering its ingestion may lower the probability/ risk of coronary heart disease/CHD;
cholesterol can be synthesized by the liver;
factors other than diet can affect levels of cholesterol / genetic factor more important than diet;

[3 max]

Option B — Physiology of exercise

4. (a) maximal heart rate decreases with age **[1]**
- (b) VO₂ max decreases with age in both;
endurance-trained have greater rates of decline than sedentary women;
(at any age) VO₂ max was higher in the endurance-trained compared with the
sedentary women; **[2 max]**
- (c) exercise reduces maximal heart rate (at all ages);
because stroke volume increases / thickness of heart wall and volume of ventricles
increase; **[2 max]**
- (d) whole age range;
heart rate lowered / aerobic capacity increased / VO₂ max increased;
less effective after age 60 years; **[2]**
5. (a) I: humerus; } *(need both)* **[1]**
II: cartilage;
- (b) I: insertion/anchorage for attachment of muscle / acts as lever;
II: decrease friction / acts as a cushion/shock absorber; **[2]**
- (c) dislocation / tendonitis / fracture / torn ligament / arthritis / torn muscle / sprain **[1]**
Do not accept common terms eg tennis elbow.

6. (a) (i)

feature	fast fibre	slow fibre
blood supply	moderate/low	abundant;
myoglobin	scarce	abundant;
cell respiration	anaerobic	aerobic;
stamina	low	high;
type of exercise used in	high intensity / sprint / weightlifting / other example	endurance / marathon / cross-country skiing / other example;
strength	higher	lower;

[2 max]

Responses do not need to be shown in a table format. Award [1] mark for each row.

- (ii) both anaerobic and aerobic are used depending on the intensity of the exercise;
as intensity increases more anaerobic / at low intensity more aerobic;
creatine phosphate used for brief bursts of intense exercise;

[2 max]

- (b) example of harmful physical effect; (*eg testicular atrophy / breast growth in males*)
example of harmful mental effect; (*eg increase aggression / violence*)
cheating/advantage over other athletes;
sport more competitive / enhance performance;
(financial) rewards encourage abuse;

[3 max]

Option C — Cells and energy

7. (a) 37 (%) (allow answer in the range of 34 (%) to 38 (%)) [1]
- (b) as the concentration increased the remaining activity decreased in both peptides; peptide 2 does not cause activity to drop significantly until higher concentration/ $25 \mu \text{mol dm}^{-3}$ while peptide 3 causes decrease at low concentrations/ $10 \mu \text{mol dm}^{-3}$;
(enzyme activity of) peptide 2 decrease steadily after $25 \mu \text{mol dm}^{-3}$ while (activity of) peptide 3 shows little change;
peptide 3 more effective than peptide 2 (after conc. of $10 \mu \text{mol dm}^{-3}$) [2 max]
- (c) peptide 1, only low concentrations needed to inhibit enzyme [1]
- (d) non-competitive does not compete for active site / binds to enzyme away from the active site;
peptides 1/3 non-competitive, only small concentrations cause inhibition;
peptide 2 competitive, only inhibits enzyme at higher concentration;
peptide 2 competes with substrate, at higher concentration it joins the active site more readily than the substrate; [2 max]
8. (a) (i) structural – collagen / membrane proteins;
transport – hemoglobin / protein channels;
movement – actin / myosin;
hormones – insulin / vasopressin / growth hormone;
defense – antibodies / immunoglobins; [3 max]
Award any other valid function and example.
- (ii) globular proteins have spherical shape while fibrous proteins are linear;
globular proteins are soluble while fibrous are not;
globular proteins have metabolic function while fibrous proteins have a structural function; [2]
- (b) I. ATPsynthase; (accept ATPsynthetase)
II. H^+ / protons;
III. O_2 /oxygen; [3]
9. (a) stroma (of chloroplast) [1]
- (b) large surface area of thylakoids/grana for light absorption/electron transport chain;
(small) space inside thylakoids for accumulation of protons;
(fluid) stroma for enzymes in Calvin cycle/light independent reactions;
arrangement of photosystems to allow electron transport to take place;
double membrane on the outside allows separation from rest of cell;
presence of DNA/ribosomes for protein synthesis;
starch grains store carbohydrate (from photosynthesis); [3 max]

Option D — Evolution

10. (a) (i) 133 (*accept answers in the range of 132 to 134*) [1]
- (ii) 18 SDs per Myr (*accept answers in range 17-19 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 duplication/SD in chimpanzees; [1 max]
11. (a) non-living synthesis of organic molecules;
formation of polymers;
origin of self-replicating molecules;
packing of molecules into membranes/protobionts;
(*Do not accept reference to reducing atmosphere unless part of a process*) [2 max]
- (b) self-replicating;
catalytic/enzyme activities;
can be used as genetic material; [2 max]
- (c) (heterotrophic) prokaryotic cell took in separate/another prokaryotic cell by endocytosis / *WTTE*;
chloroplast/mitochondria surrounded by double membranes;
chloroplast/mitochondria divide like cells;
naked loop of DNA like prokaryotes;
similar sized (70S) ribosomes found in mitochondria/chloroplasts and prokaryotes;
theory cannot be falsified/repeated; [3 max]

12. (a) measure of the proportion of a specific variation of a gene in a population [1]

(b)

<i>allopatric</i>	<i>sympatric</i>
formation of new species /interbreeding prevented by separation;	formation of new species/interbreeding prevented by separation;
different geographical area	in same geographical area;
example of barrier; (<i>mountain range</i>)	example of barrier; (<i>temporal / reproductive / behavioural isolation. Accept specific example such as release of pollen at different times</i>)
example of allopatric speciation; (<i>Darwin's finches</i>)	example of sympatric speciation; (<i>moths which produce different pheromones</i>)

[3]

Allow other valid comparisons. Award [1] for each correct row.

Option E — Neurobiology and behaviour

13. (a) as brain volume increases so does hippocampus volume / positive correlation [1]
- (b) hippocampus volumes are larger in adults than in young birds;
larger range for migratory;
young non-migratory show wider range of hippocampus volumes than young migratory;
some overlap for non-migratory / none for migratory; [2 max]
- (c) (i) adult migratory (as for any brain volume this group has the largest hippocampal volume) } (allow mathematical explanation) [1]
- (ii) needed for migration / only adults migrate/remember flight paths
(Do not accept spatial navigation on its own without reference to migration) [1]
- (d) *Hypothesis supported:*
non-migratory have larger brain volume;
larger brain implies more thinking skills;
hippocampus in non-migratory is approx same size as in migratory;
Hypothesis not supported:
only two species/small sample studied so over generalization;
similar hippocampus volume in both migratory and non-migratory birds; [2 max]

14. (a)

<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/low	bright/high;
<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.

- (b) sound waves make eardrum/tympanic membrane vibrate;
vibration passes along the bones of middle ear/ossicles/malleus, incus and stapes making oval window vibrate;
vibration passed to fluid in cochlea;
vibration in cochlea stimulate hair cells/mechanoreceptors;
nerve impulse passed to auditory nerve; [3 max]

15. (a) benzodiazepines;
alcohol;
tetrahydrocannabinol / THC / marijuana; **[2 max]**
Do not accept brand names.

(b) process in which information is processed in order to make a choice between two or more alternatives;
interaction between excitatory and inhibitory presynaptic neurons;
involves inhibitory and excitatory neurotransmitters;
sum of the effects of the inhibitory and excitatory neurons determines whether the impulse is passed on;
decisions are made on the basis of memory and reasoning; **[3 max]**

Option F — Microbes and biotechnology

16. (a) 10^5 (per squid) [1]
- (b) 100 [1]
- (c) low luminance in mutant strain while high luminance in parental strain (after 8 hours);
increase between 8 and 15 hours in parental strain but no increase in mutant strain; [2]
- (d) little bioluminescence immediately after inoculation;
only when more bacteria have grown (7 hours after colonization) luminescence can be seen;
luminescence has a rapid increase which could be caused by exponential growth of bacteria / population growth curve / example of quorum sensing;
there is no data for the number of bacteria colonizing the squid; [2 max]
- (e) peptidoglycan cell wall [1]
17. (a) *methanogens*: high methane; (*Accept suitable environment with high methane content such as deep water methane pools, bogs, ruminant stomach*)
halophiles: high salt concentration; (*Accept suitable environment with high salt content such as Dead Sea or Great Lakes*) [2]
- (b) sewage trickled over bed of rocks with (biofilm of) saprotrophs and oxygen added;
saprotrophic bacteria feed on/break down organic matter (found in sewage);
transforming it into harmless/re-usable products/ CO_2 , H_2O , ammonia; [2 max]
- (c) organic matter/manure/cellulose used as substrate;
bioreactor with anaerobic conditions;
bacteria convert organic matter into organic acids/alcohol/acetate/ CO_2 and H_2 ;
methanogenic bacteria produce methane from breakdown of acetate/ CO_2 and H_2 ;
(*Accept correct word or chemical equations*) [3 max]
18. (a) acid/lemon/vinegar lowers pH (thus) inhibiting enzyme activity;
inhibit growth of bacteria/microorganisms; [2]
- (b)
- | <i>process</i> | <i>organism</i> |
|--------------------------|-----------------------------------------|
| <i>wine production</i> | <i>Saccharomyces</i> ; |
| <i>nitrogen fixation</i> | <i>Azotobacter</i> / <i>Rhizobium</i> ; |
- [2]

Award [1] for each correct row.

Option G — Ecology and conservation

19. (a) 4 [1]
- (b) broad (realized niche as present in many communities) [1]
- (c) (i) lack of water [1]
- (ii) shading from trees / lack of light /competition from trees and shrubs [1]
- (d) communities have different species present;
grass species 1 to 15 more common in communities 1 to 7/dry south east boundary; *(accept values within 3 of the upper and lower values given in the marking point)*
grass species 32 to 45 more common in communities 13 to 17/woodlands; *(accept values within 3 of the upper and lower values given in the marking point)*
pattern linked to variation in rainfall/abiotic factors;
appears to have clusters of distinct plant species with little overlap;
species are found in certain areas only; [3 max]
20. (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;
(gross productivity/biomass increase 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]

21. (a) absorption of/protection against UV light/radiation [1]
- (b) (i) N : total number of organisms of all species }
found/in population; } (both needed) [1]
 n : number of organisms of a particular species;
- (ii) *ethical*: life should be respected / cultural importance for (local human indigenous) population / (human indigenous) population's ability to live sustainably within ecosystem might be affected / richness for future generations;
ecological: native species might be replaced by alien species / extinction of one species can lead to the extinction of many others / interdependency of species may be disrupted/negative effects on food chains /soil erosion/floods occur with deforestation / rainforests act as a carbon sink which helps reduce global warming;
economic: medicines or materials not found yet / genes of wild species need to be preserved / ecotourism improves local economy/encourages local conservation / plant sources of pharmaceuticals lost if species extinct / crops may be improved with alleles from wild plants;
aesthetic: loss of beauty of wild / inspiration for artists; [3 max]
(Words in italics alone are not worth marks)
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