



MARKSCHEME

November 2014

BIOLOGY

Standard Level

Paper 3

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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 % 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) $\frac{\text{mass in kg}}{(\text{height in m})^2}$ *accept* $\frac{\text{mass in pounds}}{(\text{height in inches})^2} \times 703$ (*accept weight for mass*) [1]
- (ii) 0.32 to 0.4 [1]
- (b) (i) the higher the glucose, the higher the Munc18c/protein / positive relationship / *vice versa* [1]
- (ii) after 48 hours both the lean and obese have lower glucose;
range/variation of glucose values greater after 48 hours than 12 hours / *vice versa*;
after 48 hours fasting the (average) glucose decreases/is lower (than the 12 hours);
details of BMI 25 to 30 not known so conclusion may not be valid; [2 max]
Accept valid numerical comparisons.
- (c) (supported as) obese individuals have less (average) Munc18c/protein after 12 hours of fasting;
(not supported as) obese individuals have very similar content / not great/significant differences in Munc18c/protein after 48 hours;
(not supported as) very little evidence that obesity is associated with decreased Munc18c/protein;
(not supported as) at any level of Munc18c/protein there are lean and obese individuals;
less information is given about obese individuals than lean; [2 max]
2. (a) before eating (appetite centre) responds to hormones/ghrelin from stomach;
after eating, insulin produced by pancreas / leptin by adipose tissue/fat / PYY₃₋₃₆ in small intestine;
control centre/hypothalamus affected making a person feel } (*no mark for*
satiated/have eaten enough/feel full; } *simply stating* [2 max]
 } *hypothalamus*
- (b)
- | <i>dietary component</i> | <i>impact of its deficiency in the diet</i> |
|--------------------------|---|
| <i>protein</i> | shortage of essential amino acids / lack of blood plasma proteins / edema/tissue fluid retention / mental/physical retardation / kwashiorkor / muscle loss; |
| <i>vitamin C</i> | scurvy / bleeding of the gums / immune depression; |
| <i>iodine</i> | lack of production of thyroxine/T3/T4 / metabolism imbalance / goitre / mental retardation / malfunction of thyroid gland; |
- [3]
- (c) trans monounsaturated (*do not accept omega-3*) [1]

3. (a) *Award [1] for any two of the following.*
traffic congestion;
pollution;
greenhouse gas emission / high carbon footprint / increased fossil fuel consumption;
(can lead to) higher cost;
food quality/freshness/requires preservatives;
economic competition with local producers; **[1 max]**
- (b) *high energy input foods: [3 max]*
negative impact on the environment due to longer distance/pollution;
excess high energy foods can lead to obesity;
(fat) can lead to circulatory problems/CHD/problems of cholesterol;
impact of the fats depends on the type of fatty acids / trans/saturated fatty acids worse;
excess sugar can lead to diabetes/tooth decay;
- low energy input foods: [3 max]*
high nutritional value / high vitamin/mineral content necessary for good health;
high fibre content which may prevent obesity/reduce problems of cancer/haemorrhoids/diabetes;
less impact on the environment; **[4 max]**

Option B — Physiology of exercise

4. (a) 32 [1]
- (b) type I have a lower percentage with high glycogen (than type IIA);
 type I have a higher percentage with moderate glycogen (than type IIA);
 type I have a higher percentage muscle fibres with low glycogen (than type IIA);
 type I have a higher percentage muscle fibres with no glycogen (than type IIA);
Accept inverse statements and numerical comparisons. [2 max]
- (c) training decreases the glycogen content in all three muscle types;
 no muscle types have high glycogen content (after training);
 type IIB fibres use up more of its glycogen (than types I and IIA);
 all three fibre types increase in percentage of muscle fibres with low/no glycogen levels;
Accept inverse statements and numerical comparisons. [3 max]
- (d) type IIB as it uses more glycogen in exercise (*must include reason*) [1]
5. (a) (i) light band [1]
- (ii) the light band/actin decreases;
 the sarcomere/length between the Z-lines shortens;
 while the length of the dark bands/myosin remains constant; [2 max]
- (b) knee joint is hinge while hip is ball and socket;
 knee allows movement in one plane while hip allows movement in all/three planes;
 knee allows flexion/bending/straightening/extension while the hip allows protraction/retraction/abduction/rotation;
Answers must make comparisons. [2 max]
6. (a) exercise increases the rate of aerobic cell respiration;
 exercise increases the need for O₂ (for aerobic respiration);
 exercise increases the need to remove CO₂;
 greater volumes (per minute) of air moved in and out of lungs increase the gas exchange; [2 max]
- (b) exercise causes lowered pH (due to production of CO₂) and sends message to brain;
 exercise increases heart rate/cardiac output;
 training increases thickness of/strengthens heart wall/increases ventricle volume;
 so stroke volume increases;
 increase in volume/rate increases the cardiac output;
 training reduces heart rate at rest and during exercise;
 (training causes) recovery to resting/normal cardiac output/heart rate is faster; [4 max]

Option C — Cells and energy

7. (a) $4 \times 10^6 / 4,000,000 / -4,000,000$ [1]

(b) 1 μM as in both cases the growth is similar for both 20 μM Fe and 1 μM Fe but less in 0.2 μM ;
 1 μM because at lower concentrations there is a bigger effect on growth; [1 max]
Answers must include reason.
Accept answers between 0.2 and 1.

(c) photosynthesis rate increases with increase in Fe / positive correlation;
 respiration stays similar/(slight) decrease; [2]

(d) as Fe concentrations decrease algae grown in both acetate and CO_2 decrease cell density;
 although cell growth is greater in acetate at all concentrations;
 as Fe concentrations decrease algae grown with acetate decrease photosynthesis much more than with CO_2 ;
 as Fe concentrations decrease there is (relatively) little impact on respiration with acetate or CO_2 ;
 although respiration with acetate is greater than with CO_2 at all concentrations; [3 max]
Accept inverse answers.

8. (a) oxidation is loss of electrons/gain of oxygen/loss of hydrogen [1]

(b)

	<i>light-dependent reactions</i>	<i>light-independent reactions</i>
<i>location</i>	thylakoids/grana	stroma;
<i>major products</i>	ATP / oxygen / $\text{NADPH} + \text{H}^+$ / $\text{NADPH} / \text{NADPH}_2$	carbohydrates/glucose/sugar;

[2]

Award [1] for two correct answers in one row (either location or major products).

(c) determine positions of proteins in membranes;
 create hydrophilic channels through membranes;
 give specificity of active sites in enzymes;
 determine the folding/3D structure of proteins;
 affect the solubility of proteins / polar are hydrophilic and non-polar are hydrophobic (both needed); [2 max]

9. (a) an inhibitor binds to a site different from the active site;
 changes the configuration/conformation/shape of the active site;
 prevents substrate binding / reduces activity/rate of reaction;
 inhibition unaffected by substrate concentration; [2 max]

(b) metabolic pathway is a series of enzyme-catalysed reactions;
 end-product acts as an inhibitor of enzyme at beginning of reaction;
 (this enzyme) has allosteric site for inhibitor to bind / allosteric enzyme with two different binding sites;
 more inhibition if end-product concentration rises;
 prevents an excess of product / build-up of intermediate product;
 this is an example of negative feedback;
 inhibition is reversible as reaction continues when end product concentration falls; [4 max]
Award marks for annotated diagrams clearly showing these processes.

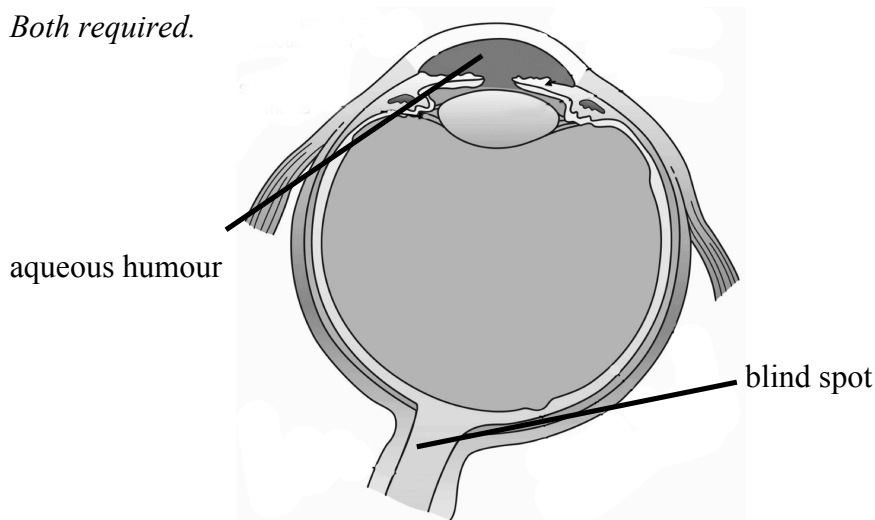
Option D — Evolution

10. (a) 0.0 (arbitrary units) (*accept answers in the range of –0.05 to +0.05*) [1]
Do not accept “none”.
- (b) as nitrogen levels increase so does epidemic size / positive correlation/relationship [1]
- (c) 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]
- (d) 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]
- (e) the resistant strains of *D. dentifera/Daphnia* will increase;
 predators eating the infected *D. dentifera/Daphnia* reduce the epidemic;
 the resistant strains of *D. dentifera/Daphnia* lose their adaptive advantage; [2 max]
11. (a) (i) deep-sea/hydrothermal vents;
 volcanoes;
 extraterrestrial locations / comets / space; [2 max]
- (ii) self replication;
 catalytic activity;
 carries genetic information; [1 max]
- (b) a diet with more protein/fat/energy / carnivorous diet promotes brain development;
 larger brain promotes greater technical development/better hunting tools/skills/
 agriculture;
 the learning of skills by peers/new generations is part of cultural evolution; [2 max]
- (c) *H. sapiens* and *H. neanderthalensis*;
Australopithecus and *H. habilis*;
H. habilis and *H. erectus*;
H. neanderthalensis/H. sapiens and *H. erectus*;
H. ergaster and *H. erectus/H. habilis*;
 other verifiable example; [1 max]
12. speciation is the formation of new species from pre-existing ones;
 usually by isolation of a population/gene pool;
 eventually genes pools so different interbreeding cannot occur;
 allopatric/sympatric speciation occurs;
 divergent evolution is where different populations adapt to different ecological roles/
 adaptive radiation/avoid competition;
 result of natural selection/competitive advantage of one population over another;
 example; } (*eg Darwin’s finches / mammalian pentadactyl limb / any other verifiable*
example of divergent evolution) [4 max]

Option E — Neurobiology and behaviour

13. (a) (i) 5.25 (allow answers in the range of 5.2 to 5.3) [1]
- (ii) depolarization similar for all three / depolarization most in mutant strain;
the control and restored strains equal / same pattern overall;
slower/more delayed/longer repolarization/return to normal in mutated; [2 max]
- (b) control and restored show little difference/similar;
mutated less than control and restored;
mutated 13 % less than restored / 14 % less than control / other numeric response; [2 max]
- (c) the carboxylesterase reduces the reaction to cVA / affects rate of depolarisation/
repolarisation/smell/detection of chemicals in air;
carboxylesterase absence/mutation makes the reaction to cVA more pronounced /
OWTTE; [1 max]
- (d) inhibition of carboxylesterase could reduce courtship behaviour;
release of mutated strain could cause lower population;
reduce damage to fruits/crops / reduce environmental impact; [1 max]
14. (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) invertebrate moves about less in optimal conditions and more in poor conditions;
non directional movement in response to a stimulus; [1 max]

15. (a) benzodiazepines;
alcohol;
tetrahydrocannabinol/THC / marijuana / cannabis;
any other verifiable example; *(do not except common names eg: pot)* **[2 max]**
- (b) *possible causes: [2 max]*
peer pressure;
cultural traditions;
inherited/genetic predisposition;
social problems/trauma;
passed from mother to newborn/when breast feeding;
- discussion of causes: [2 max]*
not all people become addicts of potentially addictive drugs;
many addictive drugs stimulate synapses with dopamine as neurotransmitter;
the pleasurable effects of dopamine may lead to addiction;
- can avoid the addiction with learned behaviour; } *(eg: avoiding/not smoking /
avoiding/not drinking)* **[4 max]**

Option F — Microbes and biotechnology

16. (a) (i) 20 *[1]*
- (ii) the acid treatment increases glucose concentration more quickly/to a greater concentration (than in water) *[1]*
- (b) (hypothesis supported as) the concentration of glucose at each pre-treatment period was greatest at 140°C acid;
(hypothesis supported as) at each of the temperatures, pre-treatments with acid reach higher levels of glucose concentration before those with water;
(hypothesis supported as) this is the only treatment that reaches 100% glucose concentration; *[2 max]*
- (c) with acid there is more hydrolysis but not that great a difference to justify its use;
acid is more expensive than water therefore it is not justified;
acid can contaminate/decrease pH of the environment in the waste waters of the plant so is harmful / *OWTTE*;
acid conditions may mean lower effectiveness of fermentation/yeast growth/reproduction; *[2 max]*

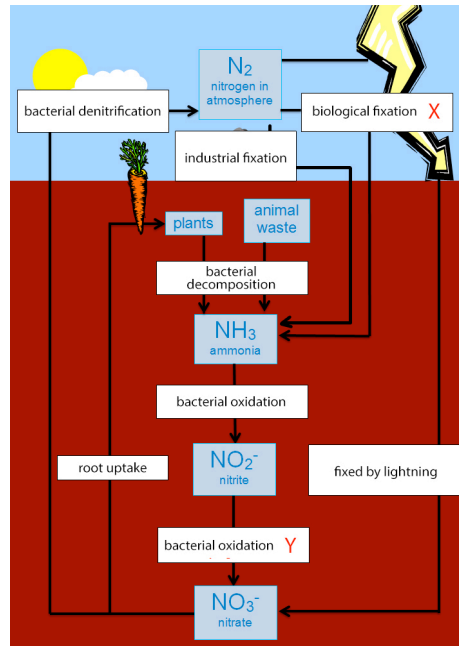
17. (a)

<i>characteristic</i>	<i>amoeba</i>	<i>euglena</i>
<i>mode of nutrition</i>	heterotrophic;	autotrophic/phototrophic/ heterotrophic;
<i>mode of locomotion</i>	pseudopods/amoeboid movement;	flagella;

[2]

Award [1] for any two correct answers.

(b)



(i) *X: Accept answer on the line between N₂ and plant protein.* [1]

(ii) *Y: Accept answer on the line between NO₂⁻ and NO₃⁻.* [1]

(c) starch hydrolysed/catalysed/converted (to sugar) by amylase;
Saccharomyces/yeast ferments/transforms the sugars to ethanol/alcohol;
 by anaerobic cell respiration;
 makes carbon dioxide/bubbles/foam; [2 max]

18. (a) (i) catalyses/converts/produces (single-stranded) DNA from RNA [1]

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

(b) used for cloning DNA/gene therapy/gene transfer/diagnosing microbial
 diseases/making antiviral drugs;
 the DNA has no introns;
 inserted into host bacteria / host bacteria have no means to remove introns;
 DNA polymerase then synthesizes a complementary DNA (double strand);
 example; (eg: human insulin DNA made from isolated RNA)
 example; (eg: treatment of SCID) [4 max]
Maximum of two examples.

Option G — Ecology and conservation

19. (a) 0.1 (*allow answers in the range of 0.08 to 0.12*) [1]
- (b) overall more *C. briggsae* was found than *C. elegans*;
C. elegans was not found in July/August but *C. briggsae* was found;
C. elegans is present in December but no *C. briggsae* was found;
 neither species were found in January;
 both species co-exist in October and November;
 more *C. elegans* in 2009 than 2010 but more *C. briggsae* in 2010 than 2009; [3 max]
- (c) *C. elegans* appears more in autumn/winter and *C. briggsae* } (*both needed*
 appears more in summer/autumn; } *for mark*)
- C. elegans* (appears more in early winter months so) would have a greater population in cooler temperatures;
C. briggsae (appears more in summer so) would have a greater population in (slightly) warmer temperatures;
 there are differences/inconsistencies between 2009 and 2010; [2]
- (d) competition/competitive exclusion as they co-exist at times but have peak populations at different times of year / as the numbers of one increases the other decreases [1]
20. (a) (i) ecological region/ecosystem (of Earth) determined by its climate/rainfall and temperature [1]
Allow answers relating to a specific biome.
- (ii) areas of Earth with living organisms / all of the biomes/ecosystems [1]
- (b) (= 96 + 45) = 141 kJ m⁻² yr⁻¹ (*units required*) [1]
- (c) an organism's spatial habitat;
 its feeding activities/nutrition;
 its interactions/relationships with other species; [2 max]
21. (a) named example; (*accept common names*)
 type of release; (*accept deliberate/accidental/description*) [2]
eg: rabbits in Australia;
deliberate/controlled release/originally farmed;
- (b) new species introduced by humans accidentally or deliberately;
 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;
 may lead to extinction of local species / reduces species diversity;
 example of negative impact by alien species;
 alien species can add to species diversity;
 example of positive impact by alien species; [4 max]