Diploma Programme
Programme du diplôme
Programa del Diploma

Markscheme

May 2015

Biology

Standard level

Paper 3

12 pages

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 <u>underlined</u> are essential for the mark.

6. The order of marking points does not have to be as in the markscheme, unless stated otherwise.

Option A — Human nutrition and health

1. (a) urea **[1]**

(b) 0.20 (kg) (less weight in HP) **[1]**

(c) LDL cholesterol increases and HDL cholesterol decreases as (proportion of) protein increases/carbohydrate decreases / *OWTTE* **[1]**

(d) a. lack of essential amino acids to form protein;
b. not enough protein for growth;
c. not enough amino acids/protein to form muscle/tissues;
d. low protein may affect production of enzymes; **[2 max]**

(e) *(the data does not support the recommendation)*:
a. as HP has the highest level of plasma urea which could be toxic;
b. HP has a high level of LDL/bad cholesterol and a low level of HDL/good cholesterol which could lead to coronary heart disease; (*accept high ratio of LDL*:*HDL*)
c. HP produces a high level of glucose (compared to AP) which could lead to diabetes;
d. HP produces a low birth weight (compared to AP) which may affect development / OWTTE;

(the data does support the recommendation):
e. the mother has a similar weight gain to AP thus avoiding health problems; **[3 max]**

2. (a) (i) liver / dairy products / fish / egg <u>yolk</u>s / other source **[1]**

(ii) sunlight **[1]**

(b)

	human milk	***artificial milk***
a.	lactose	glucose / may not be lactose;
b.	human proteins	animal proteins / soy proteins;
c.	antibodies	no human antibodies;
d.	no supplements	supplements;

[2 max]

Answer does not need to be in a table format.

3. (a) a. glucose in urine;
b. high blood glucose;
c. frequent urination / dehydration/excess thirst;
d. constant hunger;
e. weight loss;
f. tiredness; **[2 max]**

(b) a. (point) mutation of gene;
b. defective enzyme/phenylalanine hydroxylase (PAH);
c. phenylalanine/Phe not broken down to tyrosine/Tyr;
d. phenylalanine/Phe accumulates;
e. (if not treated) symptoms mental retardation/seizures;
f. diet free of phenylalanine/Phe to avoid symptoms; **[4 max]**

Option B — Physiology of exercise

4. (a) (–)9 mmol kg^{-1} (of dry matter) *(units required)* **[1]**

(b) a. (both) type II fibres decline more than type I / type I declines the least;
b. type IIx decline the most;
c. type II decrease more between 0 and 10 seconds than later whereas type I only decrease after 10 seconds; **[3]**

(c) a. type I is a slow muscle fibre capable of sustained activity (stamina)/high rates of aerobic respiration;
b. type I muscle fibre have a very good blood supply / plenty of myoglobin/mitochondria allowing for aerobic respiration to take place;
c. type II used initially in strenuous exercise (in preference to type I); **[1 max]**

(d) a. mitochondria/myoglobin required to make ATP;
b. type IIx need more ATP in a short period of time, so probably anaerobic respiration (therefore probably white fibre);
c. type IIx as shows a fast power decline, producing fatigue; **[2 max]**

5. (a) a. formation of cross-bridges/myosin binds to the thin filament/actin;
b. Z-bands pulled towards each other;
c. sliding of actin and myosin filaments/shortening the sarcomere/I-band;
d. use of ATP to break cross-bridges / myosin releases actin when binding to ATP;
e. myosin heads re-set;
f. contraction ceases when myosin head detaches from the thin filament; **[3 max]**

(b) (i) *synovial fluid*: avoids friction/lubricates / absorbs shock (at the elbow joint) **[1]**

(ii) *biceps*: flexes arm/raises lower arm **[1]**

6. (a) a. *tidal volume*: volume of air taken in with each inhalation/out with each exhalation;
b. *ventilation rate*: number of inhalations/exhalations/breaths per minute; **[2]**

(b) a. exercise increases <u>aerobic</u> respiration;
b. CO_2 concentration in blood increases;
c. drop in pH of blood detected / blood more acidic;
d. breathing centres send impulses to diaphragm and intercostal muscles;
e. increase rate of contraction;
f. increase in ventilation rate increases oxygen uptake/decreases CO_2; **[4 max]**

Option C — Cells and energy

7. (a) 50 (pmol O_2 min^{-1}) *(allow answers in the range of 49 to 51)* **[1]**

(b) a. both increase with time after fertilization;
b. mitochondrial OCR increases (a lot) more than non-mitochondrial;
c. after 48 hours there is approximately three times more mitochondrial than non-mitochondrial OCR;
d. at 3 hours non mitochondrial OCR is higher than mitochondrial; **[2 max]**

(c) a. mitosis requires a large amount of energy;
b. more cells implies higher metabolic rate/DNA synthesis/other cell processes;
c. more mitochondria present with time;
d. mitochondria work more efficiently/faster; **[2 max]**

(d) protect DNA/protein/lipids/embryo (until mitochondrial respiration removes oxygen efficiently) **[1]**

8. (a) a. (primary structure) is sequence of amino acids;
b. (quaternary structure) is the linking of two or more polypeptides to form one protein; **[2]**

(b) a. temperature;
b. pH;
c. light;
d. CO_2; **[3 max]**

9. (a) a. enzyme has <u>active</u> site;
b. enzyme-substrate complex formed;
c. substrate induces active site to change;
d. bonds in substrate are weakened;
e. activation energy is reduced; **[3 max]**

(b)

	competitive inhibition	***non-competitive inhibition***
a.	the inhibitor is similar to substrate	inhibitor (usually) different to substrate;
b.	inhibitor binds to active site	inhibitor joins away from active site/allosteric site;
c.	inhibitor prevents binding of substrate	inhibitor changes shape of active site not allowing substrate to join;
d.	increasing the substrate concentration diminishes effect of inhibitor	change in substrate concentration does not diminish inhibition;
e.	both slow down the rate of reaction;	

[4 max]

Answer does not need to be in a table format.

Option D — Evolution

10. (a) as brain mass increases life span increases / positive/direct relationship/correlation **[1]**

(b) other placental mammals **[1]**

(c)

	primates	***marsupials***
a.	larger range of brain mass	(smaller);
b.	(generally) greater brain mass	(generally less);
c.	larger range of life span	(smaller);
d.	(generally) with greater life span	(generally with lesser life span);
e.	both with positive relationship between brain mass and life span;	
f.	both overlap (with the primates higher);	

[3 max]

Do not accept answers stating only numerical values without comparative wording.

(d) a. larger brain size allows for /higher intelligence/better cognition/more complex brain functions;
b. more efficient food finding / escape from predators;
c. longer life span favours parental care/survival for more reproduction;
d. (these advantages) favour natural selection which leads to evolution; **[2 max]**

11. (a) time taken for radioactivity to fall to half its original level **[1]**

(b) a. *Homo* presents a less projecting face/smaller jaw than *Australopithecus*;
b. *Homo* presents better adaptations to bipedalism/more erect posture;
c. *Homo* has larger brain size;
d. *Homo* has smaller molar size;
e. *Homo* has smaller brow ridge size; **[2 max]**

(c) a. *balanced polymorphism*: sickle-cell trait / cystic fibrosis / other example;

b. *transient polymorphism*: industrial melanism in moths / red-wing and black spot to black-wing ladybugs/ladybirds / other example; **[2]**

12. (a) a. prebiotic Earth had a reducing atmosphere (no oxygen);
b. (some) prokaryotes were photosynthetic;
c. photosynthesis produces oxygen; **[2 max]**

(b) a. microorganisms/prokaryotes taken into cell by endocytosis;
b. kept inside cell and perform respiration/photosynthesis;
c. developing into mitochondria/chloroplasts;
d. mitochondria/chloroplasts have double membranes (as expected in cells taken in by endocytosis);
e. mitochondria/chloroplasts have (circular naked) DNA (as prokaryotes);
f. mitochondria/chloroplasts have 70S ribosomes (as prokaryotes);
g. mitochondria/chloroplasts grow and divide like (prokaryotic) cells; **[4 max]**

Option E — Neurobiology and behaviour

13. (a) *bees fed with ethanol*:
5.9 (%); *(allow answers in the range of 5.8 (%) to 6.0 (%))*
bees fed without ethanol:
1.3 (%); *(allow answers in the range of 1.2 (%) to 1.4 (%))*
(both needed) **[1]**

(b) a. without alcohol (antennation starts at a high level and) decreases with time;
b. with alcohol, the value (starts low and) very slowly increases;
c. the values of both group become very similar with time; **[2 max]**

(c) a. (time spent) walking is greater in bees without alcohol (than alcohol);
b. (time spent) grooming is greater with alcohol (than without alcohol);
c. the end point difference is greater in walking;
d. (time spent) walking increases whereas grooming decreases for both groups of bees; **[2]**

(d) a. (hypothesis supported as) alcohol decreases antennation at the start of the experiment;
b. (hypothesis supported as) alcohol increases begging at the start;
c. begging time is more variable/has less significant differences with alcohol so less clear than in antennation;
d. (hypothesis is supported as) the effect of alcohol on social behaviours becomes less distinguishable over time (with the effect of sucrose); **[3 max]**

14. (a) a. *smell*: chemoreceptor; *(do not accept olfactory)*
b. *temperature*: thermoreceptors; **[2]**

(b) *I*: *name*: intermediate/relay neuron
function: send impulse/message from sensory to motor neuron;
II: *name*: motor neuron
function: send impulse/message from spinal cord to effector/muscle;
(name and function needed for the mark) **[2]**

15. (a)

	cocaine	**THC**
a.	excitatory (psychoactive) drug	inhibitory (psychoactive) drug;
b.	affects dopamine transmitters	affects cannabinoid receptors
c.	prevents the return of dopamine to the presynaptic membrane	blocks release of excitatory neurotransmitter;
d.	depressive mood disorders	loss of memory / slurred speech / loss of balance / impairs reaction time/muscle coordination;
e.	pleasurable feeling	increases intensity of sensual perception / feeling of emotional well-being / allows clear thinking of complex ideas;
f.	addictive;	

[4 max]

Answers do not need to be in a table format.

(b) a. *excitatory drug*: nicotine / amphetamines/ other drug;
b. *inhibitory drug*: benzodiazepines / alcohol / other drug; **[2]**

Option F — Microbes and biotechnology

16. (a) 50 (%) *(allow answers in the range of 48 (%) to 52 (%))* **[1]**

(b) 16 (%) *(allow answers in the range of 12 (%) to 20 (%))* **[1]**

(c) a. there are less QS^- strains that produce cholera than those that do not produce cholera;
b. approximately 50 % in cholera producing and approximately 70 % in non-cholera producing;
c. greatest percentage in QS^- in both so most are not quorum sensing; **[2 max]**

(d) *(the hypothesis is supported as)*
a. more sensing in bacteria that cause cholera than in those that do not;
b. forming aggregates to facilitate the propagation of the pathogen / bacteria working together can produce pathogenicity;
c. bacteria with QS^+ and cholera producing strains are positively selected; **[1 max]**

(e) a. thin layer of peptidoglycan sandwiched between outer and inner membrane layer;
b. outer layer containing lipopolysaccharide and (protein);
c. high lipid and low peptidoglycan content; **[2 max]**
Accept correct answers on a clearly labelled diagram.

17. (a) a. viral vector modified to include healthy gene;
b. virus is taken up by cells;
c. inserts normal gene into chromosome;
d. white blood cells / bone marrow / other cells replaced into patient; **[2 max]**

(b) a. *Aspergillus* sp: production of miso / soy sauce / food preservatives; } *(allow other verifiable use)*

b. *Saccharomyces*: production of beer/wine/bread/other alcoholic drink; **[2]**

18. (a) a. *Rhizobium*: nitrogen fixation;
b. *Nitrobacter*: oxidizes/changes nitrites to nitrates;
c. *Azotobacter*: nitrification / bind atmospheric nitrogen / nitrogen fixation; **[3]**

(b) a. anaerobic digestion of biodegradable material;
b. fermentation (of carbohydrates) by bacteria;
c. methanogens produce methane;
d. methane/biogas used as energy;
e. waste products used as fertilizer;
f. CO_2 produced (as a by-product); **[4 max]**

Option G — Ecology and conservation

19. (a) (i) 42 (N) *(allow answers in the range of 41 (N) to 43 (N))* **[1]**

(ii) 2.6 (cm^2) *(allow answers in the range of 2.5 (cm^2) to 2.7 (cm^2))* **[1]**

(b) positive correlation / as area of foot increases so does force required **[1]**

(c) a. back of crevice less subjected to action of waves;
b. (hypothesis supported as) small area of foot requires less force;
c. amount of predators/food could be affecting the distribution;
d. larger limpets may not fit in the back of the crevice;
e. less competition with larger limpets at the back of the crevice; **[3 max]**

(d) transect line / quadrat with transect line **[1]**
Do not accept quadrat alone.

20. (a) (i) a. 380 / 64;
*Award **[1]** for the correct calculation of the numerator **or** the denominator*
b. 5.94; *(accept 5.9)*
*Award **[1]** for correct answer.* **[2]**

(ii) a. there is greater species diversity/richness than a year ago / diversity/richness has increased;
b. the community is showing signs of stability / succession has progressed; **[2 max]**

If the answer in (a)(i) is smaller than 4.3 allow ECF and use the following markscheme.

c. there is less species diversity/richness than last year / diversity/richness has decreased;
d. the community is less stable / succession has regressed; **[2 max]**

(b) tundra **[1]**

21. (a) a. named example of invasive species;
b. named example of biological control; **[2]**

possible examples:

invasive species	***control***
rats	Indian mongoose
aphid	Ladybird (beetle)
rabbits	Myxoma virus

(b) a. substances/pesticides/heavy metals accumulate up the food chain / at each trophic level;
b. substances cannot be metabolized/excreted;
c. these substances become concentrated in (fatty) tissues/internal organs;
d. magnified in organisms in upper part of chain as they eat more/larger organisms;
e. increase in concentration may become toxic in higher trophic levels;
f. example of a consequence of biomagnification *e.g (DDT causes) thinning of egg shells (in birds)*; **[4 max]**