N15/4/BIOLO/SP3/ENG/TZ0/XX/M

Diploma Programme
Programme du diplôme
Programa del Diploma

Markscheme

November 2015

Biology

Standard level

Paper 3

14 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 underlined 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) Indonesia **[1]**

(b) a. higher percentage of obese females (compared to males);
b. greatest difference is in Morocco/Brazil;
c. least difference (between obese males and females) is in China/UK; **[2 max]**
Accept numerical distinctions.

(c) a. higher total percentage of overweight/obese in Australia (compared to Morocco);
b. Australia has more overweight/obese males than females and Morocco has more overweight/obese females than males / *vice versa*;
c. less difference between male and female obesity in Australia than Morocco / *vice versa*;
d. more overweight than obese in both Australia and Morocco; **[2 max]**

(d) a. different availability/poverty/costs of inexpensive high-energy/high fat/high sugar foods;
b. portion sizes / availability of away-from-home food/fast food;
c. different levels of activity / sedentary lifestyle;
d. cultural differences;
e. nutritional education;
f. genetic/inherited differences; **[2 max]**

2. (a) *Award **[1]** for any two natural food sources.*
fatty fish / salmon/tuna/mackerel/sardines/fish oils;
egg / egg yolks;
liver;
mushrooms;
cheese/milk/butter/yogurt/other dairy product; **[1 max]**
Do not accept supplemented foods or "fish" alone.

(b) a. excess exposure to ultraviolet/UV rays can cause skin cancer/melanomas;
b. some exposure to sunlight is needed for synthesis of sufficient vitamin D;
c. people from some countries are more vulnerable (to deficiency) due to culture/environment/geographic location;
d. vitamin D supplementation / suitable diet should be considered;
e. sunscreen/clothes/choosing when to go out in the sun can prevent over exposure; **[3 max]**

3. (a)

	artificial milk	***human milk***	
a.	palm/coconut/soy/vegetable oil	(polyunsaturated) fatty acids/triglycerides;	
b.	less lactose / glucose	more lactose / no glucose;	
c.	more protein/casein/bovine protein	less protein/casein / no bovine protein;	
d.	more iron/calcium/phosphorous	less iron/calcium/phosphorous;	
e.	no enzymes	contains enzymes/amylase and lipase;	
f.	no white blood cells	contains white blood cells;	
g.	no antibodies	antibodies;	
h.	no hormones	contains hormones;	**[2 max]**

(b)
a. (excess energy in dietary) fat (is stored as body fat and) can lead to obesity;
b. high cholesterol leads to plaque (in arteries);
c. narrowing of arteries increases blood pressure;
d. higher risk of obesity-related diseases such as type II diabetes/arthritis/cancer/ insulin resistance;
e. can cause cardiovascular disease/atherosclerosis/coronary heart disease;
f. narrowing of arteries/blood clots can lead to stroke in brain;
g. can lead to inadequate consumption of other (essential) nutrients; **[3 max]**

(c)
a. small mammals/mice fed varying amounts of vitamin C;
b. diet and environment controlled except (the amount of) vitamin C intake;
c. easier to control variables with animals compared to humans;
d. animals taking insufficient vitamin C present deficiency symptoms / large doses may cause side-effects;
e. results in animals may not be the same as in humans; **[2 max]**

Option B — Physiology of exercise

4. (a) (sprint) 1 (+ creatine) **[1]**

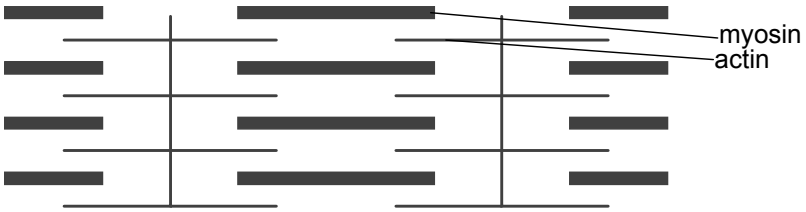
(b) 0.1 $dm^3 min^{-1}$ *(units required)* **[1]**

(c) a. neither the placebo nor the + creatine treatments affect heart rate (significantly);
b. the differences with the control are very small compared to the standard deviations/SD;
c. little difference between sprints; **[2 max]**

(d) the maximum rate at which oxygen can be absorbed by the body (and supplied to the tissues) **[1]**

(e) a. (hypothesis is not supported) no significant differences with control (for sprint times, heart rate and VO_2 max);
b. placebo differences (for sprint times, heart rate and VO_2 max) are not significant;
c. sample number too low to support hypothesis;
d. tests were done on cyclists so results may not apply to other sports;
e. there may be differences between sexes; **[2 max]**

5. (a) a. actin filaments – drawn as thin lines;
b. myosin filaments (with heads) – drawn as thick lines;
c. regions of overlap between fibres should follow diagram of sarcomere;
d. correct labelling of the A or H band/Z line; **[3 max]**



(b)

	fast muscle fibres	***slow muscle fibres***
a.	lower oxygen needs / anaerobic	greater oxygen needs / aerobic;
b.	moderate blood supply	good blood supply;
c.	lower myoglobin levels	higher myoglobin levels;
d.	high strength sport / weight lifting / other example	low strength sport / endurance sports / other example;
e.	typical in sprinters / low stamina	typical in marathon participants / high stamina;

[2 max]

6. (a) a. initially creatine phosphate can be used to regenerate ATP during intense exercise;
b. then ATP is produced by cell respiration;
c. with less intense exercise anaerobic cell respiration decreases;
d. (with less intense exercise) aerobic cell respiration increases; **[3 max]**

(b) a. increases blood flow to muscles;
b. increases delivery of oxygen/nutrients to muscles;
c. prevent/reduce injuries to muscles/ligaments/tendons;
d. psychological preparation / improved coordination / reaction times;
e. priming the nerve-to-muscle pathways so muscles are ready for exercise;
f. release of hormones;
g. research is controversial / evidence not substantiated; **[3 max]**

Option C — Cells and energy

7. (a) $4.2\ mg\ g^{-1}$ *(units required)* **[1]**
Accept answers in the range of 4.1 mg g^{-1} to 4.3 mg g^{-1}.

(b)
a. decreases with dehydration in both shade and sunlight;
b. greater decrease in sunlight than shade;
c. at 100/50 CO_2 assimilation greater in sunlight than shade but at 25 shade greater than sunlight; **[2 max]**

(c)
a. both increase (over the 25 % water content);
b. (chlorophyll in) shade plants increase to almost the same/slightly less than original levels;
c. plants grown in sunlight have almost the same/slightly more than original levels;
d. the difference between plants grown in the shade and sunlight is less than at any time at dehydration; **[2 max]**

(d)
a. decrease in chlorophyll causes lowered rate of light dependent reaction/less absorption of light energy;
b. decrease in CO_2 assimilation causes lowered rate of light independent reaction/ less CO_2 fixation/Calvin cycle;
c. both stages reduced due to wilting/less surface of leaf/closure of stomata; **[2 max]**
Candidates must include a reason to receive the mark.

8. (a) fibrous proteins have a structural function <u>and</u> globular proteins have a metabolic enzyme/hormonal/transport function **[1]**

(b)
a. unbound substrate does not fit active site exactly;
b. shape of active site changes when substrate binds;
c. weakens bonds in the substrate;
d. may bring reactive groups closer together;
e. some enzymes can bind with several different substrates; **[3 max]**

9. (a) *Award **[1]** for each of the following clearly drawn and correctly labelled.*
a. outer <u>and</u> inner membranes;
b. stroma;
c. thylakoid;
d. granum;
e. (70S) ribosomes / (naked) DNA;
f. starch granules; **[3 max]**

(b)
a. electron carriers found on inner membrane/cristae of mitochondria;
b. H/H^+/protons transported to electron carriers by NAD and FAD;
c. series of redox reactions in membrane;
d. electrons are passed down energy gradient;
e. establishes proton gradient / protons accumulate (in intermembrane space);
f. oxygen is the final electron acceptor;
g. generation of ATP through <u>chemiosmosis</u>; **[4 max]**
Accept correct answers in an annotated diagram.

Option D — Evolution

10. (a) 5.8 (%) **[1]**
Accept answers in the range of 5.7 (%) and 5.9 (%).

(b) slightly less/similar (infant mass relative to mother mass) in extinct hominids than modern humans / *vice versa* **[1]**

(c) a. shift (to birthing larger infants) occurred with *Australopithecus afarensis*/after *Ardipithicus ramidus*;
b. infant mass relative to mother mass ratio lower in *Ardipithecus ramidus* than *Australopithecus afarensis*;
c. evidence limited since time lines not indicated/may be overlap; **[2 max]**

(d) a. obstetric problems / difficulty giving birth / prenatal problems;
b. carrying/transporting a large infant could be difficult;
c. larger infants require more food; **[1 max]**

11. (a) 8 days **[1]**

(b) sickle-cell anemia (malaria) / glucose 6-phosphate dehydrogenase deficiency (malaria) / Tay–Sachs (TB) / CF (cholera) / PKU (miscarriage) / cyanogenic clover / sexual dimorphism / peppered moth / other valid plant or animal example **[1]**

(c)

	convergent evolution	***divergent evolution***
a.	unrelated / do not share a common ancestor / different origin	related / share a common ancestor / same origin;
b.	organisms evolve to become similar to each other	species diverge over time into two separate species different from original / adaptive radiation;
c.	analogous structure / different underlying structure/adaptation	homologous structure / similar underlying structure/adaptation;
d.	valid example *(eg: Euphorbias and cacti)*	valid example; *(eg: Darwin's finches)*
e.	both processes occur as a result of environmental change/selection pressure;	

[3 max]

12. (a)
a. early prokaryotes were anaerobic/did not require oxygen;
b. population increased / shortage of food;
c. photosynthetic bacteria/cyanobacteria evolved;
d. produced/released oxygen (into the atmosphere);
e. by splitting water molecules/photolysis/photosynthesis;
f. concentration of oxygen built up over time / conditions changed from reducing to oxidizing; **[3 max]**

(b)
a. chloroplasts, mitochondria and prokaryotes are a similar size;
b. all have 70S ribosomes;
c. double membrane suggests engulfing by endocytosis;
d. all contain naked DNA;
e. all divide by binary fission;
f. chloroplasts and mitochondria cannot survive on their own;
g. theory cannot be repeated/falsified; **[3 max]**

(c)
a. increased meat/protein/fat intake needed to meet energy needs of larger brain;
b. more complex tools needed for (successful) hunting shows correlation with larger brain/intelligence;
c. cooking food/control of fire requires larger brain/intelligence;
d. cultural evolution led to agriculture (therefore change in diet); **[2 max]**

Option E — Neurobiology and behaviour

13. (a) 17:00 **[1]**

(b) (i)

	summer	***winter***
a.	active for more hours	active for fewer hours;
b.	peak activity at 9:00 / more active in the morning	peak activity at 13:00 / more active mid-day / *OWTTE*;
c.	peak activity lower	peak activity (much) higher;
d.	two peaks of activity	(only) one (high) peak;
e.	both have more inactive hours than active;	
f.	same level of activity at 16:00;	

[3 max]

A table format is not required.

(ii) a. change in behaviour/availability of their prey/food sources;
b. changes in presence of predators;
c. protection from sun (in the middle of the day in summer);
d. amount of daylight hours (is reduced in winter); **[1 max]**
Do not accept answers related to temperature eg: cold blooded or poikilothermic.

(c) thermoreceptors/thermo **[1]**

14. (a) *Award **[1]** for any one of the following clearly drawn and correctly labelled.*
a. spinal cord – showing white and grey matter;
b. spinal nerves – showing dorsal and ventral roots;
c. sensory neuron / receptor;
d. motor neuron / effector;
e. relay neuron;
f. arrows showing path from stimulus/receptor to response/effector; **[4 max]**

(b)

	innate behaviour	***learned behaviour***
a.	develops independently of the environmental context	from experience / environmental stimulus;
b.	controlled by genes / inherited from parents;	not controlled by genes / not inherited from parents / from experience / environmental stimulus;
c.	developed by natural selection	from experience / environmental stimulus;
d.	increases chance of survival/ reproduction	may or may not increase chance of survival/reproduction;
e.	valid example	valid example;

[3 max]

15. (a) rods **[1]**

(b)
a. (cocaine is) an excitatory drug;
b. attaches to dopamine pumps/transporters/receptors (on presynaptic membrane);
c. blocks reuptake from the synaptic cleft;
d. dopamine builds up;
e. amplifies synaptic transmission / causes constant stimulation of postsynaptic neuron; **[3 max]**

Do not award marks for mentioning addiction or reward.

(c)
a. allows fluid in the cochlea to move;
b. as oval window moves in, round window moves out / *vice versa*; **[1 max]**

Option F — Microbes and biotechnology

16. (a) 23 (%) **[1]**
Accept answer in the range of 22 (%) to 24 (%).

(b) a. positive correlation / other Gram-negative bacteria resistance increases as fluoroquinolone use increases;
b. other Gram-negative bacteria continues to increase / slight decrease of fluoroquinolone use (in 1997);
c. from 1998, other Gram-negative bacteria resistance continues to rise even though fluoroquinolone use starts to level off/decreases; **[2 max]**

(c) *P. aeruginosa* resistance would increase (slightly)/level off **[1]**

(d) a. there is rising incidence of antibiotic/fluoroquinolone-resistant *P. aeruginosa*/ other Gram-negative bacteria;
b. use of antibiotics/fluoroquinolone is increasing/becoming less effective;
c. careful use of antibiotics/fluoroquinolone is recommended;
d. other antibiotics (that do not promote resistance) need to be developed;
e. continued monitoring of the situation is needed;
f. less chance of treating the disease / more severe symptoms / more people with the disease; **[3 max]**

17. (a)

	characteristic	***eubacteria***	***eukaryotes***
a.	histones	absent	present;
b.	introns	absent	present;
c.	size of ribosomes	70S	80S;
d.	structure of cell membrane lipids	unbranched hydrocarbons	unbranched hydrocarbons;
e.	peptidoglycan (in cell wall)	present	absent;
f.	membrane-bound organelles / example of organelle	absent	present;

[3 max]

(b) a. atmospheric nitrogen is converted to ammonia;
b. by *Azotobacter*; **[2]**
Do not accept Rhizobium.

18. (a) a. named example;
b. treatment; **[2]**

eg:
a. *Salmonella;*
b. drink plenty of water (to avoid dehydration) / intravenous fluids/antibiotics if infection has spread to blood or other parts of the body;

(b) a. virus vector might infect another cell by mistake;
b. (virus vector) might place the new gene in the wrong section of DNA/cause cancer/mutation;
c. genes may be over-expressed/make too much protein which may be harmful;
d. (virus vector) might stimulate an immune reaction;
e. (virus vector) might be transferred from person to person;
f. children might be more sensitive to long-term hazards since their tissues are still developing; **[4 max]**

Option G — Ecology and conservation

19. (a) spider **[1]**

(b) 16.75 (%) **[1]**
Accept answer in the range of 16.5 (%) to 17 (%).

(c) a. both taxonomic groups showed movement to the north;
b. slightly more spiders moved north;
c. spiders shows the furthest northern shift;
d. range of ground beetles extends further south (than spiders);
e. the spiders biggest movement is 75 to 100 km to the north and the ground beetles biggest movement is 50 to 75 km to the north;
f. overall spiders have a broader range; **[2 max]**

(d) a. competition for resources/food/space/other resource;
b. change in predation/number of other species;
c. change/decrease/increase in biodiversity;
d. food webs may change; **[2 max]**

(e) a. climate change/<u>enhanced</u> greenhouse effect/global warming;
b. competitive exclusion/availability of food/habitat;
c. increased predation / spiders and beetles feed on them; **[1 max]**

20. (a) the <u>dry</u> weight/mass of matter in organisms **[1]**

(b) a. lichens secrete chemicals/acid which break down inorganic material/rock;
b. lichens/plants/litter change pH of the soil (which prevents/assists some species to establish);
c. organisms increase the mineral/organic/humus content of the soil when they decompose;
d. (organic matter and humus) can increase water retention;
e. plant (roots) can bind soil preventing erosion / break down soil particles; **[3 max]**

(c) (i) biosphere is all the parts of the Earth where organisms live <u>and</u> biomes are divisions of the biosphere **[1]**

(ii)

biome	***typical temperatures***	***type of vegetation***
eg: tundra	cold with some warming in summer	low-growing plants / lichens / mosses;
eg: temperate rain forest	hot in the summer and cold in the winter	*eg*: coniferous trees / cedar / fir;

[2]

Accept any valid biome with accurate details.

21. (a) biomagnification/bioaccumulation **[1]**

(b) a. every organism in an ecosystem has their own role;
b. (includes) spatial habitat/space inhabited by organism;
c. (includes) feeding activities of organism;
d. (includes) interactions with other species;
e. valid description of an organism's niche including habitat, feeding activities and interaction with other species; **[3 max]**