



MARKSCHEME

May 2014

BIOLOGY

Standard Level

Paper 3

14 pages

Option A — Human nutrition and health

1. (a) 0.5 kg (*units required*) [1]
- (b) increase / positive trend / towards gain in body mass [1]
- (c) is effective at maintaining mass as final mass is equal to initial mass;
only group not showing weight/mass re-gain (after 26 weeks);
shows weight loss / maintenance (with fluctuations) in early weeks;
last weeks (from week 18) show positive trend; [2 max]
- (d) excess carbohydrates converted/stored as fat/lipids;
source of obesity / gain in weight;
may increase risk of diabetes / other related health risk factor;
other nutrients may be deficient; [2 max]
2. (a) (i) chemical substance found in foods that is used in the human body [1]
- (ii) (amino acid that) can be synthesized by the body (from other nutrients) [1]
- (b) (i) dairy products / (oily) fish / egg yolk / liver / other verified source [1]
Do not award marks for any supplements.
- (ii) malignant melanoma results from repeated/prolonged exposure to UV;
sunlight contains some UV;
(moderate) daily exposure to sunlight stimulates skin to produce vitamin D;
vitamin D may help prevent osteoporosis/rickets/weak bones/low
immunity/some cancers/cardiovascular disease;
risk balanced by having moderate exposure to sunlight/sunbathing at safe
times/using sunblock/clothes;
supplements to provide vitamin D; [3 max]
3. (a) appetite control centre in brain is stimulated by hormones/ghrelin/leptin/
PYY336/insulin;
produced by pancreas/small intestine after eating;
(produced) by adipose tissue in response to fat storage;
stretch receptors in stomach send message to brain;
makes the person feel they have eaten enough; [3 max]
- (b) food miles are a measure of distance between production and consumption;
high food miles increases transport;
causes air pollution / traffic congestion / increases greenhouse gas emissions;
local foods not found all year round, so a balanced diet might not be achieved
with locally available foods;
buying local products supports local economy;
local foods are fresh/do not require preservatives; [3 max]

Option B — Physiology of exercise

4. (a) 25 L min^{-1} (units required) (allow a range between 24 and 26 L min^{-1}) [1]

(b) both increase as ventilation rate increases;
 both initially show a rapid increase which later levels out;
 cardiac output increases with work rate at a decreasing rate; [2 max]
Do not accept answers suggesting that cardiac output decreases as heart rate increases.

(c) 150 L min^{-1} ; (units required)
 the definition of $\text{VO}_2 \text{ max}$ is maximum oxygen uptake in one minute / maximum work rate so corresponds to highest data point for ventilation rate / OWTTE; [2]

(d) stroke volume increases cardiac output only up to (about) 40 L min^{-1} ventilation rate;
 heart rate increases cardiac output at all work rates/up to V_{max} ; [2]

5. (a) (i) any correctly labelled Z line on the image [1]

(ii) any correctly labelled dark band on the image [1]

(b) relaxed / not contracted [1]

(c)

<i>fast</i>	<i>slow</i>
maximum work rate over short period / strength	sustained activity / stamina;
lower myoglobin	higher myoglobin;
(can pass on to) anaerobic respiration	aerobic respiration;
moderate blood supply	good blood supply;

[2 max]

*Award [1] for each pair of statements up to [2 max].
 Answers do not need to be shown in a table format.*

(d) liver [1]

6. (a) warm-up is gradual increase in activity/stretching;
increases muscle blood flow/temperature/heart rate/dilation of (body) blood vessels/production of adrenalin;
prevent injuries;
benefit inconclusive / stretching prior to exercise controversial; *[2 max]*
- (b) exercise increases the need for oxygen (to muscular tissue);
increase in volume allows more air / oxygen in lungs;
increase in ventilation rate allows more gas exchange/oxygen and carbon dioxide to be exchanged;
increase in ventilation volume/rate allows more oxygen in blood (to meet increased muscle need);
sufficient oxygen allows aerobic respiration/prevents oxygen debt / insufficient oxygen means anaerobic respiration; *[3 max]*

Option C — Cells and energy

7. (a) reaction rate increases [1]
- (b) reaction rate decreases;
this happens at all L-DOPA concentrations; [2]
- (c) increase in substrate/L-DOPA concentration increases reaction rate [1]
- (d) reduces the production of melanin (so would prevent food from browning);
there may be other factors in the browning of plants/oxidation;
may change the taste/smell/appearance/texture / may be toxic;
more effective at lower concentration of L-DOPA/higher concentrations of HK; [2 max]

8. (a) (i) chloroplast [1]
- (ii) stroma [1]
- (b) action spectrum is quantity of photosynthesis for each wavelength;
absorption spectrum is quantity of light absorbed (by a pigment) for each wavelength;
absorption spectra of each pigment add up/correlate to make action spectrum /
OWTTE; [2 max]
Accept the above marking points in a clearly drawn correctly labelled graph.

(c)

<i>oxidation is the</i>	loss	<i>of electrons or the</i>	gain;	<i>of oxygen</i>	[2]
<i>reduction is the</i>	gain	<i>of electrons or the</i>	gain;	<i>of hydrogen</i>	

Award [1] for each correct row.

- (d) structure – collagen;
movement – actin/myosin;
transport – hemoglobin;
enzyme – catalase/ATP synthase/endonuclease;
immunity/defence – immunoglobulin/antibody;
hormones – insulin; [1 max]
*Accept any other valid examples, excluding membrane proteins.
Award [1] for a function with a named example.*

9. (a) polar amino acid interacts with phospholipids to control position of protein within membrane;
polar amino acid creates (hydrophilic) channels through membranes;
polar amino acid creates the interaction between enzyme and substrate/specificity of active site in enzymes;
affects solubility of proteins as non-polar proteins do not dissolve in water / *vice versa*; **[2 max]**
- (b) pyruvate is decarboxylated / carbon dioxide removed;
oxidized by removal of hydrogen;
reduced NAD produced and used in oxidative phosphorylation/electron transport chain;
acetyl group combines with coenzyme A;
acetyl CoA is formed in order to enter Krebs cycle; **[3 max]**

Option D — Evolution

10. (a) 15 (teeth) (*allow a range from 14 to 16*) [1]
- (b) (both) have more teeth in the upper jaw;
P. hecqui has more teeth on the upper and lower jaw than *P. elaviae*;
 the difference between the number of teeth in the upper and lower jaw is greater in *P. elaviae*;
 greater variation in number of teeth in *P. hecqui* / overlap in error bars in upper and lower jaw in *P. hecqui* but not *P. elaviae*; [2 max]
- (c) common ancestor occupied different geographical regions / each group received different selection pressures;
 adaptive radiation/divergent evolution;
 eventually the two groups became separate species / speciation occurred;
 (ancestor of) *P. elaviae* occupied deep whereas (that of) *H. microlepis* occupied shallow water;
P. elaviae and *H. microlepis* teeth adapted to different food sources; [3 max]
11. (a) (i) protruding (upper) jaw / larger teeth;
 large (eye)brow ridges;
 absence of/low forehead;
 smaller cranium (volume) / smaller brain; [1 max]
- (ii) 2.0 to 1.7×10^6 years ago/million years ago/mya (*units required*) [1]
Accept answers within the range of the 2.0 to 1.7 giving correct units.
- (b) (i) all the genes in an interbreeding population (at a certain time) [1]
- (ii) geographical isolation – land feature prevents parts of population to interbreed;
 hybrid infertility – hybrids cannot interbreed between themselves/members of original population;
 temporal isolation – parts of population do not breed at same time;
 behavioural isolation – parts of population do not breed because of behavioural differences; [2 max]
- (c) comets / meteorites/meteors [1]
Do not accept asteroids.
- (d) self replicating;
 can act as catalysts;
 (store) genetic information; [2]

12. (a) *H. sapiens* has not changed much genetically since it appeared / genetic evolution requires many generations/thousands of years for impact;
genetic evolution is due to inheritance of genes / allows for development of brain while cultural changes passed on through learning;
most changes are cultural / occur faster than genetic evolution / have a faster cumulative effect greater than genetic evolution;

[2 max]

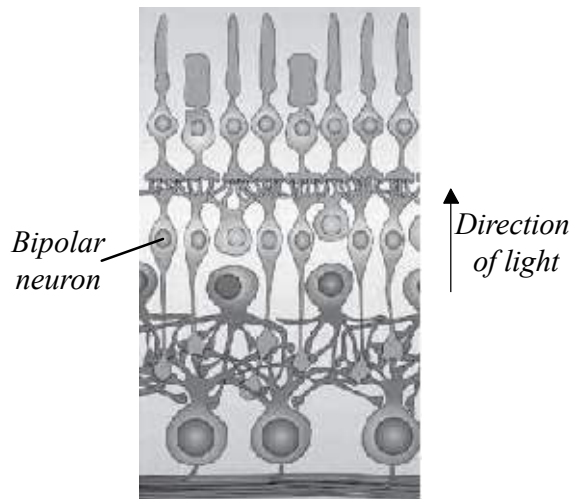
(b) species is a group of organisms able to produce fertile offspring;
reproduction of fertile hybrids is possible between close species (so definition does not apply) / explained example to that effect (eg. wolf and dog);
most hybrids are infertile (so shows definition applies) / explained example to that effect (eg. horse and donkey);

[2 max]

Option E — Neurobiology and behaviour

13. (a) (incubation time) 50% / 1 hour [1]
- (b) (i) 18 to 20 (hours) [1]
- (ii) higher earlier in the afternoon to prevent the eggs from overheating;
higher in the night to keep the eggs warm/prevent cooling;
higher at night to protect from predators; [2 max]
- (c) 4 to 6 / 6 to 8 / 8 to 10 / 18 to 20; (any two time periods required for [1])
(times when) not sitting on eggs much; [2]

14. (a) (i) correctly identified bipolar neuron [1]
- (ii) arrow pointing upwards [1]
- eg.:



(b)

<i>rod cells</i>	<i>cone cells</i>
use in dim light	use in bright light;
sensitive to all wavelengths	three types each sensitive to red, blue or green;
group of cells to one optic fibre	one cell to one fibre;
spread throughout the retina	concentrated in the centre / fovea;

[2 max]

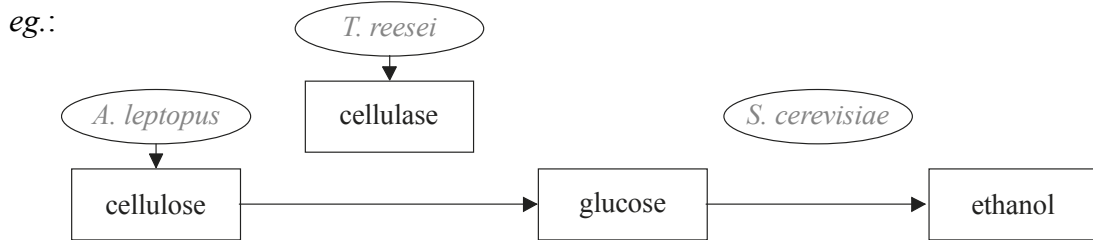
*Award [1] for each correct row up to [2 max].
Answers do not need to be shown in a table format.*

- (c) (i) arrow indicating direction of impulse to the right [1]
- (ii) X: sensory neuron;
Y: relay neuron / associative neuron / inter neuron; } (both needed) [1]
- (iii) Z: grey matter [1]

15. (a) (nerve fibres in) optic nerves cross at optic chiasma;
neurons from right visual fields from both eyes go to left brain/*vice versa*;
visual areas in the brain can therefore judge distance/produce 3D image/give
sense of depth; **[2 max]**
*Do not award marks for stating that all impulses from the left eye pass to the right
side of the brain and vice versa.*
- (b) (many) excitatory and inhibitory presynaptic neurons may be connected to
postsynaptic neuron;
impulses from excitatory neurons increase release of excitatory neurotransmitter
(in synaptic cleft);
impulses from inhibitory neurons increase release of inhibitory neurotransmitter
in (synaptic cleft);
effects of neurotransmitters combine/cancel each other to alter (probability of)
action potential/firing in postsynaptic neuron;
presynaptic neurotransmitters act at same time / add up in (very) short interval; **[3 max]**

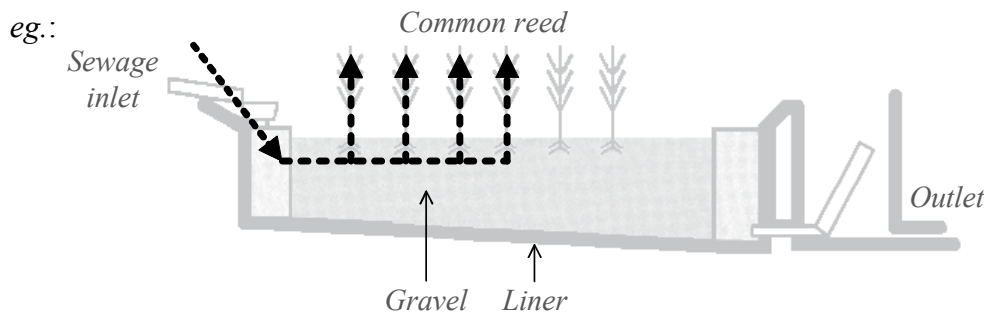
Option F — Microbes and biotechnology

16. (a) 1.0(%) [1]
- (b) Award [2] for 4 correct answers.
Award [1] for 2 or 3 correct answers.
Award [0] for 1 or no correct answer. [2 max]



- (c) both (generally) increase ethanol concentration as they increase;
cellulase has much greater effect than incubation time;
incubation time effect eventually decreases slightly; [2 max]
- (d) reduced incubation time would not change ethanol concentration much;
more product in less time (improves profit) / little increase in yield for a greater
expense due to a longer period of incubation is not worth while;
changing cellulase concentration has greater effect on yield; [2 max]
Do not accept “cellulose” instead of “cellulase”.

17. (a) (i) clear annotation indicating movement from (inlet to) gravel bed to reed [1]



- (ii) decompose organic matter / release nitrates [1]
- (iii) nitrogen fixation / use N₂/nitrogen from atmosphere to produce NH₃/ammonia [1]
- (b) uses RNA (as a template) to produce/catalyse the production of DNA;
used in the production of DNA without introns; [1max]
- (c) name of bacterium: *Pseudomonas aeruginosa*;
characteristic of aggregate: produces toxins only when in aggregates;
or
name of bacterium: *Vibrio fischeri*;
characteristic of aggregate: is bioluminescent only when in aggregates; [1 max]
Accept any other documented example.

18. (a) organism/food poisoning;
symptom;
method of transmission;
treatment;

[3 max]

eg.:

Clostridium botulinum/botulism;
weakness leading to (respiratory) paralysis;
contaminated prepared food kept in anaerobic conditions / example such as
non-sterile cans/tins;
antitoxin/respirator;
*Accept any other documented examples of diseases caused by contaminated food,
but do not accept answers relating to pathogens entering by ingestion not specific
to food poisoning.*

Award [1 max] if element is not related to the others.

Award [2 max] if organism name is not stated.

- (b) trigger an immune response;
vector/virus may spread to untargeted cells thus causing damage/disease;
virus may revert to original form causing (viral) disease;
can induce tumor if gene inserted in incorrect position;
may affect reproductive cells;
gene therapy often fails and this leads to disappointment / decades of experimentation
have led to poor results;

[3 max]

Option G — Ecology and conservation

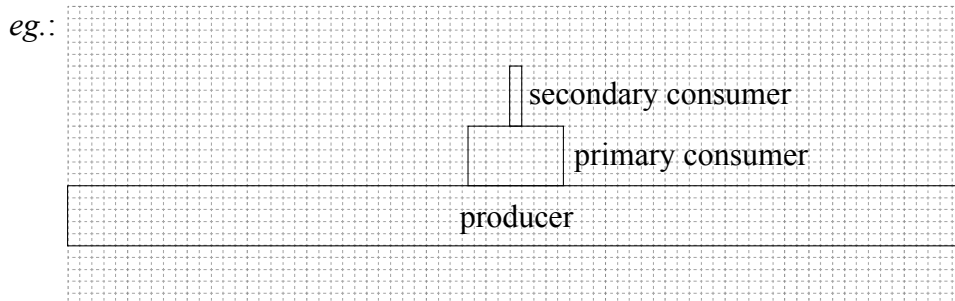
19. (a) 50% [1]

(b) the main food source for thick-lipped is insects while in thin-lipped it is algae;
thin-lipped eat more fish than thick-lipped;
they both eat the same amount/proportion of snails/plants;
only the thick-lipped eat crustaceans; [2 max]
Do not accept lists of numerical data which do not compare.

(c) they do not live in the same place;
(thin lips) not suited/adapted to feeding on crustaceans; [1 max]
Accept other reasonable responses.

(d) two species cannot occupy the same niche;
(not same species as) both Cichlids have different feeding habits;
feeding is a niche component so sufficiently different to be different species;
no information about their habitats/other niche components; [2 max]

20. (a) correct shape of pyramid with base larger than primary consumer and secondary consumer smaller than the rest;
pyramid proportions very close to 80:10:1 / correctly labelled values with units (24000, 3000 and 300 $\text{kJm}^{-2}\text{y}^{-1}$);
correctly labelled levels; [3]



(b) (i) process in which chemical substances become more concentrated at each trophic level [1]

(ii) (total) dry mass of organisms;
(total) dry mass of organic matter in ecosystem(s); [1 max]

(c) the quadrat positions are determined randomly within (the area of) the field;
the number of plantain plants in the quadrat is counted each time;
the area of the quadrat and the field are measured; *(both needed)*
apply a formula; [2 max]

21. (a) roots break down rock to create soil particles;
develop soil by adding litter/matter that decomposes;
absorb minerals deep in ground and accumulate them on top/in soil/litter;
prevent erosion by stabilizing soil with roots / retaining water that would otherwise run-off / adding organic matter that can retain water; *[2 max]*
- (b) ozone is produced in the (upper) atmosphere;
ozone absorbs ultraviolet radiation;
UV causes CFCs to dissociate;
byproducts react (repeatedly) with ozone to form (molecular) oxygen / destroy ozone;
allowing UV light to penetrate through atmosphere;
and cause damage within ecosystems/to biological molecules/cancer; *[3 max]*
-