Diploma Programme
Programme du diplôme
Programa del Diploma

Markscheme

November 2015

Biology

Higher level

Paper 2

11 pages

Subject Details: Biology HL Paper 2 Markscheme

Mark Allocation

Candidates are required to answer **ALL** questions in Section A **[32 marks]** and **TWO** questions in Section B **[2 × 20 marks]**. Maximum total = **[72 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.

Section B

Extended response questions - quality of construction

- Extended response questions for HL P2 carry a mark total of ***[20]***. Of these marks, ***[18]*** are awarded for content and **[2]** for the quality of construction of the answer.

- Two aspects are considered:
  expression of relevant ideas with clarity
  structure of the answers.

- **[1]** quality mark is to be awarded when the candidate satisfies **EACH** of the following criteria. Thus **[2]** quality marks are awarded when a candidate satisfies **BOTH** criteria.

Clarity of expression:

The candidate has made a serious and full attempt to answer all parts of the question and the answers are expressed clearly enough to be understood with little or no re-reading.

Structure of answer:

*The candidate has linked relevant ideas to form a logical sequence **within** at least two parts of the **same question** (eg: within part a and within part b, or within part a and within part c etc. but **not between** part a and part b or between part a and part c etc.).*

- It is important to judge this on the overall answer, taking into account the answers to all parts of the question. Although, the part with the largest number of marks is likely to provide the most evidence.

- Candidates that score very highly on the content marks need not necessarily automatically gain **[2]** marks for the quality of construction (and *vice versa*). The important point is to be consistent in the awarding of the quality marks.

Section A

1. (a) 59 ***or*** $50 + 9$ **[1]**

(b) higher <u>average</u>/<u>mean</u>/<u>mode</u>/<u>median</u> length in winter;
higher minimum length in winter / none below 225 mm in winter;
higher maximum length in winter / none above 260 mm in autumn;
smaller range (of length) in winter;
higher peaks in winter;
overlap between lengths of 260 and 225 mm;
more data/more caught in winter than in autumn; **[3 max]**
Allow the converse for any of the mark points.
Allow size instead of length and allow the two groups to be referred to either by season (autumn/winter) or year (2008/09).

(c) migration;
ocean currents;
food availability/distribution;
predation / fishing;
temperature;
location of rivers (flowing into the ocean);
depth of (sea)water; **[2 max]**
Reject "pollution" and mark only the first two responses.

(d) 11.7 g; (*accept answers in the range of 11.4 to 13.0 g)*
1.8 to 13.5 g; *(accept answers in the range of 1.6 to 2.0 g and 13.4 to 13.6 g)* **[1 max]**

(e) *autumn 2008*:
positive correlation / fork length increases as lipid content increases;

winter 2009:
no correlation / no overall trend; *(reject "constant" or "almost same")* **[2]**

(f) lipid stores accumulated during summer/in freshwater/before moving out to sea;
food resources/availability may decline rapidly during autumn/winter;
more food close to the shore (than in offshore water);
lipid stores used up during winter / more active/migrating in winter; **[2 max]**
Do not accept answers relating to the size of O. nerka because O. nerka with similar sizes showed different lipid content values.

(g) direct/positive correlation / higher PCB concentration further up the river **[1]**

(h) 1000 ng g^{-1} *(accept answers in the range 950 ng g^{-1} to 1050 ng g^{-1})* **[1]**
Do not award the mark if the units are missing or incorrect.
Allow units shown as ng g^{-1}.

(i) lipids used up so same quantity of PCB in smaller amount of lipid;
no excretion of lipids so same quantity of PCB in smaller amount of lipid;
PCB absorption through gills; **[1 max]**

2. (a) (i) 136 *(accept answers in the range of 132 to 140)* **[1]**

(ii) anaphase **[1]**

(iii)

onion cell	honey bee
cell wall	no cell wall;
chloroplast	no chloroplast;
large vacuole	no large vacuole;
fixed shape	no fixed shape;
starch stored	glycogen stored;
no centrioles/no centrosomes	has centrioles / has centrosomes;

[2 max]

*Award **[1]** for two correct, **[2]** for three correct answers.*
To award the mark both parts of a comparison must be stated explicitly or unambiguously implied.

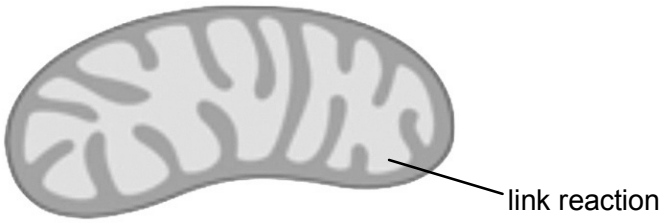
(b) much protein of one type needed/produced by polysomes;
mRNA is being repeatedly translated; **[1 max]**

3. (a) (i) *X*: humerus;
Y: synovial fluid / cartilage / joint capsule / elbow joint; **[2]**

(ii) join/attach muscles to bones **[1]**

(b) action potential/nerve impulse/motor neuron causes release of calcium;
calcium released from sarcoplasmic reticulum;
calcium causes binding sites on actin to be exposed;
myosin heads bind to binding sites/to actin and push actin (inwards); **[3 max]**

(c) (i)



[1]

Accept a line or arrow pointing to any part of the matrix, or a circle in it. It is not necessary to state link reaction unless more than one area is indicated.

(ii) accept/bind acetyl group/acetate / acetyl coenzyme A/acetyl CoA formed;
passes acetyl group/acetate to Krebs cycle; **[2]**

4. (a) tall and yellow **[1]**

(b) both indicate the same phenotypes / both represent tall green plants;

(AaBb indicates unlinked genes and) $\frac{A\ B}{a\ b}$ linked genes;

AaBb indicates genes on different chromosomes and $\frac{A\ B}{a\ b}$ on the same chromosome;

independent assortment/AB, Ab, aB and ab (gametes) with AaBb but not independent assortment/only AB and ab (gametes) with $\frac{A\ B}{a\ b}$ (unless there is crossing over); **[2 max]**

(c) Aabb ***or*** aaBb ***or*** $\frac{A\ b}{a\ b}$ ***or*** $\frac{a\ B}{a\ b}$ ***or*** tall yellow ***or*** short green **[1]**

Section B

Remember, up to TWO "quality of construction" marks per essay.

5. (a) *Award **[1]** for each structure accurately drawn and correctly labelled.*
a. haploid nucleus;
b. cytoplasm – with nucleus-to-membrane distance >4 times nucleus diameter;
c. centrioles – two must be shown but only one needs to be labelled;
d. cortical granules – needs to be drawn in vicinity of plasma membrane;
e. plasma membrane – shown as a single line and approximately circular overall;
f. polar cell / (first) polar body – needs to be drawn outside the egg cell;
g. zona pellucida / layer of gel (outside the cell membrane);
h. follicle cells / corona radiata (outside the cell membrane);
i. size shown as 100 µm/0.1 mm; *(accept 90 µm to 120 µm)* **[5 max]**

(b) a. plasmid used for gene transfer/removed from bacteria;
b. plasmid is a small/extra circle of DNA;
c. restriction enzymes/endonucleases cut/cleave DNA (of plasmid);
d. each restriction enzyme cuts at specific base sequence/creates sticky ends;
e. same (restriction) enzyme used to cut DNA with (desired) gene;
f. DNA/gene can be added to the open plasmid/sticky ends join gene and plasmid;
g. (DNA) ligase used to splice/join together/seal nicks;
h. recombinant DNA/plasmids inserted into host cell/bacterium/yeast; **[5 max]**

(c) a. variation in population;
b. (variation is) due to mutation/sexual reproduction;
c. valid example of variation in a specific population;
d. more offspring are produced than can survive / populations over-populate;
e. competition / struggle for resources/survival;
f. example of competition/struggle for resources;
g. survival of fittest/best adapted (to the changed environment)/those with beneficial adaptations / converse;
h. example of changed environment and adaptation to it;
i. favourable genes/alleles passed on / best adapted reproduce (more) /converse;
j. example of reproduction of individuals better adapted to changed environment;
k. alleles for adaptations to the changed environment increase in the population;
l. example of genes/alleles for adaptations increasing in a population;
m. evolution by natural selection;
n. evolution is (cumulative) change in population/species over time / change in allele frequency; **[8 max]**

Suitable examples are antibiotic resistance and the peppered moth but any genuine evidence-based example of adaptation to environmental change can be credited.

*(Plus up to **[2]** for quality)*

6. (a) *Award **[1]** for each structure clearly drawn and correctly labelled.*

a. sarcomere – clearly indicated between Z lines (whether Z lines named or not);
b. Z lines – shown at the ends of a sarcomere;
c. actin (filaments) – drawn as thin lines attached to Z lines;
d. myosin (filaments) – drawn as thick lines interdigitating with thin/actin filaments;
e. myosin heads – on both sides of at least one myosin filament;
f. light band and dark band – indicating regions of actin only and myosin plus actin; **[5 max]**

(b)
a. resting potential is –70 mV / relatively negative inside in comparison to the outside;
b. Na^+/K^+ pumps maintain/re-establish (the resting potential);
c. more sodium ions outside than inside (when at the resting potential);
d. more potassium ions inside than outside (when at the resting potential);
e. nerve impulse is an action potential that stimulates a (wave of) depolarization along the membrane/axon;
f. if neuron is stimulated/threshold potential/–50 mV is reached sodium ion channels open;
g. sodium ions diffuse/move in;
h. (Na^+ move in) causing depolarization;
i. potassium ion channels open / potassium ions diffuse/move out;
j. (K^+ move out) causing repolarization;
k. local currents / description of Na^+ ion diffusion between depolarized region and next region of axon to depolarize; **[8 max]**

Accept any of the above points clearly explained in an annotated diagram.

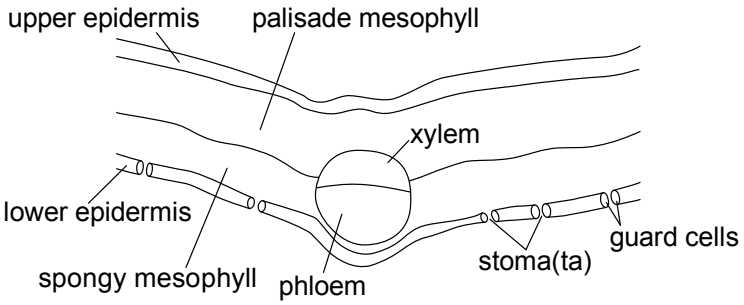
(c)
a. (plasma) membrane encloses/engulfs solid particles/droplets of fluid/molecules;
b. fluidity of the membrane allows endocytosis;
c. plasma membrane forms pit/forms indentation/pulled inwards/invaginates;
d. membrane pinches off/seals back on itself/edges fuse;
e. vesicle/vacuole formed;
f. inside of plasma membrane becomes outside of vesicle membrane / converse;
g. vesicle breaks away from plasma membrane/moves into cytoplasm;
h. active process / endocytosis/vesicle formation requires energy; **[5 max]**

Accept any of the above points clearly described in an annotated diagram.

*(Plus up to **[2]** for quality)*

7. (a) *Award **[1]** for each of the following structures, shown in the correct relative position and labelled. Individual cells are not needed but do not penalize if they are shown.*

eg:



a. epidermis – shown and labelled on either the upper or lower surface or both;
b. upper and lower epidermis – both labelled;
c. palisade layer / palisade mesophyll;
d. spongy layer / spongy mesophyll;
e. xylem (in upper part of a major or minor vein);
f. phloem (in a major or minor vein); *(accept whether upper or lower)*
g. guard cells; *(do not accept stoma or stomata only)* **[5 max]**

Do not penalize diagrams that show individual cells rather than tissues.

(b) a. less transpiration/water loss as (atmospheric) humidity rises;
b. air spaces inside leaf are saturated/nearly saturated (with water vapour);
c. smaller concentration gradient with higher atmospheric humidity;

d. more transpiration/water loss as temperature rises/with more heat;
e. faster diffusion / more kinetic energy (of water molecules);
f. faster evaporation (due to more latent heat available);

g. more transpiration/water loss as wind (speed) increases;
h. humid air/water vapour blown away from the leaf;
i. increasing the concentration gradient (of water vapour);

j. more transpiration/water loss in the light;
k. light causes stomata to open / stomata closed in darkness;
l. low CO_2 concentration inside leaf in bright light so stomata open wider; **[8 max]**

Accept any of the points if clearly made on an annotated graph.

(c) a. coolant in sweat/in transpiration;
b. water has a high heat of vaporisation / heat taken when hydrogen bonds break;
c. water is cohesive so can pulled up/so can be moved under tension in xylem;
d. water is an excellent/universal solvent/dissolves many different substances;
e. medium for transport in blood/xylem/phloem;
f. medium for metabolic reactions / (metabolic) reactions happen dissolved in water;
g. surface tension due to cohesion allows organisms to live on water surface;
h. water has high heat capacity so much energy required to change its temperature;
i. ice floats so lakes/oceans do not freeze allowing life under the ice;
j. high heat capacity so stable habitat/so temperature of water changes slowly;
k. used in chemical reactions/photosynthesis/hydrolysis in organisms; **[5 max]**

*(Plus up to **[2]** for quality)*

8. (a) *Award **[1]** for each of the following structures clearly drawn and labelled correctly in a diagram of the heart.*

a. left ventricle/right ventricle – both left and right ventricles must be shown but the mark can be awarded if either is correctly labelled. The left must be thicker walled than right and both must be larger than the atria;
b. left atrium/right atrium – both left and right atria must be shown with thinner walls than ventricles, but the mark can be awarded if either atrium is correctly labelled;
c. atrio-ventricular valves/tricuspid and bicuspid valves – positioned between atria and ventricles, with both labelled and tri/bicuspid correct if these names are used;
d. semi-lunar valves –shown at the start of the aorta and pulmonary artery, with the cusps facing in the right direction;

*Award **[1]** for any **two** blood vessels clearly drawn and correctly labelled.*
aorta – shown connected to the left ventricle;
pulmonary artery – shown connected to the right ventricle;
pulmonary vein – shown connected to the left atrium;
vena cava – shown connected to the right atrium; **[5 max]**

(b) a. (high blood glucose levels) detected by pancreas islet cells/beta cells;
b. insulin secreted in response (to high blood glucose/glucose above threshold level);
c. insulin stimulates cells to absorb glucose;
d. glucose used in cell respiration (rather than lipids);
e. glucose converted to glycogen (in liver/muscle cells);
f. glucose converted to fatty acids/triglycerides/fat;
g. negative feedback process; **[5 max]**

(c) a. ultrafiltration in the glomerulus produces (large volumes of) filtrate;
b. 80 %/most of water in filtrate is (always) (re)absorbed in proximal convoluted tubule;
c. water reabsorbed from filtrate in descending loop of Henle;
d. pituitary gland secretes ADH if blood solute concentration is too high;
e. ADH makes the collecting duct/distal convoluted tubule more permeable to water;
f. ADH moves aquaporins into the membranes (of cells in the tubule wall);
g. more water reabsorbed from filtrate/into blood due to ADH;
h. blood becomes more dilute / small volume of urine with high solute concentration;
i. with low/no ADH less water is reabsorbed in the collecting duct;
j. blood becomes more concentrated / large volume of dilute urine;
k. water reabsorption in collecting duct due to high solute concentration of medulla;
l. active transport of Na^+ ions from filtrate in ascending limb of loop of Henle; **[8 max]**

*(Plus up to **[2]** for quality)*