Diploma Programme
Programme du diplôme
Programa del Diploma

# Markscheme

## May 2023

## Biology

## Standard level

## Paper 2

16 pages

**Subject Details: Biology SL Paper 2 Markscheme**

Candidates are required to answer **all** questions in Section A and **one** out of **two** questions in Section B. Maximum total = **50 marks**.

**1.** Each row in the "Question" column relates to the smallest subpart of the question.

**2.** The maximum mark for each question subpart is indicated in the "Total" column.

**3.** Each marking point in the "Answers" column is shown by means of a semicolon (;) at the end of the marking point.

**4.** A question subpart may have more marking points than the total allows. This will be indicated by "**max**" written after the mark in the "Total" column. The related rubric, if necessary, will be outlined in the "Notes" column.

**5.** An alternative word is indicated in the "Answers" column by a slash (/). Either word can be accepted.

**6.** An alternative answer is indicated in the "Answers" column by "***OR***". Either answer can be accepted.

**7.** An alternative markscheme is indicated in the "Answers" column under heading ***ALTERNATIVE 1*** *etc*. Either alternative can be accepted.

**8.** Words inside brackets ( ) in the "Answers" column are not necessary to gain the mark.

**9.** Words that are <u>underlined</u> are essential for the mark.

**10.** The order of marking points does not have to be as in the "Answers" column, unless stated otherwise in the "Notes" column.

**11.** 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 "Answers" column 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) in the "Notes" column.

**12.** Remember that many candidates are writing in a second language. Effective communication is more important than grammatical accuracy.

**13.** 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.

**14.** Do **not** penalize candidates for errors in units or significant figures, **unless** it is specifically referred to in the "Notes" column.

## Section B

**Extended response questions - quality of construction**

- Extended response questions for SLP2 carry a mark total of **[16]**. Of these marks, **[15]** are awarded for content and **[1]** for the quality of the answer.

- **[1]** for quality is to be awarded when:
  - the candidate's answers are clear enough to be understood without re-reading.
  - the candidate has answered the question succinctly with little or no repetition or irrelevant material.

- 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 **[1]** for quality (and *vice versa*).

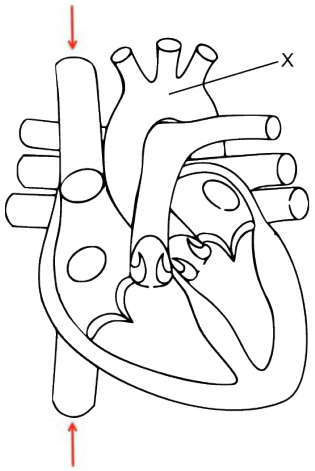
## Section A

| Question | | | Answers | Notes | Total |
|---|---|---|---|---|---|
| **1.** | **a** | | Japan: 6000 and USA: 4000; *(both needed)* | *state* | **[1]** |
| | **b** | | a. higher mode for the number of steps in UK/4000 versus 3000 in Saudi Arabia;<br>b. UK has more variation/is more spread out/greater standard deviation<br>**OR**<br>UK has a more normal distribution;<br>c. people in UK take more steps than people in Saudi Arabia; | *distinguish* | **[2 max]** |
| | **c** | | *highest*: New York and *lowest*: Charlotte; *(both needed)* | *identify* | **[1]** |
| | **d** | | a. majority of individuals are active/walk to places if walkability is high;<br>**OR**<br>high walkability encourages the habit of walking so the coefficient of activity inequality would be low;<br>b. with low walkability some individuals take exercise/go jogging and some do not;<br>c. (with high walkability) people don't need to drive increasing the incentive to walk; | *Suggest*<br>*Accept reasonable answer.* | **[2 max]** |

| Question | | | Answers | Notes | Total |
|---|---|---|---|---|---|
| 1. | e | | Similarities (Compare)<br>a. lower percentage of obesity with more steps per day in both males and females<br>***OR***<br>percentage obesity is most similar at 1000 steps<br>***OR***<br>correlation of steps to percent obesity plateaus after 8000 steps for both males and females;<br><br>Differences (Contrast)<br>b. the range difference of obesity percentage among different steps is bigger in females (9% - 31% versus 18% to 30%)<br>***OR***<br>walking has a greater impact on lowering obesity rates in females than males<br>***OR***<br>men show a greater percentage of obesity<br>***OR***<br>at 1000 steps per day there are more obese women than men; | *compare and contrast*<br>*One similarity and one difference required for two marks.* | **[2]** |
| | **f** | | *(any order)*<br>a. obesity causes people to be less active/take fewer steps;<br>b. people who are less active/take fewer steps (are more likely to) become obese;<br>c. People who are not obese tend to have healthier habits, including walking more; | *suggest*<br>*Accept hypothesis and a null hypothesis for the two.* | **[2 max]** |

| Question | | | Answers | Notes | Total |
|---|---|---|---|---|---|
| 1 | g | | as activity inequality rises percentage obesity rises<br>**OR**<br>Positive/direct correlation/relationship; | *state* | **[1]** |
| | h | | a. use public education to encourage people to walk more/become more active;<br>b. improve city design to improve walkability;<br>c. reduce distances between homes / shops / workplaces / parks;<br>d. more sidewalks / make it easier for pedestrians to cross roads / other specific measure; | *suggest*<br><br>*Do not accept answers that involve diet as that is beyond the scope of the data given.* | **[2 max]** |

| Question | | | Answers | Notes | Total |
|---|---|---|---|---|---|
| **2.** | **a** | | a. genes for digestive enzymes are transcribed in the nucleus;<br>b. rough ER/ribosomes produces/synthesizes enzymes/proteins;<br>c. mitochondrion produces ATP to provide energy for protein/enzyme production;<br>d. Golgi apparatus/body processes enzymes/proteins<br>***OR***<br>Golgi apparatus/body packages enzymes into vesicles;<br>e. vesicles carry enzymes to (plasma) membrane<br>***OR***<br>vesicles secrete enzymes by exocytosis; | *explain*<br>*Function must be attached to the name of the organelle to earn the mark.*<br>*Credit may be given for named pancreatic enzyme for mp-a or mp-b* | **[3 max]** |
| | **b** | **i** | digestion/hydrolysis/break down of lipids/fats/triglycerides (into fatty acids and glycerol); | *outline* | **[1]** |
| | | **ii** | amylase / endopeptidase / trypsin / trypsinogen / protease; | *state*<br>*Accept other verified pancreatic enzymes.* | **[1]** |

| Question | | | Answers | Notes | Total |
|---|---|---|---|---|---|
| 3 | a | | arrows added to the diagram to show how deoxygenated blood enters the heart;<br>  <br><br>[Source: CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=606903. Open access.] | *annotate* | **[1]** |
| | b | | aorta; | *identify* | **[1]** |
| | c | | a. contracts to generate high pressure / pumps blood at high pressure;<br>b. pump blood (through the aorta) to all parts of the body (apart from the lungs);<br>c. receives blood from the left atrium;<br>d. contraction is stimulated by the AV node; | *explain* | **[2 max]** |

| Question | | | Answers | Notes | Total |
|---|---|---|---|---|---|
| **4** | **a** | **i** | 10; | *state* | **[1]** |
| | | **ii** | hydrogen bonds/H bond; | *identify* | **[1]** |
| | **b** | **i** | a. heat increases molecular motion/vibration;<br>b. hydrogen bonds break/bonds between water molecules break;<br>c. water evaporation is separation of water molecules/water changes from liquid to gas/vapour;<br>d. heat removed from skin surface/body; | *explain* | **[2 max]** |
| | | **ii** | a. cooling/removal of heat/lowering body temperature;<br>b. to prevent overheating<br>***OR***<br>to help maintain body temperature/temperature homeostasis/for thermoregulation<br>***OR***<br>to keep temperature at 37 °C; | *outline* | **[2]** |

<table>
<tr><th colspan="3">Question</th><th>Answers</th><th>Notes</th><th>Total</th></tr>
<tr><td>5</td><td>a</td><td></td><td>a. allele/trait/gene for banded is dominant/allele for unbanded is recessive;<br>b. because two banded spiders produced some unbanded offspring<br>OR<br>because there is a ratio of 3 banded:1 unbanded;<br>c. both parents are heterozygous;</td><td>explain<br>Accept answers given in punnett squares</td><td>[2 max]</td></tr>
<tr><td></td><td>b</td><td></td><td>a. (1:1 ratio) in cross 2 banded parent is heterozygous/has one copy of each allele;<br>b. (no unbanded offspring) in cross 3 as banded parent is homozygous/has two alleles for banded;<br>c. (In crosses 2 and 3) banded parental phenotypes are the same, but their genotypes are different;</td><td>deduce<br>Accept answers given in punnett squares</td><td>[2 max]</td></tr>
<tr><td></td><td>c</td><td></td><td><table><tr><td>0</td><td>79</td><td>0.000/0</td></tr></table></td><td>predict</td><td>[1]</td></tr>
<tr><td></td><td>d</td><td></td><td>a. natural selection could favour one type over the other;<br>b. greater survival of one type<br>OR<br>one type better camouflaged than the other type;<br>c. one type more attractive during courtship/mate selection;</td><td>suggest<br>Do not accept a list. Natural selection or sexual selections alone are not adequate.</td><td>[2]</td></tr>
</table>

## Section B

***Clarity of communication*: *[1]***

*The candidate's answers are clear enough to be understood without re-reading. The candidate has answered the question succinctly with little or no repetition or irrelevant material.*

| Question | | | Answers | Notes | Total |
|---|---|---|---|---|---|
| **6.** | **a** | | a. supercoiling/condensation of chromosomes;<br>b. breakup of nuclear membrane;<br>c. growth of spindle/microtubules;<br>d. attachment of spindle/microtubules to chromosomes/centromeres;<br>e. chromosomes line up at the equator/middle<br>f. division of centromeres;<br>g. separation of sister chromatids/chromosomes<br>**OR**<br>sister chromatids/chromosomes move to opposite poles;<br>h. reformation of nuclear membranes around chromosomes at each pole; | *outline*<br>*If events are not in the correct order, then award a maximum of 4 marks.*<br>*Names of phases of mitosis not required.*<br>*Award a max of 1 mark for listing the phases in the correct order when the list constitutes the entire response.* | **[5 max]** |

| Question | | | Answers | Notes | Total |
|---|---|---|---|---|---|
| **6.** | **b** | | a. DNA is replicated;<br>b. unwinding of the double helix/DNA (by helicase)<br>**OR**<br>supercoiled DNA is relaxed (by gyrase);<br>c. hydrogen bonds broken<br>**OR**<br>strands separate;<br>d. synthesis of new strands of DNA (by DNA polymerase);<br>e. DNA replication occurs semi-conservatively<br>**OR**<br>existing strand used as a template (for a new strand of DNA);<br>**OR**<br>DNA replication is continuous on the leading strand, but discontinuous on the lagging strand;<br>f. copying base sequences occurs through complementary base pairing (in both transcription and replication);<br>g. DNA is transcribed;<br>h. synthesis of RNA/mRNA (by RNA polymerase);<br>i. copy of a gene produced/only one gene transcribed;<br>j. introns are removed;<br>k. RNA/mRNA exported/moves to the cytoplasm; | *describe* | **[7 max]** |
| | **c** | | a. gene/genetic information on Y chromosome causes embryo to develop testes;<br>b. (developing) testes in embryo secrete testosterone;<br>c. testosterone causes male genitalia/penis to develop; | *explain*<br>*Accept SRY gene in mp-a* | **[3 max]** |

| Question | | | Answers | Notes | Total |
|---|---|---|---|---|---|
| 7. | a | | a. binomial naming<br>**OR**<br>genus and species name;<br>b. plants constitute a kingdom<br>c. plants are eukaryotes/belong to the domain eukaryota<br>d. classified using a hierarchy of taxa<br>**OR**<br>kingdom, phylum, class, order, family, genus, species<br>e. bryophyta/filicinophyta/coniferophyte/angiospermophyta is a <u>phylum</u> (of plants);<br>f. bryophytes have only rhizoids/spores (produced in a capsule)/no roots/ no vascular tissue;<br>g. filicinophytes have stems/roots/xylem-phloem/reproduce by spores/leaves that uncurl; but no seeds<br>h. coniferophytes have seeds in cones/ vascular tissue/xylem-phloem/cambium/ but no flowers/no fruits<br>i. angiospermophytes have flowers/produce seeds/produce fruits/vascular tissue/xylem-phloem;<br>j. named example showing ~~of~~ the classification of a plant from species to domain or vice versa<br>k. <u>cladistics</u> is used to reclassify groups of plants<br>***OR***<br>named example of a group of plants reclassified by <u>cladistics</u>;<br>l. use a dichotomous key to discriminate among plant features | *describe*<br>*Each phylum of plants requires at least 2 features for the mark.*<br>*Mp-e does not require all 4 phyla to be named.* | **[7 max]** |

| Question | | | Answers | Notes | Total |
|---|---|---|---|---|---|
| 7. | b | | a. absorption/diffusion of carbon dioxide from the atmosphere/water by plants;<br>b. <u>photosynthesis</u> fixes/converts carbon (dioxide) to carbohydrates/carbon compounds;<br>c. respiration in plants converts carbohydrates/carbon compounds to carbon dioxide;<br>d. saprotrophs/detritivores digest dead plants/plant matter releasing carbon/carbon dioxide;<br>**OR**<br>decomposition returns carbon to the soil/releases $CO_2$ to atmosphere/water/environment<br>e. peat forms when decomposition of dead plant matter is incomplete storing carbon/ creating a reservoir;<br>***OR***<br>fossilization of carbon stores carbon as coal/oil/natural gas;<br>f. forest fires/combustion of plants converts (carbohydrates/carbon compounds) to carbon dioxide;<br>g. plants are eaten by consumers (moving carbon in the food chain)<br>h. humans use plant products for making cloth/household items/building/arts creating a reservoir for carbon<br>***OR***<br>Humans burn fossil fuels releasing $CO_2$;<br>i. Plants act as carbon sinks/reservoirs | *outline*<br>*Note: carbon may be used in place $CO_2$ an carbohydrates* | **[5 max]** |

| Question | | | Answers | Notes | Total |
|---|---|---|---|---|---|
| 7. | c | | *Award **[2 max]** for risks and **[2 max]** for benefits.*<br><br>*Risks*:<br>a. harm to a wild species because the GMO might out compete the wild species removing it from the ecosystem / example of harm to a wild species;<br>b. spread of the transferred gene has resulted in farmers being sued for growing GMOS without permission / other example<br>c. consumer resistance to genetically modified crop plants can result in countries experiencing famine not accepting seeds from aid organizations / other reason;<br>d. some nutritional improvements may result in allergens being introduced;<br>e. resistance to herbicides is used to kill weeds around crops and this herbicide can cause damage from overspray;<br><br>*Benefits*:<br>f. higher yields can feed more people / other value;<br>g. resistance to pests because less pesticide use results;<br>h. resistance to herbicides results in farmers being able to use herbicides to kill weeds without causing damage to the crops;<br>i. improved nutritional quality / example of improved nutritional content/shelf life;<br>i. increased tolerance to drought/salinity allows yields in places where crops were previously unsuccessful;<br>k. reducing land use for crops makes the land available for other uses; | *discuss*<br><br>*Risk or benefit must be supported to earn the mark.*<br><br>*Other supported risks or benefits may be accepted.* | **[3 max]** |