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 underlined 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.

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.

Section A

Question			Answers	Notes	Total
1.	a		a. nearly half is *Bacteroides* / more *Bacteroides* (than other enterotypes); b. few *Prevotella*/fewer *Prevotella* than in P and R ***OR*** less *Faecalibacterium* than other enterotypes **OR** *Ruminococcus* is the lowest in B2; c. only 40% other taxa / fewer other taxa (than other enterotypes) / less overall diversity (of taxa);		**2 max**
1.	b		1.9×10^{11} / 190000 million / 190 billion (cells per gram);	*Cells per gram not needed as in stem.* *Accept 1.80×10^{11} to 1.95×10^{11}.*	**1**

(continued…)

(Question 1 continued)

Question			Answer	*Notes*	Total
1.	**c**		a. lower values for cell counts in B2 (than in R) / converse ***OR*** median is higher in R (than in B2) / R median is 1.9 versus B2 median is 1.1 ***OR*** lower number of cell counts in R; b. all counts in R higher than third/75th/upper quartile in B2 ***OR*** 25-75% range (box) in B2 is smaller than in R; c. R maximum 3.1 versus B2 maximum is 2.1 ***OR*** R maximum is higher than B2 max; d. B2 minimum is lower than R minimum;	*The ranges are basically the same.*	**2 max**
1.	**d**		a. only one sample/count/data point; b. only analysed feces from one person (with this enterotype); c. not a big enough sample;		**1 max**

(continued…)

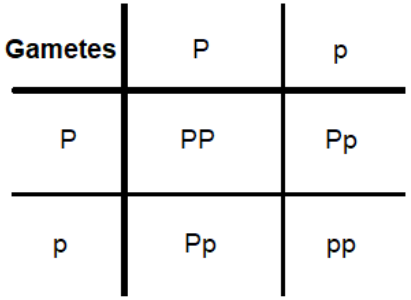
(Question 1 continued)

Question			Answer	Notes	Total
1.	**e**	**i**	0.35;	*Accept any values between 0.33 and 0.37.* *Accept 35%.*	**1**
1.	**e**	**ii**	B2 is associated/commoner/more prevalent in people with higher BMI ***OR*** (prevalence of) B2 increases as BMI increases;	*Accept positive correlation/**OWTTE**.*	**1**
1.	**f**		a. R is more common/prevalent in people with low BMI; b. statement about it being far more common; c. but this correlation does not prove that R causes low BMI; d. low BMI could(actually) be the cause of higher prevalence of R;	*So 'R is <u>far more</u> common in people with low BMI', would gain both a and b.*	**2 max**

(continued…)

(Question 1 continued)

Question			Answers	Notes	Total
1.	**g**		a. high/highest % of B2 enterotype in people with BMI greater than (or equal to) 30 with no statins ***OR*** taking statins could reduce the percentage of B2 enterotype in people with BMI ≥ 30 ***OR*** reducing BMI to below 30 could lower % of people with B2 enterotype without taking statins; b. but statins may not cause a person to change from B2 to another enterotype ***OR*** lower B2 in those taking statins if BMI is >30 so might reduce IBD/inflammatory bowel disease ***OR*** but when BMI < 30, there is almost double the prevalence of B2 in those taking statins so might not have an effect / increase (prevalence of) inflammatory bowel disease;	*One for correct data and one for discussion*	**2**

Question			Answers	Notes	Total
2.	**a**		12;	*No alternative.*	**1**
2.	**b**		a. male and female gamete genotypes/alleles shown as P and p (or others following convention with a suitable key) in a punnet grid; b. F_2 genotypes shown as PP, Pp, pP and pp; c. F_2 phenotypes indicated for each genotype on the Punnett grid / 3 purple to 1 white ratio indicated;	*Accept other upper-case and lower-case letters for the alleles.*  *No punnet grid = 2 MAX.* *Allow ECF if alleles incorrect.*	**3**
2.	**c**		chance / ***OWWTE***;	*(any of the usual mechanisms causing recombination of alleles) NOT mutation.* *Any wording that implies the bigger the sample size, the closer to 3:1.*	**1**

Question			Answers	Notes	Total
3.	a		a. smoking/tobacco; b. passive smoking; c. Radon/other radiation; d. exposure to arsenic/asbestos/smoke from coal burning/fires/silica/rock dust/vehicle exhaust fumes/nitrogen oxides;		**1 max**
3.	b		a. fewer/smaller/lack of alveoli/air spaces; b. many cells/nuclei per area / much denser tissue; c. more cells undergoing mitosis (in the tumour);		**1 max**
3.	c		**See** a. more mitosis ***OR*** cells in prophase/metaphase/anaphase/telophase; **Why** b. more dividing cells/tumour cell divide uncontrollably ***OR*** a higher mitotic index;		**2 max**

Question			Answers	Notes	Total
4.	**a**	**i**	heterotrophic because it feeds on/eats food/other organisms /eats ants/termites/ doesn't photosynthesise/does not produce its own food;	*Do not accept "it is not autotrophic" as it is part of the stem question.*	**1**
4.	**a**	**ii**	a. what (prey) it eats/feeds on/ stomach content; b. the trophic level of what (prey) it eats/feeds on/the trophic level of ants/termites; c. trophic level is the position an organism occupies in the food chain/web;	*Do not award points for indicating that predator information is needed.*	**2 max**
4.	**b**		a. pentadactyl; b. homologous with limbs of other vertebrates; c. due to common ancestry; d. adaptation;		**2 max**
4.	**c**	**i**	three;		**1**
4.	**c**	**ii**	by counting the number of base/amino acid sequence differences;		**1**

Question			Answers	Notes	Total
5.	**a**		a. water forms hydrogen bonds but methane does not/hydrogen bonds form between water molecules, but are absent in methane; b. energy needed to break hydrogen bonds/intermolecular attractions; c. hydrogen bonds raise the freezing point/boiling point/heat capacity/heat of vaporization	*Mpa; a clear difference between the 2 substances is expected.* *Mpc; do not accept "water has a high boiling point", etc. if no reference is made to hydrogen bonds.*	**2 max**
5.	**b**		a. boiling point of methane is -160°C ***OR*** methane is in gaseous state when temperatures are above/higher than -160ºC; b. temperatures on Earth are always above -160°C;	*Mpb; accept reference to Earth average temperature being warmer / higher than methane boiling point.*	**2**
5.	**c**		a. heat of vaporization is low/heat of vaporization is only 760 J g^{-1} ***OR*** methane has a lower heat of vaporization compared to water; b. no hydrogen bonds need to be broken; c. not enough heat removed when methane evaporates; d. methane boils at -160 °C so would already be a gas (in/on the human body);	*Mpa: the second statement aims at the idea of a comparison*. *Mpa: accept vice versa.* *If methane is not referred to directly in the answer, then award **[1 max]**.*	**2 max**

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. speed of reaction/catalysis increases as temperature rises; b. faster molecular motion so more collisions between substrate and active site; c. denaturation at higher temperatures; d. (denaturation causes) shape/conformation/structure of enzyme/active site altered/damaged; e. an enzyme works fastest at its optimum temperature; f. inactivation at lower temperatures (due to very few collisions); g. sketch graph to model the effect of temperature on enzyme activity;	*Graphs would need to be well annotated.* *Must not be bell shaped.*	**4 max**
6.	**b**		a. secretes thyroxin; b. thyroxin causes the metabolic rate to rise; c. heat released by metabolism; d. thyroxin increases generation of body heat; e. thyroxin stimulates shivering/stimulates brown adipose tissue (to release heat); f. more thyroxin secreted if body temperature too low/converse;		**4 max**

(continued…)

(Question 6 continued)

Question			Answers	Notes	Total
6.	**c**		a. release of carbon dioxide; b. combustion of fossil fuels produces carbon dioxide; c. forest fires (caused by humans) produce carbon dioxide; d. deforestation reduces carbon dioxide uptake by photosynthesis; e. release of methane; f. from cattle/sheep/ruminant digestive systems / other verified source of anthropogenic methane; g. greenhouse effect / carbon dioxide/methane is a greenhouse gas; h. carbon dioxide/methane allow short wave radiation in sunlight to pass through the atmosphere; i. longer wave/infra-red radiation emitted by the warmed Earth's surface; j. carbon dioxide/methane absorbs/reflects back longer wave/infra-red radiation;		**7 max**

[Plus one mark for quality]

Question			Answers	Notes	Total
7.	a		a. plasma membrane is thin layer forming outer boundary; b. cytoplasm fills space between membrane and nucleus; c. nucleus enclosed in nuclear membrane / nuclear membrane enclosing nucleus; d. chromosomes inside the nucleus/ visible during mitosis/ as rods (of condensed DNA); e. mitochondria with cristae/double membranes; f. (80S) ribosomes seen as dots free in cytoplasm/attached to rough ER; g. endoplasmic reticulum is a network interconnected tubes/ membranes /rough ER has ribosomes/ smooth ER does not; h. Golgi apparatus with stack of sacs/cisternae/curved or folded membranes/ vesicles budding off; i. vesicles which are small membrane sacs; j. lysosome which contains enzymes/which is densely staining; k. any other organelle that would be visible correctly described;	*Allow any point made on an annotated diagram.* *Do not award any marks for just labels. Descriptions are needed.*	**7 max**

(continued…)

(Question 7 continued)

7.	**b**		a. respiration/cell respiration; b. energy released from glucose/lipids/organic compounds; c. anaerobic respiration does not require oxygen; d. lactate is produced in anaerobic respiration/word equation for anaerobic respiration; e. oxygen used in aerobic respiration; f. carbon dioxide and water produced in aerobic respiration/word equation for aerobic respiration; g. mitochondria used for aerobic respiration; h. larger yield of ATP from aerobic than anaerobic respiration;		**5 max**
7.	**c**		a. reptiles dry skin versus amphibians moist skin; b. reptiles with scales versus amphibians not having scales / reptiles scaly skin versus amphibians soft skin; c. reptile eggs have (soft) shells versus amphibian eggs no shell/coated in gel; d. reptiles internal fertilisation/sperm enters female versus amphibians external fertilisation ***OR*** amphibians require water for reproduction, reptiles do not; e. reptiles do not have larval stage versus amphibians have larval stage; f. reptiles do not develop gills versus amphibian larvae have gills;	*Both reptile and amphibian should be mentioned in each distinction.*	**3 max**

[Plus one mark for quality]