2226 – 4027M

Diploma Programme
Programme du diplôme
Programa del Diploma

Markscheme

May 2026

Biology

Standard level

Paper 2

17 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. 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. An alternative answer is indicated by "***OR***". Either answer can be accepted.

5. An alternative markscheme is indicated under heading ***ALTERNATIVE 1*** etc. Either alternative can be accepted.

6. Words in brackets ( ) in the markscheme are not necessary to gain the mark.

7. Words that are underlined are essential for the mark.

8. The order of marking points does not have to be as in the markscheme, unless stated otherwise.

9. 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 markscheme 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).

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

11. 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.

12. Do **not** penalize candidates for errors in units or significant figures, **unless** it is specifically referred to in the markscheme.

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**		a. (overall/gradual/steady) increase / increase in most years; b. (small) decreases in a few/some years; c. error bars increase in size with time ***OR*** error bars show data becomes less reliable / more uncertain over time ***OR*** large error bars show no significant difference from year to year;	*Accept reference to specific years for mpa and mpb.* *Accept positive relationship / correlation for mpa.* *Do **not** accept "exponential" for mpa* *Do **not** accept "proportional" or "directly proportional" for mpa.*	**2 max**
1.	**b**		48.2 million;	*Accept correct answer with no working,* *Do **not** accept 48.2 alone (must state "million")* *Accept other correct formats for the number e.g. 48 200 000 or* *4.82×10^7 or 48.2×10^6.*	**1**

Question			Answers	Notes	Total
1.	c		*Hypothesis supported:* a. most/the biggest number of the prey items are mammals ***OR*** mammals 56 (%) / grey squirrel 52 (%) and birds 41 (%); b. grey squirrels are the most numerous/most common prey species (and are mammals); *Hypothesis not supported:* c. only two species of mammal but more species of birds; d. other factors/ size of prey/ time of year/ seasonal changes in prey/ experimental repeats not considered; e. prey remains may not be from goshawks/ may be from other predators;	*Award **[2 max]** for hypothesis not supported.*	**3 max**
1.	d		a. larger/older trees more likely to be damaged ***OR*** proportion/percentage or trees damaged increases with age/size; b. larger/older trees more likely to be ring barked; c. bark damage mostly above 4m ***OR*** few trees damaged below 4m ***OR*** no damage below 1m (at all diameters);	*Do **not** accept greatest number of damaged trees in the size range 75 to 124 mm.* *Accept converse for mpa and mpb:* *smaller trees less likely to be damaged;* *smaller/younger trees less likely to be ring barked;*	**2 max**

Question			Answers	Notes	Total
1.	e		*Forest Sustainability* ***[2 max]*** a. killing goshawks reduces sustainability of forests; b. grey squirrels are a major prey item for goshawks ***OR*** fewer goshawks would mean more grey squirrels / fewer grey squirrels eaten / bigger population of grey squirrels; c. leading to more damage to trees / less regeneration of woodland; *Pheasant Sustainability* ***[2 max]*** d. goshawk population too small to control/reduce pheasant population ***OR*** goshawks don't eat many birds so pheasant population/sustainability not strongly affected; e. goshawks feed on corvids which eat pheasant eggs; f. fewer goshawks leads to more corvids / more predation (of pheasant eggs);	*Award **2 max** for points relating to forest sustainability (mp a,b and c) and **2 max** for points relating to pheasant sustainability (mp d,e and f).*	**3 max**

Question			Answers	Notes	Total
2.	**a**		glucose;		**1**
2.	**b**		a. oxygen needed for aerobic but not anaerobic; b. aerobic produces a lot of ATP/releases a lot of energy whereas anaerobic produces only a little ATP/releases a little energy; c. <u>carbon dioxide</u> and <u>water</u> produced by aerobic whereas <u>lactic acid</u>/<u>lactate</u> produced by anaerobic; d. aerobic requires/occurs partly in <u>mitochondria</u> whereas anaerobic only occurs in the <u>cytoplasm;</u> e. aerobic can use many substrates/organic carbon sources whereas anaerobic only uses glucose/carbohydrate;	*Mp a: Distinction must involve both types of respiration, such as when they use "only" e.g Only aerobic requires oxygen.* *Mp b: Accept more ATP/energy produced by aerobic (per glucose). Accept numbers showing aerobic produces more.* *Mp c: Do not award the mark if additional incorrect products are given e.g lactate and carbon dioxide for anaerobic.* *Mp e: accept two or more substrates for aerobic, e.g. carbohydrates and fats.* *If the candidate writes out both equations correctly award a and c and additional marks if additional marking points included e.g of a specimen answer* *<u>Aerobic</u>* *glucose + oxygen → carbon dioxide +water + a lot of energy* *<u>Anerobic</u>* *glucose → lactic acid + a little energy* *This would be worth 3 marks for a. b. and c.* *By showing both equations, a distinction is implied.*	**2 max**

Question			Answers	Notes	Total
2.	**c**		a. (many) alveoli provide large (total) surface area ***OR*** round shape of alveoli provides large surface area; b. extensive network/beds of capillaries provide a large surface area for gas exchange ***OR*** extensive network/beds of capillaries maintain high concentration gradient for gas exchange; c. alveolus/capillary wall one cell thick / have thin walls for short diffusion distance; d. surfactant/moisture lining the alveoli allows oxygen to dissolve / prevents collapse; e. branched network of bronchioles delivers oxygen to all parts of lungs;	*A structural feature linked to an adaptation or function is needed for each mark point. E.g. mpa is not met by "lungs have a large surface area" on its own.* *Mpa and b may be addressed in a single statement.* *Mpb: Accept "continuous blood flow"*	**3 max**

3.	**a**		harvesting/capturing/taking in/absorbing more light ***OR*** more photosynthesis ***OR*** greater safety from ground herbivores;	*Response must indicate an advantage (more/greater).* *Do **not** accept "moss gains nutrients".* *Do **not** accept benefits for the host tree.*	**1**
3.	**b**		*Advantage* a. abundant water supply / avoiding competition / greater opportunities for pollination/seed dispersal; *Disadvantage* b. anaerobic soils / poor supply of oxygen to roots / limited supply of nutrients / anaerobic/denitrifying bacteria encouraged / waterlogged soil damages roots;		**2**

Question			Answers	Notes	Mark
3.	**c**		a. long/large/pointed beak; b. long legs; c. good eyesight; d. long neck;	*Accept first answer only.* *Accept other reasonable suggestions e.g. white colour / large mouth / ability to move quickly.*	**1 max**

4.	**a**		a. hormone/chemical messenger; b. regulates/increases metabolic rate/processes; c. regulates/increases heat production / thermoregulation;		**2 max**
4.	**b**	i	(radioactive isotopes emit radiation that causes) mutation / is a mutagen / changes/damages DNA;	*Do **not** accept "damages/disrupts the cell".*	**1**
4.	**b**	ii	not passed on as the mutation is in somatic cells / not in germ cells/gametes ***OR*** only mutations in germ cells can be passed on;	*Do **not** allow "not passed on because the cause is environmental" or "because it is an acquired characteristic".*	**1**

Question			Answers	Notes	Total
4.	**c**		a. probably autosomal as all female children have the condition ***OR*** probably autosomal as the male II–1 is affected; b. dominant since all children affected in every generation / no identified carriers; c. can only be recessive if I–1 and II–3 are both carriers/heterozygous ***OR*** I–1 and II–3 unlikely to both be carriers of the same rare condition; d. could be recessive since not much data / outcomes could be due to chance;	*For mpa and mpb discussion points must be linked to evidence from the pedigree chart.* *For mpa accept "not sex linked as not more common in males" or equivalent statement.* *Accept answers that state "autosomal dominant because all children are affected" This gains mpa and mpb*	**2 max**

5.	**a**		a. vaccinating high percentage/proportion of population ***OR*** very infectious diseases require high proportion of population to be vaccinated/exposed/immune; b. to stop spread of disease / impede transmission / low chance of infection; c. campaigns to vaccinate as many of a population as possible ***OR*** babies/children/vulnerable groups targeted (as they are not immune);		**2 max**

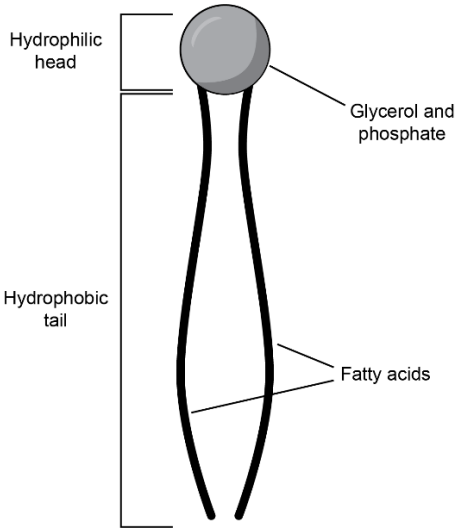
Question			Answers	Notes	Total
5.	**b**		a. memory cells produced; b. produce same/specific/identical antibodies if re-infected; c. antibodies produced rapidly (on secondary exposure) so preventing infection ***OR*** rapid secondary immune response;	*Do **not** accept a description of the primary immune response for mpb or mpc. The emphasis here is on long lasting changes: memory cells / secondary immune response.*	**2 max**
5.	**c**		measles has the highest R_0 therefore it is very infectious/spreads quickly ***OR*** one infected person transmits the disease to many /12 to 18 people, so measles is very infectious;	*"measles is very infectious" is not enough to gain the mark. Reasoning must also be given, simply stating the R_0 value is not sufficient.*	**1**
5.	**d**		a. targeted/at risk groups are more likely to be infected/become seriously ill/die if infected ***OR*** foetus may be affected/at risk ***OR*** frontline health workers have a high risk of exposure; b. herd immunity is only 17–29 % / not all adults need to be immune/vaccinated to achieve herd immunity; c. may have large cost implications to vaccinate all / less expensive / less resources to vaccinate few / more cost effective to vaccinate high risk groups first;	*Accept responses that specify any one named target group.*	**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. plasma/cell membrane controls what can enter and leave the cell; b. cytoplasm is the site for metabolic reactions / contains enzymes for catalyzing reactions; c. ribosomes carry out protein synthesis/translation; d. cytoskeleton provides structure/shape ***OR*** cytoskeleton is involved in internal transport; e. DNA is the genetic material ***OR*** RNA is needed for translation/transcription/protein synthesis;	*Award **[3 max]** if one or more features that not all cells have is included: common examples include: cell wall, membrane-bound organelles, chloroplast, plastids, mitochondria, nucleus, nucleolus, nuclear envelope, vacuoles, vesicles, golgi apparatus, ER (smooth or rough), centrioles.* *Do **not** accept a simple list of components. The role must be given.*	**4 max**

Question			Answers	Notes	Total
6.	**b**		a. new species formed by speciation; b. populations may undergo geographical/physical separation / named example; c. (this leads to) reproductive isolation (of populations); d. no interbreeding/gene transfer between isolated populations; e. variation may arise due to random mutation; f. selection operates in different ways ***OR*** selection pressures may differ / named example of selection pressure; g. species/populations evolve by natural selection; h. characteristics/alleles diverge (in each population); i. divergence/change is gradual/requires many generations; j. change in heritable characteristics/alleles is evolution; k. separation when fertile offspring cannot be produced by interbreeding ***OR*** a species is a group of organisms that can interbreed and produce fertile offspring;	*Accept answers based on the chimpanzee / bonobo example.* *Accept other valid examples of speciation.*	**7 max**
6.	**c**		a. codons are triplets of bases; b. (most) codons/triplets code for an amino acid; c. there are 64 possible codons but only 20 amino acids (to be coded for); d. stop codons have no corresponding amino acid; e. degenerate / more than one codon/triplet for a single/the same amino acid; f. universal / shared by all organisms; g. evidence for the common ancestry/unity of life;	*mpd, accept any one correct stop codon: UAA/UGA/UAG*	**4 max**

Question			Answers	Notes	Total
7.	a		a. <u>two</u> fatty acids/fatty acid chains (make up the tail); b. phosphate group linked to glycerol (makes up the head); c. (phospholipid molecule is) amphipathic ***OR*** has **both** hydrophobic and hydrophilic regions/properties; d. head is hydrophilic / head attracts/is attracted to water; e. (fatty acid/hydrocarbon) tails are hydrophobic / tails repel/are repelled by water; f. form bilayers (in water);	*Accept correctly annotated diagram.*  *Diagram with labels earns 4 marks: mpa, b d and e.* *Accept diagrams with two fatty acids drawn and labelled.* *Award mpb only if both phosphate and glycerol are mentioned.* *Mpc must be stated explicitly and cannot be earned simply by addressing mpd and mpe.*	**4 max**

Question			Answers	Notes	Total
7.	b		a. integral/transmembrane proteins are embedded in the phospholipid bilayer; b. integral/transmembrane/membrane proteins transport molecules/specific ions/dissolved substances across the membrane; c. allows membrane to be selectively permeable; d. channel proteins for facilitated diffusion; e. (net) passive movement of particles from higher to lower concentration / along/down/with the concentration gradient; f. channel proteins can be open (allowing transport) or closed (preventing transport); g. pump proteins for active transport; h. use energy from (hydrolysis of) ATP; i. particles move from lower to higher concentration/against the concentration gradient; j. aquaporins facilitate the movement of water; ***OR*** aquaporins allow rapid movement of water ***OR*** aquaporin movement of water more rapid than simple diffusion;	*Allow named examples of substances transported for mpb.* ***Do not** allow "transport protein" or "protein" (unqualified) for mpb since this is given in the question.* *Allow molecules/specific ions/dissolved substances/solutes for "particles" in mp e and i.* *Mp c: Membrane selectivity must clearly relate to proteins.* *Accept specific examples for d (calcium channels) and g (e.g. sodium/potassium pump).*	**7 max**

Question			Answers	Notes	Total
7.	**c**		a. resting potential is approximately –70mV; b. active transport/active process / requires (the hydrolysis of) ATP; c. controlled by sodium-potassium pumps ***OR*** the sodium-potassium pump is a transmembrane protein (antiport); d. 3 Na+ ions pumped out for every 2 K+ ions pumped in; e. concentration/electrochemical gradient (established); f. the cell interior is (relatively) negative compared to the extracellular environment;	*Accept a drawing for mpf if charges of intracellular and extracellular regions are labeled correctly.*	**4 max**