Biology B Paper 3 Mark Scheme

Question Number	Correct Answer	Additional guidance	Mark
1(a)	An answer that makes reference to two of the following: • drain land to reduce mosquito larvae habitats (1) • use of mosquito repellent to prevent bites (1) • reduce mosquito population by use of insecticides (1)		**(2)**

Question Number	Correct Answer	Additional guidance	Mark
1(b)	An explanation that makes reference to the following: • malarial {parasite/merozoite} {invades/destroys} red blood cells (1) • therefore reduced haemoglobin {red cell count} which causes anaemia (1)		**(2)**

(Total for Question 1 = 4 marks)

Question Number	Correct Answer	Additional guidance	Mark
2(a)	Measurement from diagram: 2.1 cm = 0.021 m (1) Actual distance: 0.021 m ÷ 226 = 9.2×10^{-4} m (1) Calculate speed: 0.02 ms = 2.0×10^{-5} s 9.2×10^{-4} m ÷ 2.0×10^{-5} s = 4.65 ms^{-1} (1)	e.c.f. at any stage penalise once only Correct answer gains full marks with no working	**(3)**

Question Number	Correct Answer	Additional guidance	Mark
2(b)	An explanation that makes reference to the following: • myelin may absorb / reflect light (1) • therefore less light passes to light sensitive cells (1) • hence some rod / light sensitive cells not stimulated / bleached (1)		**(3)**

(Total for Question 2 = 6 marks)

Question Number	Correct Answer	Additional guidance	Mark
3(a)	An answer that makes reference to the following: • measure volume by use of {formula / three way tap and syringe} (1)		**(1)**

Question Number	Correct Answer	Additional guidance	Mark
3(b)	An explanation that makes reference to the following: • the indicator fluid movement would move to the left (1) • because there is lower pressure (1) • because there is respiration but no photosynthesis (1) • therefore the pressure is reduced because the carbon dioxide produced is absorbed (1)		**(4)**

Question Number	Correct Answer	Additional guidance	Mark
3(c)(i)	An explanation that makes reference to five of the following: • use of a larger container because mice are bigger (1) • need to use more carbon dioxide absorber to ensure all carbon dioxide is absorbed (1) • convert readings into units per gram for each animal (1) • attach a syringe to enable {repeat measurements / volume measurements}(1) • abiotic variables such as light / temperature to be same as in the woodlouse experiment (1) • barrier to protect mouse from carbon dioxide absorber / do not leave mouse in the container for a long time (1)		**(5)**

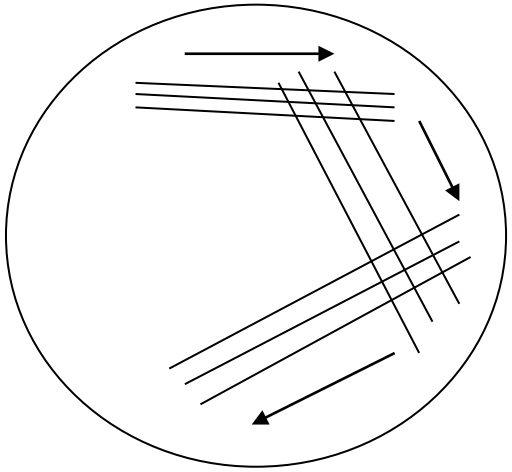
Question Number	Correct Answer	Additional guidance	Mark
3(c)(ii)	An answer that makes reference to the following: • mouse rate of respiration greater than woodlouse (1) • because mice are endotherms / metabolic rate greater / need to maintain body temperature because of heat loss (1)		**(2)**

(Total for Question 3 = 5 marks)

Question Number	Correct Answer	Additional guidance	Mark
4(a)	An explanation that makes reference to the following: • Tasmanian wolf and Dunnart more closely related (1) • because there are fewer base differences between Dunnart and the Tasmanian wolf than between the grey wolf and Tasmanian wolf (1)	For answers relating to grey wolf and Dunnart Base differences quantified {only 2 differences between Tasmanian wolf and Dunnart but 5 between grey wolf and Dunnart, and 7 between grey wolf and Tasmanian wolf}	**(2)**

Question Number	Correct Answer	Additional guidance	Mark
4 (b)	An explanation that makes reference to the following: • placental mammal/grey wolf has more successful reproduction than marsupial mammal/ Tasmanian wolf (1) • because young are born more {developed/mature}marsupial offspring very small so less likely to survive (1) • therefore grey wolves outcompete Tasmanian wolves unless Tasmanian wolves are geographically isolated (1)		**(3)**

(Total for Question 4 = 5 marks)

Question Number	Correct Answer	Additional guidance	Mark
5(a)	 A description that makes reference to the following: • <u>flame</u> a wire loop / use of <u>sterile</u> swab (cotton bud) (1) • first streaks of sample in straight /zig-zag lines on surface of <u>sterile</u> agar plate (1) • at least 3 streaks in total (1) • second and third streak must pass through lines of previous streak (1) • incubate and take off individual colonies with wire loop (1)	Accept points from an appropriately labelled diagram (must be labelled if not described in text)	**(5)**

Question Number	Correct Answer	Additional guidance	Mark
5(b)	An explanation that makes reference to the following: • above 30 °C close to human body temperature (1) • so risk of incubating human pathogens which could infect students (1)	Reject higher temperature might kill off some bacteria	**(2)**

(Total for Question 5 = 7 marks)

Question Number	Correct Answer	Additional guidance	Mark
6(a)	An explanation that makes reference to the following: • the shaded leaves have a larger surface area to mass ratio and are therefore bigger and thinner than leaves in the sun (1) • bigger allows more {chloroplasts / chlorophyll} for absorption of light (1) • thinner allows shorter diffusion path for entry of carbon dioxide (1)		**(3)**

Question Number	Correct Answer	Additional guidance	Mark
6(b)	An explanation that makes reference to five of the following: • growing nettles in {pots / eq} to ensure soil pH / {mineral/ named mineral} content in pots is the same (1) • {measure / control} the {light intensity / duration} for both treatments to ensure light intensities are different (1) • watering regime is the same in both treatments to ensure same potential for leaf growth (1) • use {groups of pots / measure more leaves} so that data collected is reliable (1) • use genetically identical nettles in each treatment as some genes may affect growth (1) • make sure that all pathogens / consumers are prevented from access as they can reduce growth (1)		**(5)**

(Total for Question 6 = 8 marks)

Question Number	Correct Answer	Additional guidance	Mark
7(a)	An explanation that makes reference to the following: • initial concentration of casein will change quickly (1) • because enzymes cause large increase in reaction rates (1) • therefore only initial rate will measure the speed of reaction at the correct value of the independent variable/concentration of casein (1)	Active site occupation Substrate becomes limiting	**(3)**

Question Number	Correct Answer	Additional guidance	Mark
7(b)(i)	An explanation that makes reference to the following: • absorption has not decreased for 0.1% from 20 s to 30 s/reaction has stopped after 20 s/substrate has been used up (1) • but all other concentrations show a consistent change every 10 s for the whole 30 s (1)		**(2)**

Question Number	Correct Answer	Additional guidance	Mark
7(b)(ii)	An explanation that makes reference to the following: • an appropriate casein concentration chosen because substrate is not limiting (1) • absorption recorded in first 20s in order to obtain initial rates (1)		**(2)**

(Total for Question 7 = 7 marks)

Question Number	Correct Answer	Additional guidance	Mark
8(a)	• Numerator = 219.34 (1) • Denominator = 5 (1) • Standard deviation = 6.6 (1)	Correct answer gains full marks	**(3)**

Question Number	Correct Answer	Additional guidance	Mark
8(b)	An explanation that makes reference to the following: • S.D. shows variation from the mean (1) • a larger S.D. means greater spread, smaller S.D. is more reliable representation of the data (1) • therefore although ranges of A and B are the same, the S.D. shows there is more variation in the data for method B (1)	S.D. indicates spread of data	**(3)**

Question Number	Correct Answer	Additional guidance	Mark
8(c)	An explanation that makes reference to the following: • for method A if there is an error made it is multiplied by four, when calculating pulse rate per minute (1) • for method B counting for one minute may lead to inaccuracy due to loss of concentration (1) • both methods are measuring pulse rate rather than heart rate (1)		**(3)**

(Total for Question 8 = 9 marks)

Question Number	Correct Answer	Additional guidance	Mark
9(a)	*Staphylococcus* spp.		**(1)**

Question Number	Correct Answer	Additional guidance	Mark
9(b)	An explanation that makes reference to the following: • the number of living bacteria does not increase (1) • because cell division is prevented (1)	Accept more sophisticated answers that give details of how cell division is prevented	**(2)**

Question Number	Indicative content
***9(c)**	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. Candidates are expected to reach a decision/conclusion on whether the development of bacterial resistance is so serious and rapid that antibiotics will become ineffective in the treatment of the majority of bacterial infections. • Prior use of antibiotics increases the percentage of resistant bacteria, supported by quantitative data • Prior use of the named antibiotic has the greatest effect, supported by quantitative data • Increasing use of antibiotics increases selection pressures so more resistant strains • Shows understanding that resistance mechanisms are inherited by sexual means and lateral gene transfer, e.g. via plasmids and this means they can spread rapidly and in some cases across species • Bacteria have high reproduction rates and mutations more likely within a short time • Understands current methods used to limit increase in resistant strains such as strict controls on antibiotic prescribing, problems of ensuring patients complete course of treatment when symptoms disappear, limit use of antibiotics in animal husbandry etc. • Comments on difficulties of developing new drugs • Methods of preventing spread of resistant strains especially hospital infection • Movement of humans means that transfer of resistant strains will spread to new hosts more easily

Level	Mark	Descriptor
	0	No awardable material
Level 1	1-3	Provides little or no reference to a range of scientific ideas, processes, techniques and procedures. Scientific argument may be attempted, but fails to link biological concepts and/or ideas in order to support decision/conclusion. Limited attempt to address the question.
Level 2	4-6	Scientific reasoning occasionally supported through the linkage of a range of scientific ideas, processes, techniques and procedures. Scientific argument is partially developed. Attempts to synthesise and integrate relevant knowledge with linkages to biological concepts and/or ideas, leading to a notional scientific argument or decision/conclusion based on evidence.
Level 3	7-9	Scientific reasoning supported throughout by sustained linkage of a range of scientific ideas, processes, techniques or procedures. Scientific argument is well developed and logical. Demonstrating throughout the skills of synthesising and integrating relevant knowledge with consistent linkages to biological concepts and/or ideas, leading to nuanced and balanced scientific argument or decision/conclusion based on evidence.

(Total for Question 9 = 12 marks)

Question Number	Correct Answer	Additional guidance	Mark
10(a)	A description that makes reference to the following: • use of named fixative, e.g. fixation in ethanoic (acetic) ethanol (1) • remove 2 mm (accept 1 mm > 3 mm) of the tip and place on a slide (1) • add named stain for DNA {acetic or propanoic orcein / toluidene blue / Feulgen} (1) • add cover slip and press firmly vertically / without moving the cover slip (1)		**(4)**

Question Number	Correct Answer	Additional guidance	Mark
10(b)(i)	An explanation that makes reference to one of the following: • species – use other plant roots (1) • water culture used – grow in soil (1) • light – cover conical flask with opaque material (1) • distance – look at cells further from the root tip (1)		**(1)**

Question Number	Correct Answer	Additional guidance	Mark
10(b)(ii)	An explanation that makes reference to five of the following: • use of weeds grown {in a range of herbicide concentrations and without herbicide / units for range of herbicide concentrations to be used} to allow valid comparison (1) • weed roots exposed to herbicide for same time because time of exposure may affect mitosis (1) • compare MI of cells at same distance(s) because MI is different at different distances from the root tip (1) • reference to same abiotic factor such as {light / temperature / soil / field} because any of these may affect MI (1) • use of root tips that are the same {age / length} because these may affect MI (1) • plot graph to show the relationship between herbicide concentration and MI to allow lowest concentration that works to be identified (1)		**(5)**

Question Number	Correct Answer	Additional guidance	Mark
10(c)	An explanation that makes reference to three the following: • prophase absorbs twice as much light as cytokinesis because DNA/chromosome has replicated prior to prophase so twice as much DNA present (1) • as pairs of chromatids have separated in cytokinesis therefore DNA is reduced by half (1) • endosperm nucleus has 3 x DNA in pollen tube nucleus because a pollen tube nucleus {has only one set of chromosomes / haploid chromosome number} is produced by meiosis (1) • and the endosperm tissue has a triploid set of chromosomes (1)		**(3)**

(Total for Question 10 = 13 marks)

Question Number	Correct Answer	Additional guidance	Mark
11(a)	An explanation that makes reference to the following: • wash immerse in water / water without nitrate ions (1) • at a suitable temperature / stated temperature (less than 25 °C) (1) • reference to sterile water (1)		**(3)**

Question Number	Correct Answer	Additional guidance	Mark
11(b)	An answer that makes reference to the following: • reading from graph 5 mins = 4 μmol dm^{-3} 30 mins = 8 μmol dm^{-3} (1) • mean rate = increase ÷ time (4 ÷5) (1) • correct answer with units = 0.8 μmol dm^{-3} min^{-1} (1)	Candidate must state units for full marks	**(3)**

Question Number	Correct Answer	Additional guidance	Mark
11(c)	An explanation that makes reference to the following: • rate the same for both solutions between 0–10 minutes because initial uptake in both by (passive) diffusion (1) • rate with DNP zero between 20–30 minutes because uptake requires {energy / ATP} for active transport (1) • DNP prevents formation of ATP by chemiosmosis (1)		**(3)**

Question Number	Correct Answer	Additional guidance	Mark
11(d)	An explanation that makes reference to the following: • DNP transports protons across the inner mitochondrial membrane (1) • therefore preventing the establishment of a gradient across the membrane (1) • which prevents the formation of ATP (1)	 cristae Accept inhibits interaction between protons and ATP synthase	 **(3)**

(Total for Question 11 = 12 marks)

Question Number	Correct Answer	Additional guidance	Mark
12(a)	An explanation that makes reference to the following: • {Active site changes shape / not correctly formed} and no longer an efficient 'fit' to substrate (1) • because if one amino acid is changed then these bonds cannot form (1) • because only certain amino acids (e.g. cysteine needed for S –S bonding) can form disulphide bridges/hydrogen bonds/ionic bonds (1) • and these bonds are important in the formation of a tertiary/3D protein structure (1)		**(4)**

Question Number	Correct Answer	Additional guidance	Mark
12(b)(i)	An explanation that makes reference to the following: • (reduced activity of GA_{20} oxidase means) less active GA_{20} is produced (1) • therefore less GA_{20} means more DELLA proteins present (1) • hence more DELLA proteins means fewer transcription factors binding to growth regulator genes (1) • therefore resulting in growth regulator genes not expressed / growth less because transcription factors needed for expression of genes (1)	Less DELLA protein broken down	**(4)**

Question Number	Correct Answer	Additional guidance	Mark
12(b)(ii)	• equation $p^2 + 2pq + q^2 = 1$ (1) • $p^2 = 0.36$ so $p = 0.6$ (1) • $q = 0.4$ so $2pq = 2 \times 0.6 \times 0.4$ (1) • correct answer 48% (1)		**(4)**

(Total for Question 12 = 12 marks)

Question Number	Correct Answer	Additional guidance	Mark
13(a)	See table below • differences in ranks of distance and diameter (1) • D^2 values correct (1)		**(2)**

Distance from low water mark / m	**Rank of distance**	**Mean diameter of limpets / mm**	**Rank of diameters**	**Difference in the two ranks (D)**	**D^2**
0	9	19.8	3	6	36
5	8	20.2	1	7	49
10	7	19.6	4	3	9
15	6	18.8	5	1	1
20	5	20.1	2	3	9
25	4	17.4	6	-2	4
30	3	16.1	**9**	**-6**	**36**
35	2	16.9	8	-6	36
40	1	17.2	**7**	**-6**	**36**
				$\sum D^2$ =	**216**

Question Number	Correct Answer	Additional guidance	Mark
13(b)(i)	• 6 ΣD^2 = 1296 (1) • n (n^2-1) = 720 (1) • Correct r_s value = -0.8(00) (1)	e.c.f. from (a) Correct answer (with minus sign) gains full marks Must be minus sign for marking point 3	**(3)**

Question Number	Correct Answer	Additional guidance	Mark
13(b)(ii)	An answer that makes reference to the following: • there is a <u>significant negative</u> correlation between diameter of a limpet and height up the rocky shore (1) • because calculated value is greater than critical value (1) • at 5% significance level / 0.683 quoted (1)	Accept 2% or 1% critical value for m.ps 1 and 2 only Where no value is calculated in (b)(i) then accept marks in b(ii) for MP2 and 3 for theoretical explanation E.g. 'if value of r_s was greater than critical value (0.683) then there would be a significant correlation' would gain 2 marks	**(3)**

Question Number	Correct Answer	Additional guidance	Mark
13(c)	An answer that makes reference to five of the following: • limpets kept in sea-water in tanks at the same {temperature / salinity} as they affect growth (1) • suitable number of {limpets in each tank / tanks containing limpets} to ensure reliability (1) • size of limpets in each tank selected to be within (narrow) range to start / or same distribution of sizes to ensure same potential for growth (1) • provision of food for limpets in equal amounts in each tank as food affects growth (1) • withdrawal of water from tanks for different periods of time (1) • size measured {mass / diameter / area of foot} because dependent variable must be quantitative to allow for statistical testing (1)		**(5)**

(Total for Question 13 = 13 marks)