Mark Scheme (Results)

Summer 2018

Pearson Edexcel GCE In Biology Spec B (9BI0) Paper 03 General and Practical Principles in Biology

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

Using the Mark Scheme

Examiners should look for qualities to reward rather than faults to penalise. This does NOT mean giving credit for incorrect or inadequate answers, but it does mean allowing candidates to be rewarded for answers showing correct application of principles and knowledge. Examiners should therefore read carefully and consider every response: even if it is not what is expected it may be worthy of credit.

The mark scheme gives examiners:

- an idea of the types of response expected
- how individual marks are to be awarded
- the total mark for each question
- examples of responses that should NOT receive credit.

/ means that the responses are alternatives and either answer should receive full credit.

( ) means that a phrase/word is not essential for the award of the mark, but helps the examiner to get the sense of the expected answer.

Phrases/words in **bold** indicate that the meaning of the phrase or the actual word is **essential** to the answer.

ecf/TE/cq (error carried forward) means that a wrong answer given in an earlier part of a question is used correctly in answer to a later part of the same question.

Candidates must make their meaning clear to the examiner to gain the mark. Make sure that the answer makes sense. Do not give credit for correct words/phrases which are put together in a meaningless manner. Answers must be in the correct context.

Quality of Written Communication

Questions which involve the writing of continuous prose will expect candidates to:

- write legibly, with accurate use of spelling, grammar and punctuation in order to make the meaning clear
- select and use a form and style of writing appropriate to purpose and to complex subject matter
- organise information clearly and coherently, using specialist vocabulary when appropriate.

Full marks will be awarded if the candidate has demonstrated the above abilities.
Questions where QWC is likely to be particularly important are indicated (QWC) in the mark scheme, but this does not preclude others.

Question Number	Answer	Additional Guidance	Mark
1(a)	• E		**(1)**

Question Number	Answer	Additional Guidance	Mark
1(b)	An explanation that makes reference to three of the following: • slows {transmission / impulse} (1) • because reduced {myelin sheath / Schwann cells} (1) • affects saltatory conduction / affects jumping between nodes of Ranvier (1) • (change to membrane) affects action potential / ion movement / ion channels (1)		**(3)**

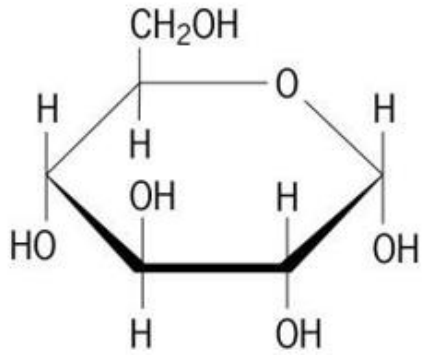
Question Number	Answer	Additional Guidance	Mark
1(c)	An answer that makes reference to the following: • neurone at resting potential (1) • because (voltage gated) sodium (ion) channels {closed / blocked} (1) • therefore no movement of sodium (ions) into neurone / into cell / into axon / across membrane (1) • therefore prevents {depolarisation / action potential} (1)	**ACCEPT** not open **DO NOT ACCEPT** nerve	**(4)**

Question Number	Answer	Additional Guidance	Mark
2(a)	An explanation that makes reference to two of the following: • dry leaves / do not put leaves under water (1) • because wet leaves reduce diffusion (1) or • {seal / use stem that fits} rubber connection (1) • therefore prevent loss of water from apparatus / maintain cohesion between water molecules (1) or • do not cut in air / cut under water (1) • prevents blocking xylem / prevent air getting into xylem / maintain {transpiration stream / water column / cohesion between water molecules} (1)	**ACCEPT** stem same size as capillary tube **DO NOT ACCEPT** entry of air	**(2)**

Question Number	Answer	Additional Guidance	Mark
2(b)	A explanation that makes reference to the following: • attach syringe / reservoir and (3-way) tap (1) • to return bubble to scale / reset bubble (1) or • use longer capillary tube / longer scale (1) • bubble on scale for longer (1)		**(2)**

Question Number	Answer	Additional Guidance	Mark
2(c)(i)	An explanation that makes reference to the following: • multiply cross-sectional area by distance moved by bubble / $\pi r^2 \times d$ / $\pi r^2 \times h$ (1) • divide by total area of leaves (1) • divide by 5 (1)		**(3)**

Question Number	Answer	Additional Guidance	Mark
2(c)(ii)	An explanation that makes reference to two of the following: • moving air moves {water molecules / droplets} away (from leaf) (1) • therefore increases concentration gradient / diffusion gradient / water potential gradient (1) • difference is significant because SDs do not overlap (1)	**ACCEPT** converse **ACCEPT** wind	**(2)**

Question Number	Answer	Additional Guidance	Mark
3(a)	• correct structure of alpha glucose		**(1)**

Question Number	Answer	Additional Guidance	Mark
3(b)(i)	An answer that makes reference to two of the following: • less needed for same sweet effect (1) • therefore less {energy / calorie} intake (1) • therefore less risk of appropriate named health benefit (1)	**e.g.** reduced obesity / (type 2) diabetes / tooth decay / heart disease / atherosclerosis / high blood pressure / CVD / CHD	**(2)**

Question Number	Answer	Additional Guidance	Mark
3(b)(ii)	• 0.066 to 0.074	**DO NOT ACCEPT** 0.06°	**(1)**

Question Number	Answer	Additional Guidance	Mark
3(b)(iii)	An answer that makes reference to the following: • with and without magnesium ions (1) • use same {volume / stated cm^3 / concentration} of isomerase enzyme (1) • use excess {glucose / substrate} (1) • control {temperature / pH} (1) • repeat to {calculate mean / calculate average / standard deviation / standard error / recognise anomalies} (1)	**ACCEPT** same mass **DO NOT ACCEPT** if in list	**(5)**

Question Number	Answer	Additional Guidance	Mark
4(a)	A description that makes reference to three of the following: • add {extract / pigment} to (start) line (1) • (concentrate spot by) dry and repeat (1) • place paper in named solvent (1) • obtain solvent front / place paper so line or spot above solvent / until reaches near top (1)	**e.g.** propanone / ethanol / petroleum ether **DO NOT ACCEPT** water	**(3)**

Question Number	Answer	Additional Guidance	Mark
4(b)(i)	An answer that makes reference to the following: • axis for chlorophyll content is linear and uses at least half grid (1) • accurate plot and standard deviation for little traffic (1)		**(2)**

Question Number	Answer	Additional Guidance	Mark
4(b)(ii)	An explanation that makes reference to three of the following: • quadrats placed at random / sampling at random (1) • method of random number sampling (1) • sampling done at same distance from {traffic / road} / transect placed parallel to {traffic / road} (1) • therefore removes bias / obtain running mean / ensures valid data (1)	**e.g** use of random number generator	**(3)**

Question Number	Answer	Additional Guidance	Mark
4(b)(iii)	An answer that makes reference to two of the following: • {heavy traffic / more lead} reduces chlorophyll content (1) One from: • photosynthesis not measured (1) • lead may be from other sources / other named factor may be responsible (1) • only one species of plant investigated (1)	**ACCEPT** converse **e.g.** light / Mg / other pollutant	**(2)**

Question Number	Answer	Additional Guidance	Mark
5(a)	• division (1) • multiplication (1)	3 ÷ 16 = 0.1875 0.1875 × 100 = 18.75 / 18.8 /19	**(2)**

Question Number	Answer	Additional Guidance	Mark
5(b)	A description that makes reference to four of the following: • use warm acid (1) • remove acid using water (1) • add named stain (1) • macerate or tease with needle (1) • use coverslip and squash (1)	**e.g.** acetic orcein / toluidine blue / Schiff's / Giemsa / Feulgen / (aceto) carmine	**(4)**

Question Number	Answer	Additional Guidance	Mark
5(c)	An answer that makes reference to four of the following: • use waterlogged soil and non-waterlogged soil / range of water content (1) • use same plant variety / type / species / age / size (1) • control {temperature / light / soil type / mineral ions / pH} (1) • leave for same stated time (1) • take cells from same part of root tips (1)	 **DO NOT ACCEPT** nutrients **DO NOT ACCEPT** less than 24 hours **e.g** both cut at 2mm	 **(4)**

Question Number	Answer	Additional Guidance	Mark
5(d)	An explanation that makes reference to four of the following: • aerobic respiration inhibited / anaerobic respiration occurs (1) • therefore {electron transport chain / oxidative phosphorylation} inhibited / therefore {glycolysis occurs / ethanol produced} (1) • less {ATP synthesis / reduced NAD} (1) • (less) active transport (of mineral ions) (1) • less {GP / GALP / IAA pumping / spindle fibre contraction / protein synthesis} (1)	**ACCEPT** valid substances / energy requiring processes **DO NOT ACCEPT** starch	**(4)**

Question Number	Answer	Additional Guidance	Mark
6(a)	A description that makes reference to three of the following: • locate specimen by using {low power / medium power} objective lens (1) • (focus) using {low power / medium power} objective lens before the high power objective lens (1) • only use fine focus with high power lens (1)		**(3)**

Question Number	Answer	Additional Guidance	Mark
6(b)	• multiplication (1) • division (1)	3.142×0.2^2 / 3.142×0.04 = 0.126 / 0.1257 / 0.12568 $18 \div 0.126 = 143$ Allow one mark if answer is 142.857 / 143.198 / 143.220 Correct answer gains full marks, with no working shown	**(2)**

Question Number	Answer	Additional Guidance	Mark
6(c)	conversion of mm into µm conversion of µm into mm conversion of µm into cm (1) divide image size by actual size (1)	Correct answer gains full marks, with no working shown 27 mm = 27 000 µm / 20 ÷ 1000 = 0.02 mm / 20 ÷ 10 000 = 0.002 cm 27 000 ÷ 20 = (×) 1350 / 13.5 x 10^2 / 1.35 x 10^3	**(2)**

Question Number	Answer	Additional Guidance	Mark
6(d)(i)	• calculate sum of d^2 and divide (1) • calculate square root (1)	Correct answer gains full marks, with no working shown 68.8 ÷ 4 = 17.2 square root of 17.2 = 4.1 / 4.147 / 4.15 One mark for 17.2 / 68.8	**(2)**

Question Number	Answer	Additional Guidance	Mark
6(d)(ii)	A description that makes reference to two of the following: • leaves at {same height / same age} on stem (1) • sample at same stated position of leaf (1) • same surface of leaf (1)	**DO NOT ACCEPT** same location / same part / same place **DO NOT ACCEPT** same area / same part / same place	**(2)**

Question Number	Answer	Additional Guidance	Mark
6(d)(iii)	An answer that makes reference to three of the following: • (reduced growth) because less carbon dioxide absorbed (1) • therefore less {GP / GALP / glucose / sucrose} (1) • less transpiration so less mineral ions (1) • therefore less named product (1)	**ACCEPT** converse **ACCEPT** cellulose / amino acids / protein / chlorophyll / DNA **DO NOT ACCEPT** starch	**(3)**

Question Number	Answer	Additional Guidance	Mark
7(a)(i)	An explanation that makes reference to the following: • to {kill / attenuate / inactivate / weaken / prevent reproduction} (1) • therefore less risk of {infection / disease / malaria} (1)		**(2)**

Question Number	Answer	Additional Guidance	Mark
7(a)(ii)	• vaccinate with {no *Plasmodium* / saline / water}	**ACCEPT** placebo	**(1)**

Question Number	Answer	Additional Guidance	Mark
7(a)(iii)	An explanation that makes reference to three of the following: • effective for {group B / high dose} because zero infected / not effective for {group A/ low dose} as some infected (1) • sample size of {group B / high dose} was {small / only 6 people} / sample sizes were small (1) • {group A / low dose} result similar to the {control / group C} (1) • (sample selection unknown so) no information about {gender / age / culture / health / prior infection} (1)	**ACCEPT** 100% effective for group B	**(3)**

Question Number	Answer	Additional Guidance	Mark
7(a)(iv)	A description that makes reference to five of the following: • antigen presenting cells / MHCs (1) • APC binds to {T cell / CD4 receptors} (1) • production of T memory cells (1) • (activated) T cells {stimulate B cells / release cytokines} (1) • production of B memory cells (1) • plasma cells release antibodies (1)		**(5)**

Question Number	Answer	Additional Guidance	Mark
7(b)	An explanation that makes reference to three of the following: • {random / chance} mutations (1) • produce {proteins / enzymes} that make the drug ineffective (1) • therefore resistant organisms pass on allele (1) • drug is the selection pressure (1)	**DO NOT ACCEPT** if mutation caused by drug **DO NOT ACCEPT** pass on mutation / gene	**(3)**

Question Number	Answer	Additional Guidance	Mark
8(a)(i)	• 1.52×10^7		**(1)**

Question Number	Answer	Additional Guidance	Mark
8(a)(ii)	A description that makes reference to three of the following: • damage to {endothelium} caused by {high blood pressure / toxins / smoking} (1) • inflammatory response and arrival of {macrophages / white blood cells} (1) • deposits of {cholesterol / calcium} (1) • formation of {atheroma / plaque} (1)	**DO NOT ACCEPT** fat / lipid	**(3)**

Question Number	Indicative content
***8(b)**	Answers will be credited according to candidate's deployment of knowledge and understanding of 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 Hardy Weinberg equation could be used to predict the number of people in the future who would need treatment in the UK for health disorders. **Lifestyle (L)** • HW only predicts genetic disorders • many health disorders are not genetic / caused by lifestyle • example of a lifestyle disease **Formula and Assumptions (A)** • assumes frequency of alleles remains constant / $p + q = 1$ refers to allele frequency • assumes frequency of genotypes remains constant / $p^2 + 2pq + q^2 = 1$ refers to genotype frequency • p^2 = homozygous dominant / $2pq$ = heterozygotes / q^2 = homozygous recessive • assumes no selection / random mating • assumes no mutation • assumes no migration • assumes large population / no genetic drift **Problems (P)** • recognises assumptions invalid • explain why assumptions are invalid • understands that countries have different population sizes • people unwilling to have a genetic test / risks with genetic tests / tests need to be done • genetic testing is expensive • cannot test for all alleles • understands that environment can affect gene expression

Level	Marks	
0	0	No awardable content
1	1-3	Demonstrates isolated elements of biological knowledge and understanding to the given context with generalised comments made. Vague statements related to consequences are made with limited linkage to a range of scientific ideas, processes, techniques and procedures. The discussion will contain basic information with some attempt made to link knowledge and understanding to the given context. **1 to 3 from L A or P (only one of L A or P)**
2	4-6	Demonstrates adequate knowledge and understanding by selecting and applying some relevant biological facts/concepts. Consequences are discussed which are occasionally supported through linkage to a range of scientific ideas, processes, techniques and procedures. The discussion shows some linkages and lines of scientific reasoning with some structure. **4 to 6 from L A or P (from at least two of L A or P)**
3	7-9	Demonstrates comprehensive knowledge and understanding by selecting and applying relevant knowledge of biological facts/concepts. Consequences are discussed which are supported throughout by sustained linkage to a range of scientific ideas, processes, techniques or procedures. The discussion shows a well-developed and sustained line of scientific reasoning which is clear and logically structured. **7 plus from L and A and P**

Question Number	Answer	Additional Guidance	Mark
9(a)(i)	• calculate rate of growth for both treatments (1) • subtraction (1)	rate for weeds 11 ÷ 5 = 22 rate for herbicide 180 ÷ 5 = 36 36 - 22 = 14 (cm year^{-1}) Correct answer gains full marks, with no working shown	**(2)**

Question Number	Answer	Additional Guidance	Mark
9(a)(ii)	An explanation that makes reference to the following: • herbicide is more effective at removing weeds (1) • therefore there is less competition for {light / carbon dioxide / mineral ions / water} (1)	**ACCEPT** converse **e.g.** herbicide kills all the weeds but removing by hand lets them grow again **DO NOT ACCEPT** nutrients	**(2)**

Question Number	Answer	Additional Guidance	Mark
9(a)(iii)	An explanation that makes reference to two the following: • same species of tree because trees grow at different rates (1) • {animals / pests / disease / herbivores / insects} as they {affect growth / feed on trees} (1) • same {number / spacing} of trees to control (intraspecific) competition (1)	**ACCEPT** trees get same light / mineral ions / water	**(2)**

Question Number	Answer	Additional Guidance	Mark
9(b)(i)	An explanation that makes reference to four of the following: • use same light intensity (1) • use red filter (1) • use tube {with clean sides / no scratches / holding opaque side} (1) • use a control tube with water to {calibrate / obtain zero absorbance} (1) • same {concentration / volume} of {chloroplasts / DCPIP} (1)	**DO NOT ACCEPT** same lamp / same bulb / same power / same distance	**(4)**

Question Number	Answer	Additional Guidance	Mark
9(b)(ii)	An explanation that makes reference to four of the following: • with herbicide DCPIP not {decolourised / reduced / stays blue} (1) • no electrons available / reduced electron transport (1) • less {reduced NADP / NADPH} (1) • therefore less ATP (1) • because the {Calvin cycle / light independent stage} are affected (1)	**ACCEPT** converse **DO NOT ACCEPT** absorbance does not change **DO NOT ACCEPT** if from ETC implies respiration	**(4)**

Question Number	Answer	Additional Guidance	Mark
10(a)(i)	• benzylpenicillin		**(1)**

Question Number	Answer	Additional Guidance	Mark
10(a)(ii)	An answer that makes reference to one of the following: • human cells are {eukaryotic / lack cell wall / lack peptidoglycan} (1) • human cells have different {ribosomes / enzymes} (1)	**ACCEPT** these antibiotics only affect prokaryotes	**(1)**

Question Number	Answer	Additional Guidance	Mark
10(b)	An explanation that makes reference to the following: • {binds to / changes shape of} the {enzyme / active site / RNA polymerase} (1) • therefore {transcription / mRNA synthesis} prevented (1) • no {proteins / polypeptides / enzymes} can be made (1)		**(3)**

Question Number	Answer	Additional Guidance	Mark
10(c)(i)	• multiplication (1) • division (1)	2×10^{10} divisions per day x 10^{-7} mutations per division / $2 \times 10^{10} = 20\,000\,000\,000$ $\div$ 10 000 000 / = 2 000 / 2×10^{3} Correct answer gains full marks, with no working shown ALLOW one mark for 20 000 000 000 / $\div$ 10 000 000 / 10×10^{6} / 1×10^{7}	**(2)**

Question Number	Answer	Additional Guidance	Mark
10(c)(ii)	An explanation that makes reference to three of the following: • different {R groups / disulphide bonds / hydrogen bonds / ionic bonds} (1) • therefore different secondary / tertiary structure (1) • therefore different shaped ribosome (1) • therefore streptomycin cannot bind (to ribosome) (1)		**(3)**

Question Number	Answer	Additional Guidance	Mark
10(d)	An answer that makes reference to five of the following points: • same species of bacteria (1) • same {concentration / volume} of antibiotic (1) • use {agar / broth / culture medium} (1) • incubate between 20 ^{0}C and 25 ^{0}C for stated time (1) • measure {zone of inhibition / turbidity} (1) • use of described aseptic technique (1)	**DO NOT ACCEPT** less than 24 hours **e.g.** use of Bunsen burner / flame loop / swab bench	**(5)**

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