

Mark Scheme (Results)

Summer 2022

Pearson Edexcel GCE
In Biology A Salters Nuffiled (9BN0)
Paper 3: General and Practical Applications 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.

Question number	Answer	Additional guidance	Mark
1(a)(i)	A description that makes reference to two of the following: • shading (coleoptile tip) reduces / stops bending (1) • light {detecting / sensitive} part of coleoptile is in first 5 mm (1) • no (significant) difference between {(exposure for) 2 or 3 hours / (shading of) 5 mm or 10 mm } (1)	ALLOW as (length of) shading increases degree of bending decreases ALLOW converse ALLOW part of coleoptile that bends is below the part that detects light	(2)

Question number	Answer	Additional guidance	Mark
1(a)(ii)	An explanation that makes reference to the following: • {5% / 1 in 20} probability (1) • the results (obtained) occurred by chance (1) OR • 95% probability (1) • the results (obtained) did not occur by chance (1)	IGNORE reference to null hypothesis ALLOW less than 5% ALLOW probability of 0.05 DO NOT ALLOW results are {accurate / correct / wrong}	(2)

Question number	Answer	Additional guidance	Mark
1(b)(i)	• temperature / light wavelength / light intensity (1)	ALLOW (mineral) ion concentration (in the buffer) / carbon dioxide concentration IGNORE humidity /sunlight / light unqualified	(1)

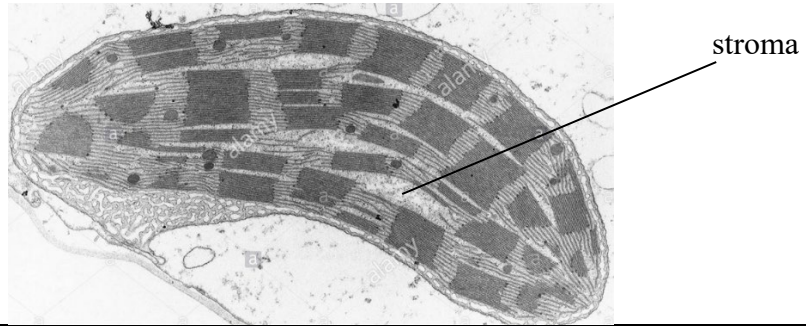
Question number	Answer	Additional guidance	Mark
1(b)(ii)	• calculation of both rates (1) • difference in rates with correct units (1)	Example of calculation (900 - 800) ÷ 30 = 3.33 ALLOW (896 – 800) ÷ 30 = 3.2 (806 – 800) ÷ 30 = 0.20 ALLOW (808 -800) ÷ 30 = 0.26 3.13 μm min^{-1} ALLOW value between 2.9 and 3.13 for difference Correct answer with no working gains full marks.	(2)

Question number	Answer	Additional guidance	Mark
1(c)	An explanation that makes reference to the following: • {IAA/auxin} is a (plant) hormone (1) • (investigation showed) cells grew longer with IAA / IAA stimulates cell elongation (1) • {light sensing / IAA producing} cells are in the tip (of the coleoptile) (1) • (results show) cell elongation happened in cells below the (shoot) tip (1) • the response to IAA is (relatively) {slow / prolonged} (1)	ALLOW IAA caused cell growth / increases cell length ALLOW cells that respond to IAA are in a different part of the coleoptile to the light sensing structures for MP 3 and 4	(3)

Question number	Answer	Additional guidance	Mark
2(a)	An explanation that makes reference to two of the following: • because influenza is (caused by) a virus (1) • antibiotics target {prokaryotes / bacteria} (1) • structure of a virus is different to that of a {prokaryote / bacteria} (1)	IGNORE antibiotics only kill bacteria ALLOW treat bacterial infections ALLOW description of structure or process targeted by antibiotics and only found in bacteria e.g cell wall, (70S) ribosomes IGNORE receptors / antigens / processes	(2)

Question number	Answer	Additional guidance	Mark
2(b)	• surface area of virus (1) • surface area of one spike protein (1) • correct whole number (1)	Example of calculation $4 \times \pi \times 120^2 = 180955.7$ (nm^2) ALLOW 180864 / 181028.6 $(22.4 \times 20) \div 2 = 224$ (nm^2) $180955.74 \div 224 = 808$ ALLOW 807 ECF for one incorrect area values For a maximum of 2 marks Correct answer with no working gains full marks.	(3)

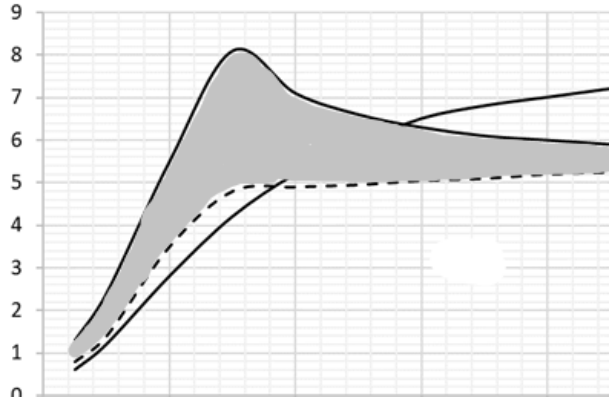
Question number	Answer	Additional guidance	Mark
2(c)	An answer that makes reference to the following: • {isolate / extract} RNA from (saliva) samples (1) • amplify the {RNA/DNA/nucleic acid} by PCR (1) • cut the {RNA/DNA/nucleic acid} into fragments (using restriction enzymes) (1) • (separate fragments using) gel electrophoresis (1) • more similar the {banding / profile} (of the fragments) the more closely related the strain (1)	ALLOW (reverse) transcribe RNA to DNA and amplify DNA ALLOW sequence the virus genome ALLOW the fewer the number of base changes the more closely related the strains	(4)

Question number	Answer	Additional guidance	Mark
3(a)(i)		ALLOW location of carbon fixation IGNORE unqualified letters	(1)

Question number	Answer	Additional guidance	Mark
3(a)(ii)	• granum	ALLOW stack of thylakoids / thylakoid / grana	(1)

Question number	Answer	Additional guidance	Mark
3(a)(iii)	A description that makes reference to three of the following: • large surface area (1) • containing {chlorophyll / photosystems / photosynthetic pigments} (1) • to absorb as much light as possible (1) • the membrane (contains) electron transport chain / (contains) ATP synthase for the synthesis of ATP (1)	 ALLOW PSII IGNORE to absorb light unqualified ALLOW ATP-ase	(3)

Question number	Answer	Additional guidance	Mark
3(a)(iv)	A description that makes reference to the following: • (the enzyme) RUBISCO (1) • combines carbon dioxide with RuBP (1) • unstable {6 carbon / 6C} molecule breaks down into (two) GP (1)	ALLOW five carbon molecule / 5C molecule / ribulose bisphosphate ALLOW glycerate phosphate	(2)

Question number	Answer	Additional guidance	Mark
3(b)(i)	Choose an item.  	ALLOW solid or hatched shading Shading must be complete (e.g. not stop at biomass line)	(1)

Question number	Answer	Additional guidance	Mark
3(b)(ii)	A description that makes reference to the following: • change in communities (1) • (taking place) over time (1)	 ALLOW change in species ALLOW a description of succession as a change from pioneer species to climax communities	 (2)

Question number	Answer	Additional guidance	Mark
3(b)(iii)	An answer that makes reference to three of the following: • (the energy lost in) respiration {levels off / stops increasing} (1) • accumulation of (the energy incorporated into) biomass continues (1) • therefore, with succession more carbon dioxide is fixed (1) • reduces the amount of carbon dioxide (in the atmosphere) (1)	 ALLOW more carbon sinks ALLOW more photosynthesis to remove carbon dioxide ALLOW (with succession) carbon dioxide released from respiration is less than the carbon dioxide fixed (by RUBSCO)	 (3)

Question number	Answer	Additional guidance	Mark
4(a)	• mass of dry powdered leaf (1) • mass of wet leaf (1)	Example of calculation 5000 ÷ 501.3 = 9.97 (9.974 ÷ 0.105) = 95.0 (g) ALLOW 1 mark only for correct figures but to incorrect d.p. e.g. 9.50 ALLOW 1 mark only for 47.6 Correct answer with no working gains both marks	(2)

Question number	Answer	Additional guidance	Mark
4(b)(i)	An answer that makes reference to the following: • solvent B (extract) has greatest (antimicrobial) activity / solvent A (extract) has the least (antimicrobial) activity (1) • {Gram negative bacteria / *Klebsiella*} are more sensitive (to both the solvent extracts) (1)	ALLOW solvent B {is more effective / increases the effectiveness} solvent A {is less effective / reduces the effectiveness} ALLOW both extracts more effective against {Gram negative bacteria / *Klebsiella*}	(2)

Question number	Answer	Additional guidance	Mark
4(b)(ii)	An answer that makes reference to the following: • prepare an agar plate with a bacterial lawn (1) • description of how extract can be added to the (agar plate) (1) • incubate at a stated temperature between 20 °C and 37 °C (1) • measure the diameter of the zones of inhibition after a (suitable) stated time (1)	ALLOW adding bacteria to agar / seeding agar plate with bacteria e.g. added to wells / on paper disks IGNORE at room temperature ALLOW time periods between 1 day and 1 week ALLOW calculate diameter	(4)

Question number	Answer	Additional guidance	Mark
5(a)	An explanation that makes reference to the following: • allows an animal (to learn) to ignore (repetitive) non-threatening stimuli (1) • therefore allowing it to focus on (potentially) more relevant stimuli (1)	ALLOW therefore allowing it to conserve {energy / resources} ALLOW converse – such as if animals did not habituate they would waste energy on unimportant stimuli	(2)

Question number	Answer	Additional guidance	Mark
5(b)(i)	An answer that makes reference to two of the following: • frequency of light-off pulses (1) • duration of light-off pulse (1) • {wavelength / intensity} of light (1)	ALLOW interval between {pulses / turning lights off}	(2)

Question number	Answer	Additional guidance	Mark
5(b)(ii)	An answer that makes reference to three of the following: • (with reduced synapsin) habituation is not as complete / there was a greater percentage of maximum jump response (1) • (with reduced synapsin) habituation takes place more slowly / jump-response decreases more slowly (1) • appropriate {manipulation / comparative use of data} (1)	ALLOW converse for normal synapsin ALLOW higher jump-response / jumped-more e.g. jump response decreases by (14-4) 10% more with normal synapsin / takes (30-5) 25 more light-off stimuli to get maximum response for reduced synapsin after 100 light stimuli 16% higher with reduced synapsin	(3)

Question number	Answer	Additional guidance	Mark
5(b)(iii)	An explanation that makes reference to three of the following: • (reduced synapsin) increases the number of vesicles fusing with the presynaptic membrane (1) • (resulting in more) {exocytosis / release} of neurotransmitter (into the synapse) (1) • therefore, (more) action potentials generated in post synaptic membrane (1) • therefore the flies (continue to) respond to the light-off stimulus (1)	ALLOW vesicles can continue to fuse ALLOW (more) depolarisation of post synaptic membrane	(3)

Question number	Answer	Additional guidance	Mark
5(c)	A description that makes reference to the following: • sequencing the {genome / genes / DNA} of people with (and without) ASD (1) • identify (genes that have) {mutations / differences in sequence} (between ASD and non-ASD individuals) (1)	ALLOW compare genomics of people with and without ASD ALLOW DNA profiling of people with ASD	(2)

Question number	Answer	Additional guidance	Mark
6(a)	• correct length calculated	3.3 / 3.33	(1)

Question number	Answer	Additional guidance	Mark
6(b)	A description that makes reference to the following: • starch can be {broken down / hydrolysed} into glucose (1) • by hydrolysis of the glycosidic bonds (1) • glycogen is formed by condensation reaction forming glycosidic bonds (between glucose molecules) (1)		(3)

Question number	Answer	Additional guidance	Mark
6(c)(i)	• correct values selected from graph and difference calculated (1) • correct percentage calculated (1)	Example of calculation 0.16 – 0.064 = 0.096 60% Correct answer with no working gains full marks	(2)

Question number	Answer	Additional guidance	Mark
6(c)(ii)	A description that makes reference to three of the following: • comparison using sensible period of time before 20 hours and after 24 hours (1) • use of a carbon dioxide absorber (1) • {observe movement of / measure distance moved by} (coloured) liquid in {capillary tube / respirometer} (1) • (coloured liquid) does not move during anaerobic respiration and moves during aerobic respiration compared to (1)	e.g. 0 to 20 hours compared with 24 to 30 hours / use 18 to 26 hours e.g. soda lime, sodium hydroxide ALLOW measure change in volume of gas in gas syringe (above embryos) ALLOW answers in terms of volume of gas produced / used	(3)

Question number	
*7	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. **Indicative content** Information • there are 20 000 different proteins • these proteins carryout different functions • there are a {large number of / 20} different {R groups / amino acids} • most R groups are non-polar, some are polar a few have a charge Linkage to **s**tructure • R groups determine {3D shape / structure} of proteins • {large number of / 20 R groups} • many combinations of amino acids required to give wide variety of protein structures • R groups can form bonds to stabilise 3D structure (e.g. cysteine) • role of R-groups in structure of haemoglobin • role of R-groups in structure of collagen • location of cysteine allows formation of disulfide bonds Linkage to **f**unction • R groups variety of protein shapes are required to allow proteins to carry out wide range of functions • examples of functions that require specific structure e.g. antibodies specific to an antigen / enzymes specific for a substrate / receptors e.g. neurotransmitters and (acetylcholine) and ion-gated channels • polar / ionic R groups increase solubility • non-polar R groups will be on outside of insoluble proteins / structural proteins / collagen / proteins inserted into membranes • role of R-groups in function of haemoglobin • role of R-groups in function of collagen Linkage to **l**ocation • polar R groups will be in aqueous environment /non-polar regions in a non-aqueous environment • polar /ionic R groups soluble in {plasma/ tissue fluid / cytoplasm} / line the inside of ion channels / found on the outside of soluble proteins such as hormones / transport proteins / immunoglobulins / cytokines • role of R-groups in location of haemoglobin • role of R-groups in location of collagen

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.	Selection of some information from the table – little or no linkage
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.	Linkage between R groups and two aspects from structure, function and location
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.	Linkage between R groups and all three aspects (structure, function and location)

Question number	Answer	Additional guidance	Mark
8(a)	An explanation that makes reference to three of the following: • there was isolation of (populations) of finches (1) • there were different selection pressures (at the different locations) (1) • (different / random) mutations in (different) populations of finches (1) • therefore allowing populations to adapt to different selection pressures (1)	ALLOW finches in different locations ALLOW different food sources act as a selection pressure ALLOW different beak shapes due to mutations DO NOT ALLOW selection pressures caused mutations ALLOW finches with better adapted beaks passed on their (favourable) alleles resulting in a change in the {allele frequency / gene pool}	(3)

Question number	Answer	Additional guidance	Mark
8(b)	An explanation that makes reference to three of the following: • {chemical mediators / histamine} released (1) • increasing blood flow / increasing capillary permeability / causing oedema (1) • {increasing number of / activating / recruiting} white blood cells (in the area of inflammation) (1) • (stimulating) the release of (catabolic) enzymes / increasing phagocytosis (of damaged tissue) (1)	ALLOW activating T killer cells / activating phagocytes / activating macrophages ALLOW tissues destroyed by {macrophages / phagocytes / T killer cells}	(3)

Question number	Answer	Additional guidance	Mark
8(c)	A description that makes reference to the following: • use of {MRI / CT / PET} scans (1) • before treatment and after treatment (1)	 ALLOW ultrasound scans / clinical investigation ALLOW regular scans / scans at stated frequency / over course of treatment	(2)

Question number	Answer	Additional guidance	Mark
8(d)	An explanation that makes reference to three of the following: • {chemicals in smoke / carcinogens / radiation} can damage DNA (1) • by changing the {DNA base sequence / chromosome number} (1) • with age there have been a greater number of cell divisions (1) • therefore a greater chance of an error (being introduced) in the base sequence of the DNA (during replication) (1)	 IGNORE they cause mutations ALLOW 'they damage DNA' ALLOW causing {epigenetic changes / methylation of DNA / acetylation of histones} ALLOW longer period of exposure (to mutagens) ALLOW (with age) there is a greater chance of change in chromosome number	(3)

Question number	Answer	Additional guidance	Mark
8(e)	An explanation that makes reference to two of the following: • cancer cells {grow / divide} (1) • therefore they need {oxygen / glucose} for respiration (1) • therefore they need {amino acids / nucleotides / lipids} for {growth / cell division} (1)	 ALLOW for production of a named cell component or process e.g. DNA / proteins cell membranes, protein synthesis	(2)

Question number	Answer	Additional guidance	Mark
8(f)	An explanation that makes reference to three of the following: • {mutation / change in base sequence} of a gene for {check point protein / cell cycle (control) protein} (1) • no check point (1) • activating oncogenes / deactivating tumour suppressor genes (1) • cell {cycle / division} is no longer inhibited / shortening the cell cycle (1)	IGNORE mitosis ALLOW 'mutation in gene involved in controlling the cell cycle' IGNORE rate of division increases ALLOW shorter S / G stage ALLOW uncontrolled cell division	(3)

Question number	Answer	Additional guidance	Mark
8(g)	A description that makes reference to four of the following: • stem cell is undifferentiated whereas a 'key player' is differentiated (to undertake a specific function) (1) • example of a 'key player' (1) • example of specific function of a named 'key player' cell (1) • number of divisions of a stem cell is unlimited whereas for a 'key player' the number of cell divisions is limited (1) • 'key player' has undergone differential gene expression (1)	ALLOW unspecialised and specialised e.g. B cells / plasma cells / phagocytes / lymphocytes e.g. (B cells) produce antibodies ALLOW Hayflick limit for 'key players' but not for stem cells	(4)

Question number	Answer	Additional guidance	Mark
8(h)	A description that makes reference to four of the following: • suitable study group selected (1) • treat one group with high dose and a second group with {minimum / lower} dose (1) • suitable sampling method (1) • repeat sampling over a period of time (1) • description of how results would demonstrate competitive release (1)	e.g. (two) groups of patients with same cancer (two) similar fields (two) flasks of bacteria e.g. chemotherapy agent pesticide antibiotic e.g. scanning random quadrats zones of inhibition e.g. (demonstrates competitive release if eventually) the cancer responds better to low dose of drugs than high dose only the low dose treated group remain sensitive to the antibiotic number of pests in field sprayed with high concentration of pesticide greater than number in field sprayed with lower concentration	(4)

Question number	Answer	Additional guidance	Mark
8(i)	A description that makes reference to two of the following: • (accumulation of) mutations resulting in change in target recognised by host (1) • transfer of genetic material coding for resistance genes (1) • example of a resistance mechanism (1)	 ALLOW mutations result in change in shape of antigens ALLOW transfer of plasmids between bacteria e.g. enzyme / change in shape of receptor binding protein / TB mechanisms, waxy coat / virus using host cell membrane	(2)

Question number	Answer	Additional guidance	Mark
8(j)	An answer that makes reference to four of the following: Argument in favour • a utilitarianism – the overall benefits of the experiments are greater than any harm done (1) • welfare argument - animals can be used if they are treated well as far as possible (1) Argument against • rights argument - all animals have rights (not just humans) (1) • results may not be applicable to humans (1) • consent argument - animals are unable to give consent (as is required for human trials) (1)	 e.g. animals can be used if their use is regulated e.g. it is not acceptable to keep animals in laboratory cages / not acceptable to cause pain suffering to mice	(4)

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