

Mark Scheme (Results)

Summer 2025

Pearson Edexcel A Level GCE
In Biology A Salters - Nuffield (9BN0)
Paper 03: General and Practical Applications in Biology

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Summer 2025
Question Paper Log Number P78659A
Publications Code 9BN0_03_2506_MS
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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

Question number	Answer	Additional guidance	Mark
1(a)(i)	An answer that makes reference to two of the following: • change in species (of plants and animals) (1) • taking place over time (1) • leading to a climax community (1)	 ALLOW change in community IGNORE organisms	 (2)

Question number	Answer	Additional guidance	Mark
1(a)(ii)	An answer that makes reference to the following: • correct values taken from the graph (1) • correct answer given to two significant figures with an appropriate unit (1)	<u>Example of calculation</u> 16 - 2 = 14 1995 – 1986 = 9 (ALLOW 14.2 and 9) 14 ÷ 9 = 1.6 (species) year^{-1} e.g. of acceptable unit (species) per year / (species) per y One mark can be given for 1.6 with no units Correct answer with no working gains full marks	 (2)

Question number	Answer	Additional guidance	Mark
1(a)(iii)	An answer that makes reference to the following: • colonising (species) / pioneer (species)	ALLOW coloniser IGNORE reference to plants	(1)

Question number	Answer	Additional guidance	Mark
1(b)(i)	An answer that makes reference to the following: • group of (different) tissues that work together to carry out a (specific) function	ALLOW functions plural / job / role / task / process DO NOT ALLOW similar tissues	(1)

Question number	Answer	Additional guidance	Mark
1(b)(ii)	An answer that makes reference to two of the following: • amino acids (1) • {DNA / RNA / nucleic acids} (1) • DNA polymerase / RNA polymerase (1)	 ALLOW nucleotides / ATP / mRNA / tRNA / rRNA ALLOW DNA helicase	 (2)

Question number	Answer	Additional guidance	Mark
2(a)(i)	An answer that makes reference to the following: • correct values substituted into the equation (1) • correct answer to three decimal places (1)	<u>Example of calculation</u> $V = \pi(0.2)^2 \frac{1}{3}$ = 0.042 (mm^3) One mark can be given for 0.0419 Correct answer with no working gains full marks.	(2)

Question number	Answer	Additional guidance	Mark
2(a)(ii)	An answer that makes reference to the following: • Eukaryota / Eukarya / Eukaryotes		(1)

Question number	Answer	Additional guidance	Mark
2(b)(i)	An answer that makes reference to the following: • strength / force of tap	ALLOW hardness	(1)

Question number	Answer	Additional guidance	Mark
2(b)(ii)	An answer that makes reference to the following: • data from graph used to estimate the percentage contracting (between 50 and 60 taps) to be within the range of 25 to 35 (%) (1) • show how a value close to 45 can be derived from relevant percentage of 150 stentors (1)	e.g. 30(%) of 150 Stentor / 0.3 x 150 = 45 ALLOW values from 37 - 53	(2)

Question number	Answer	Additional guidance	Mark
2(b)(iii)	An answer that makes reference to the following: • (overall) as number of taps increases the {number / percentage} of Stentor contracting decreases (1) • the Stentors were becoming habituated (1)	 ALLOW negative correlation between number of taps and percentage of Stentors contracting IGNORE inversely proportional ALLOW not all Stentors habituated at 60 taps ALLOW Stentors can become habituated	 (2)

Question number	Answer	Additional guidance	Mark
2(b)(iv)	An explanation that makes reference to two of the following: • Stentors become habituated to the {tapping / stimulus} (1) • so less energy wasted on {an unnecessary response / responding to non-threatening stimulus} (1)	 ALLOW with increased number of taps the Stentor ignore the {tapping / stimulus} / Stentor become less responsive to the {tapping / stimulus} ALLOW less energy wated on unimportant stimulus	 (2)

Question number	Answer	Additional guidance	Mark
3(a)	An answer that makes reference to three of the following: • fibrinogen is converted to fibrin (1) • by thrombin (1) • from soluble (fibrinogen) to insoluble (fibrin) (1) • (to form) a mesh (that traps platelets / blood cells) to form a clot (1)		(3)

Question number	Answer	Additional guidance	Mark
3(b)(i)	An answer that makes reference to the following: • dominant		(1)

Question number	Answer	Additional guidance	Mark
3(b)(ii)	An explanation that makes reference to two of the following: • (T did not inherit mutation from mother) because the mother is homozygous recessive (1) • none of individual T's siblings are affected / only T out of the six offspring had the condition (1) • if mutation was present in individual S then more in T's generation {likely to be / would be} affected (1)	(Assume that 'father', 'mother', 'siblings/offspring' are in relation to T) ALLOW mother does not have the {mutation / condition} /the mother is unaffected ALLOW only T is affected ALLOW more detailed descriptions e.g. if individual S was homozygous dominant would expect all of individual T's generation to be affected for both MP2 and 3	(2)

Question number	Answer	Additional guidance	Mark
3(b)(iii)	An answer that makes reference to the following: • blood from individual T {forms fewer clots / clots less} / individuals with {dysfibrinogenemia / the condition} have a reduced ability for the blood to clot (1) • blood from individual T clots slower / blood takes longer to clot for those with {dysfibrinogenemia / the condition} (1)	ALLOW converse statements for individual U IGNORE reference to ease of clotting ALLOW ref to a part of the clotting process e.g. individual T cannot convert fibrinogen to fibrin therefore less clotting ALLOW reference to rate of blood clotting	(2)

Question number	Answer	Additional guidance	Mark
3(c)	An explanation that makes reference to three of the following: • (clots) narrow lumen of coronary artery (1) • reducing blood flow (to cardiac muscle/heart) (1) • reducing supply of oxygen (to heart muscle) (1) • for aerobic respiration (1)	ALLOW blocked lumen of coronary artery ALLOW no blood flow / stops blood flow IGNORE volume of blood ALLOW ischemia Note: 'reduced flow of oxygenated blood' gains both second and third marking points	(3)

Question number	Answer	Additional guidance	Mark
4(a)(i)	An answer that makes reference to the following: • base correctly identified on the dinucleotide	ALLOW any rectangle/s circled on the left hand molecule	(1)

Question number	Answer	Additional guidance	Mark
4(a)(ii)	An answer that makes reference to one of the following: • (RNA) contains ribose (sugar) / DNA contains deoxyribose (sugar) (1) • (RNA) contains uracil / DNA does not contain uracil (1)	IGNORE references to U	(1)

Question number	Answer	Additional guidance	Mark
4(b)(i)	An answer that makes reference to the following: • ribosome {binds / attaches} to RNA (1) • binding between tRNA anticodons and RNA codons (1) • tRNA bind to {amino acids / lysine} (1)	ALLOW reference to mRNA instead of RNA IGNORE translation of amino acid chain/polypeptide ALLOW correct description of hydrogen bonds between anticodon and codon ALLOW tRNA brings {amino acids / lysine}	(3)

Question number	Answer	Additional guidance	Mark
4(b)(ii)	An explanation that makes reference to the following: • (the genetic code) is a triplet code (1) • (triplet code because) only trinucleotides bind lysine t-RNA to ribosomes (1) • (the genetic code for lysine) is degenerate (1) • (degenerate because) both AAA and AAG bind lysine-tRNA to ribosomes (1)	ALLOW three bases needed to code for an amino acid ALLOW dinucleotides do not bind lysine RNA to ribosomes ALLOW only trinucleotides coded for lysine / dinucleotides do not code for lysine ALLOW both AAA and AAG code for {lysine / the same amino acid}	(4)

Question number	Answer	Additional guidance	Mark
5(a)	An answer that makes reference to the following: • (a substance) that inhibits the {increase in number / division / reproduction / multiplication / replication} of bacteria	ALLOW prevents or stops for inhibiting ALLOW reduces instead of inhibits	(1)

Question number	Answer	Additional guidance	Mark
5(b)(i)	An explanation that makes reference to the following: • (antibiotic) resistance decreases (1) • DOX resistant bacteria no longer had an advantage (1) • (presence of) antibiotic is a selection pressure (1)	ALLOW {allele/gene} for antibiotic resistance becomes less frequent ALLOW resistance no longer of use ALLOW absence of selection pressure (during 60 days with no antibiotic)	(3)

Question number	Answer	Additional guidance	Mark
5(b)(ii)	An answer that makes reference to four of the following: • use of agar plates with {*E. coli* / bacteria} (1) • method of applying {antibiotic / DOX} (1) • range of concentrations taken from graph 0 to 35 (au) (1) • incubate {at a set temperature / for a set period of time} (1) • method of determining minimum antibiotic concentration that has an effect (1)	ALLOW a bacterial lawn with agar / agar seeded with bacteria / agar spread with bacteria ALLOW broth culture e.g. filter paper discs, wells in agar, mast rings IGNORE units ALLOW any values between 0 – 35 (au) ALLOW values between { 24 and 48 hours / 20 and 40 ^{o}C } e.g. lowest concentration on paper disc that produces a zone of inhibition, turbidity	(4)

Question number	Answer	Additional guidance	Mark
5(c)(i)	An answer that makes reference to the following: • both values correctly read from graph (1) • correct ratio (1)	 10 000 000 and 30 330 000 : 1 ALLOW 300 000 : 1 333 000 : 1 333 300 : 1 333 330 : 1 333 333 : 1 Correct answer with no working gains full marks	 (2)

Question number	Answer	Additional guidance	Mark
5(c)(ii)	An explanation that makes reference to the following: • tetracycline has little effect on number of living cells / therefore tetracycline is bacteriostatic (1) • streptomycin decreases number of living cells / streptomycin is bactericidal (1)	 ALLOW tetracycline stops {E.coli / bacteria} increasing in number ALLOW streptomycin kills {E.coli / bacteria}	 (2)

Question number	Answer	Additional guidance	Mark
6(a)(i)	An answer that makes reference to the following: • found only in one geographical location	ALLOW only found in one area / found only in Western North America	(1)

Question number	Answer	Additional guidance	Mark
6(a)(ii)	A description that makes reference to the following: • niche is the role (of the Coastal tailed frog / of an organism) in its ecosystem (1) • (Coastal tailed frog) {feeds at night / feeds on invertebrates / feeds along edges of streams} (1)	ALLOW 'habitat', 'community' 'environment' for ecosystem	(2)

Question number	Answer	Additional guidance	Mark
6(b)(i)	An answer that makes reference to the following: • correct values from the data (1) • correct percentage given to a whole number (1)	<u>Example of calculation</u> 45 – 9 = 36 streams with no frogs observed 21 of these with eDNA (21÷36) × 100 =58 (%) One mark if answer not given as a whole number e.g. 58.3 % Correct answer with no working gains full marks	(2)

Question number	Answer	Additional guidance	Mark
6(b)(ii)	An answer that makes reference to three of the following: Advantages • less disruptive to {ecosystem / frogs} (1) • can be carried out during day / frogs do not need to be seen / at night the frogs {may be missed / hard to observe} (1) Disadvantages • does not indicate if frog still present / DNA can travel in the stream (1) • does not give any idea of how many frogs are present (1)	ALLOW an example such as: no trapping / no trampling of stream / no need to move rocks / less harm to vegetation / less likely to harm non-target species / frogs do not have to be handled ALLOW may detect DNA of dead frogs	(3)

Question number	Answer	Additional guidance	Mark
6(c)	An answer that makes reference to four of the following: • collect DNA from both species (of frog) (1) • collect DNA from the {streams / water} (1) • amplify DNA using PCR (1) • cut DNA (into fragments) using restriction enzymes (1) • (separate DNA fragments) using gel electrophoresis (1) • identify species by comparing {distance bands have travelled / location of the bands / spacing of the bands / pattern of banding} (1)	ALLOW identify differences in genome of the two frog species DO NOT ALLOW for collecting DNA directly from the frogs ALLOW use primers specific to DNA of each species ALLOW a description of electrophoresis e.g. putting samples into wells of gel, use of buffer, passing a current through the gel, use of dye to make bands visible, use of agarose gel e.g. identify bands of different {sizes/positions} that are unique to each species ALLOW band only seen if correct primers are used	(4)

Question	Answer	Mark
*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** Muscle contraction • Complementary shape of myosin to binding site on actin / allows filaments to slide • Consequence – allows muscle contraction Enzymes • enzymes bind specific substrates /active site / R groups in active site enabling binding • examples of enzyme specificity / loss of specificity • enable chemical reactions to take place (at a useful rate) • consequence – lower activation energy for reactions/enzymes are essential for metabolic processes to {occur/be regulated} – e.g. respiration/protein synthesis/photosynthesis Nucleotides • complementary bases /examples of complementary bases • description of binding by complementary bases • allows transfer of genetic code (DNA to new DNA, DNA to mRNA, mRNA via tRNA to primary structure) • {proteins / transcription factors / splicing enzymes} bind specific sequences of bases • role of proteins in gene regulation / pre-mRNA splicing • consequence – allow cell division, growth, protein synthesis, specific protein due to specific amino acid sequence, contributes to stable double helix, gene expression Hormones / signalling molecules / neurotransmitters (Hormones may be in context of animals or plants) • neurotransmitters binding to membrane receptors on neurones • hormones binding to receptors – e.g. insulin or IAA • only cells with complementary receptors can respond • receptor response– change shape / trigger specific cellular response / causing ion channels to open / action potential • consequence - allows {coordinated / controlled} responses to environmental stimuli Immune system • antigen presentation / APC • antibodies bind specific antigens /variable regions • T cell receptors • consequence – allows specific immune response / antibodies/memory cells make it more likely a pathogen will be destroyed	(9)

Level	Marks		Additional Guidance
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.	One or two examples from list in the indicative content, with attempt to provide details or link to consequences.
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	Two to three examples from the list in the indicative content described, with some relevant details. Some discussion of consequences.
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.	Three examples from the list in the indicative content, with relevant details about each and discussion of consequences.

Question number	Answer	Additional guidance	Mark
8(a)	An explanation that makes reference to the following: • {several / many / most /different} mammals hibernate (1) • gene/alleles associated with hibernation passed down from (common) ancestor (1)	 ALLOW named examples from scientific article e.g. dormice, hedgehogs, bats, ground squirrel, black bears ALLOW adaptations (for hibernating) were present {when first mammals evolved / before different (taxonomic) groups evolved}	 (2)

Question number	Answer	Additional guidance	Mark
8(b)	An explanation that makes reference to three of the following: • fewer metabolic reactions / lower metabolic rate / metabolism decreases (1) • reducing requirement for ATP (1) • therefore reduced respiration (1) • therefore less heat {released/generated} (1)	 ALLOW (reduced physiological activity) means reduced muscle activity ALLOW fewer exothermic reactions ALLOW 'produced' in place of {released/generated}	 (3)

Question number	Answer	Additional guidance	Mark
8(c)	A description that makes reference to five of the following: • negative feedback / homeostasis / thermoregulation (1) • new (lower) set point (1) • thermoreceptors detect temperature (1) • hypothalamus receives impulses from thermoreceptors (1) • impulses from {hypothalamus / thermoregulatory centre} to effectors (involved in heat regulation) (1) • named mechanism leading to {heat loss / heat gain} (1)	ALLOW hypothalamus {altering / changing} set point ALLOW hypothalamus detects changes away from set point ALLOW heat loss / heat gain centre ALLOW named effector e.g. vasodilation, shivering, sweating	(5)

Question number	Answer	Additional guidance	Mark
8(d)	An explanation that makes reference to three of the following: • tissue samples from hibernating and non-hibernating animals compared (1) • (identify which) genes are {active / transcribed} from the {mRNA / proteins} present (1) • description of how mRNA can be used to produce copies of active genes (1) • analyse {amino acid sequence of proteins/base sequence of mRNA} to identify active gene	ALLOW tissue samples from mammals at different stages of hibernation ALLOW 'switched on' for active e.g. use of reverse transcriptase or {production / use} of cDNA IGNORE references to DNA methylation / histones	(3)

Question number	Answer	Additional guidance	Mark
8(e)	An explanation that makes reference to two of the following: • to increase {blood flow / delivery of oxygen} to cells (1) • for {respiration} / for generation of {ATP / energy} (1) • for muscle contraction / movement (1)	ALLOW faster blood flow to tissues/organs, such as muscles and brain	(2)

Question number	Answer	Additional guidance	Mark
8(f)	An explanation that makes reference to two of the following: • amine group from urea (1) • used to synthesise {amino acids / nucleotides} (1) • to synthesise {DNA / proteins} (1)	 IGNORE nitrogen ALLOW nucleic acids ALLOW reference to (ground squirrels) not eating during hibernation	 (2)

Question number	Answer	Additional guidance	Mark
8(g)	A description that makes reference to two of the following: • physical activities are less demanding / muscles do not work as hard (1) • (and) bones are no longer weight-bearing (1) • {cosmic radiation / lack of nutrients in diet} leads to {bone loss / muscle atrophy} (1)	ALLOW less force needed to move {muscles/limbs}/ less movement ALLOW fewer contractions / less intense contraction / decreased contraction force ALLOW bones under less stress / fewer microbreaks ALLOW muscles 'waste away' for 'atrophy' ALLOW lack of calcium in diet leading to bone loss	(2)

Question number	Answer	Additional guidance	Mark
8(h)	An explanation that makes reference to the following: • (lowering body temperature leads to) less kinetic energy (1) • (resulting in) {fewer enzyme-substrate collisions / fewer enzyme substrate complexes / reduced enzyme activity} (1) • metabolic activities depend on enzymes / lower enzyme activity reduces metabolic activity (1)	ALLOW a named/described example of a metabolic reaction ALLOW role of enzymes in metabolic reactions	(3)

Question number	Answer	Additional guidance	Mark
8(i)	An answer that makes reference to two of the following: • (neurotransmitters are released) {into a synapse / from presynaptic membrane} (1) • (neurotransmitters) bind to postsynaptic membrane / transmit nerve impulses from one neurone to another (1) • to {stimulate / inhibit} formation of an action potential (1)	ALLOW bind to post-synaptic receptors IGNORE if there is reference to post synaptic knob ALLOW {depolarisation / movement of sodium ions in} / {hyperpolarisation / movement of chloride ions in} DO NOT ALLOW references to neurotransmitter causing voltage gated channels to open	(2)

Question number	Answer	Additional guidance	Mark
8(j)	An explanation that makes reference to three of the following: • (adenosine) can be an inhibitory neurotransmitter / reduces neural activity in the hippocampus (1) • binding to receptors in the hippocampus / binds to receptors in synapse (1) • inhibits {release of neurotransmitters / depolarisation of neurones / binding of neurotransmitters to post-synaptic neurone} (1) • results in {reduced generation of action potentials in / hyperpolarisation of} the post-synaptic neurone (1)	ALLOW blocks calcium channels on presynaptic membrane ALLOW {no /less} sodium ions enter, fewer sodium channels open ALLOW {chloride ions / Cl^-} move in / {potassium ions / K^+} move out ALLOW reduced transmission of impulses in the hippocampus ALLOW threshold potential not reached	(3)

Question number	Answer	Additional guidance	Mark
8(k)	An explanation that makes reference to three of the following: • adenosine binds to receptors in the hypothalamus (1) • reduces neural activity (in hypothalamus) (1) • so fewer impulses sent to (skeletal) muscles (1) • {less/no} contraction of (skeletal) muscle (1)	ALLOW adenosine binds to thermoreceptors ALLOW thermoregulatory centre not activated	(3)

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