

Mark Scheme (Results)

Summer 2024

Pearson Edexcel Advanced Level
In Biology A Salters – Nuffield (9BN0)
Paper 01: The Natural Environment and Species Survive

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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	Mark
1(a)(i)	The only correct answer is D *31874 kJm^{-2}yr^{-1}.* (GPP-R) A is incorrect because it is sunlight-GPP B is incorrect because it is sunlight-GPP-R C is incorrect because it is GPP+R	(1)

Question Number	Answer	Additional guidance	Mark
1(a)(ii)	• correct values selected (1) • correct calculation of percentage light energy fixed as biomass (1)	<u>Example of calculation</u> 4615 and 7112800 (4615 ÷ 7112800) x100 = 0.065% ALLOW one mark if 4615 divided by incorrect value and used to calculate percentage Correct answer with no working gains full marks	(2)

Question Number	Answer	Additional guidance	Mark
1(b)	A description that makes reference to three of the following • nitrates are needed for amino acid synthesis (1) • magnesium (ions) are needed to make chlorophyll (1) • calcium (ions) are needed for {calcium pectate / middle lamella} (1) • chlorophyll is needed for photosynthesis and the production of { organic molecules / biomass } (1) • phosphates are needed for { membranes / phospholipids / nucleic acids / ATP / NADP } (1)	ALLOW nucleotides / (nitrogenous) bases / DNA / RNA / nucleic acids / ATP / protein IGNORE nitrogen ions	(3)

Question Number	Answer	Additional Guidance	Mark
2(a)	A description that makes reference to the following • (carbon dioxide is) needed for { light-independent stage / Calvin cycle } (1) • it combines with RuBP / ribulose bisphosphate (1) • catalysed by RUBISCO (1) • for the synthesis of named organic molecules (1)	ALLOW carbon fixation ALLOW involves the enzyme RUBISCO e.g. GP, GALP, glucose	(4)

Question Number	Answer	Mark
2(b)(i)	The only correct answer is **C** *positive correlation* A is incorrect because the relationship is not exponential B is incorrect because the relationship is not a negative correlation D is incorrect because there is a correlation	(1)

Question Number	Answer	Mark
2(b)(ii)	The only correct answer is **B** *to determine the repeatability of the data* A is not correct because a chi-squared test- does not require repeats C is incorrect because this does not improve the accuracy D is not correct because this does not increase validity	(1)

Question Number	Answer	Additional guidance	Mark
2(c)	An explanation that makes reference to three of the following • all the active sites (of the enzymes) are occupied (1) • enzyme concentration is limiting / no more enzyme-substrate complexes can be formed (1) • RUBISCO cannot fix carbon dioxide any faster (1) • (therefore) limiting the rate (of photosynthesis) (1)	ALLOW named enzyme e.g. RUBISCO ALLOW reference to other named limiting factors such as light { intensity / wavelength }, temperature or water availability	(3)

Question Number	Answer	Additional guidance	Mark
3(a)	• digitalin / digitalis / digitalis soup (1)	ALLOW extract of foxglove plants / foxglove extract IGNORE 'foxglove' alone IGNORE digoxin	(1)

Question Number	Answer	Additional guidance	Mark
3(b)	Table completed correctly- one mark for each two correct x or ✓	All correct- full marks 2 or 3 correct-1 mark	(2)

Methods used	William Withering
Use of a placebo	x
Testing of dose	✓
Tested on healthy volunteers	x
Double blind trial	x

Question Number	Answer	Additional guidance	Mark
3(c)	An answer that makes reference to the following • shortening of the spindle (fibres) separates the chromatids (1) • if spindle fibres cannot shorten, the { chromatids / chromosomes } cannot be pulled to opposite poles of the cell / cell remains in metaphase stage (1) • (if the spindle cannot shorten) the cell cannot enter { anaphase / telophase } / mitosis cannot be completed (1)	ALLOW pull chromatids apart	(3)

Question Number	Answer	Additional guidance	Mark
4(a)	A description that makes reference to the following • there is a change in the { base sequence / triplet code } in the { DNA / gene } (1) • this changes the sequence of bases in mRNA (during transcription) (1) • causing a change in the amino acid sequence (at translation) (1)	ALLOW different (mRNA) codons ALLOW fewer amino acids in chain (because of earlier STOP codon)	(3)

Question Number	Answer	Additional guidance	Mark
4(b)(i)	A description that makes reference to the following • (CFTR) is in the phospholipid bilayer (1) • it extends through both layers (of the bilayer) (1)	ALLOW intrinsic / integral / transmembrane IGNORE ref to basal and apical membrane	(2)

Question Number	Answer	Additional guidance	Mark
4(b)(ii)	An answer that makes reference to the following • (from ribosome) moves to rER where it is { folded / takes tertiary structure } (1) • transported to Golgi apparatus where it is { modified / packaged into vesicles } (1) • vesicles fuse with { plasma / cell } membrane (inserting protein into membrane) (1)	ALLOW 3D shape IGNORE binds IGNORE exocytosis	(3)

Question number	Answer	Additional Guidance	Mark
4(c)	An explanation that makes reference to three of the following • the amino acids (in the protein) are changed (1) • (therefore) there will be different R groups (1) • this will change bonds formed between { amino acids / R groups } (1) • (polypeptide) folds differently / different tertiary structure (of protein) (1)	ALLOW correctly named bonds such as ionic, disulfide, hydrogen	(3)

Question Number	Answer	Mark
5(a)(i)	The only correct answer is D *the thylakoid where the light dependent reaction takes place* • A is incorrect because L is not the plasmid • B is incorrect because Krebs cycle does not take place in the chloroplast • C is incorrect because L is not the stroma	(1)

Question Number	**Answer**	**Mark**
5(a)(ii)	The only correct answer is D *the stroma where the light-independent reaction takes place* • A is incorrect because it is not the matrix • B is incorrect because it is not the matrix • C is incorrect because it is not the site of the light- dependent reaction	(1)

Question Number	Answer	Mark
5(a)(iii)	The only correct answer is D *starch* • A is incorrect because it does not store chlorophyll • B is incorrect because it does not store glucose • C is incorrect because it does not store lipid	(1)

Question Number	**Answer**	**Additional guidance**	**Mark**
5(b)(i)	An answer that makes reference to any two the following oxygen, ATP, reduced NADP	ALLOW O_2, NADPH, NADPH + H^+, $NADPH_2$	(1)

Question Number	Answer	Additional guidance	Mark
5(b)(ii)	An answer that makes reference to four of the following • suitable range of temperatures given (1) • light intensity constant for duration of investigation (1) • one other abiotic variable controlled (1) • biotic variable controlled (1) • measure time taken for DCPIP to { decolourise / change colour } (at each temperature) (1)	e.g. values between 0°C and 50°C e.g. concentration or volume of DCPIP, pH e.g. plant species / mass of plant material used / concentration or volume of chloroplast extract DO NOT ALLOW the solution goes colourless ALLOW use of colorimeter to measure the change in absorbance over time	(4)

Question Number	Answer	Additional guidance	Mark
6(a)	A description that makes reference to three of the following • {polymer / polysaccharide} of alpha glucose (1) • made up of amylose and amylopectin (1) • amylose is unbranched and amylopectin is branched (1) • amylose has 1,4-glycosidic bonds and amylopectin has 1,6 and 1,4 glycosidic bonds (1)	DO NOT ALLOW beta glucose ALLOW amylose is {linear / straight-chained}	(3)

Question Number	Answer	Additional guidance	Mark
6(b)(i)	An explanation that makes reference to three of the following • increase in (spring) temperature increased germination for all three species (1) • (because) there is more (kinetic) energy and more (frequent) collisions between substrate and enzyme (1) • (therefore) starch is { broken down / hydrolysed } faster (1) • greater supply of glucose increases the rate of respiration (1)	ALLOW { lipids/proteins } broken down faster	(3)

Question Number	Answer	Additional guidance	Mark
6(b)(ii)	An explanation that makes reference to the following • increase in temperature may lead to { earlier germination / plants will grow further north } (1) • change in rainfall patterns may lead to { an increase in drought resistant plants /a change in the distribution of plants } (1)	ALLOW increase in temperature may lead to {plants growing in different areas / more germination}	(2)

Question Number	Answer	Additional guidance	Mark
6 (c)	An answer that makes reference to the following • { reduces / prevents } enzyme activity / inhibits metabolic reactions (1) • prevents germination (1) • prevents { bacteria growth / fungal growth / decomposition } (1)	ALLOW {stops / slows} respiration DO NOT ALLOW photosynthesis ALLOW prevents growth of pathogens	(3)

Question Number	Answer	Mark
7(a)(i)	The only correct answer is D *A group of individuals of one species living in the same habitat* A is incorrect because they are not different species B is incorrect because they are not in different communities C is incorrect because they are not in different ecosystems	(1)

Question Number	Answer	Additional guidance	Mark
7(a)(ii)	An explanation that makes reference to the following • (each species) occupies a different niche (1) • therefore there is no competition (between species of deer) for { food /space /territory } (1)	ALLOW no competition for resources	(2)

Question Number	Answer	Additional guidance	Mark
7(b)(i)	An answer that makes reference to the following • correct calculation of the frequency of both alleles (1) • correct calculation of 2pq (1) • correct calculation of the number of heterozygotes (1)	<u>Example of calculation</u> q^2 =250 ÷ 800 = 0.3125 q= 0.56 / 0.559 and p = 0.44 / 0.441 2pq = 0.493 / 0.49 394 ALLOW 392 Correct answer with no working gains full marks	(3)

Question Number	Answer	Mark
7(b)(ii)	The only correct answer is C 1 and 3 A is incorrect as it is not only 1 B 1 and 2 is incorrect as it is not beneficial to reduce genetic diversity D 2 and 3 is incorrect as it is not beneficial to reduce genetic diversity	(1)

Question Number	Answer	Additional guidance	Mark
7(c)	An answer that makes reference to four of the following • detail of random sampling / random sampling in the two areas (1) • suitably sized quadrat used to sample at least 10 times (in each area) (1) • count the number of species in each quadrat (1) • count the number of individuals of each species in each quadrat (1) • calculation of { diversity index / t-test } (1)	e.g 0.5m x 0.5m, 1mx1m IGNORE grid, frame, pin ALLOW comparison of species richness using { a t-test / diversity index values }	(4)

Question Number	Answer	Mark
8(a)(i)	The only correct answer is D *lactase reduces the activation energy of the reaction* A is incorrect because enzymes do not change the products of a reaction B is incorrect because enzymes do not increase the activation energy of a reaction C is incorrect because enzymes are not used up in the reaction	(1)

Question Number	Answer	Additional guidance	Mark
8(a)(ii)	A description that makes reference to three of the following • the ribosomes receive mRNA (from the nucleus) / mRNA binds to the ribosome (1) • (at the ribosome) an anticodon on tRNA pairs with the (complementary) codon on the mRNA (1) • ribosome moves along the mRNA (1) • peptide bonds form between the amino acids (held at the ribosome) (1)	ALLOW ribosome is the site of mRNA translation ALLOW mRNA moves along the ribosome	(3)

Question Number	Answer	Additional guidance	Mark
8(b)(i)	• difference in frequency of mutation calculated from figures in table (1) • percentage increase correctly calculated (1)	<u>Example of calculation</u> 0.740 – 0.096 = 0.644 (0.644 ÷ 0.096) x 100 670.83 / 670.8 / 671 (%) Correct answer with no working gains full marks	(2)

Question Number	Answer	Additional guidance	Mark
8(b)(ii)	An answer that makes reference to the following • diet containing milk and dairy acted as a selection pressure (1) • individuals able to produce lactase { have an advantage / have better nutrition } (1) • more likely to { survive / live longer } and reproduce (1) • (therefore) over time the frequency of the allele increases (1)	ALLOW (lactase) allele is advantageous ALLOW reference to passing down or producing offspring for reproduce	(4)

Question Number	Answer	Additional guidance	Mark
9(a)(i)	An explanation that makes reference to two of the following: • increase in (core) body temperature (1) • it is part of the non-specific immune response / increases efficiency of immune response (1) • the high temperature in a fever destroys the { pathogen / virus } (1)	ALLOW part of the inflammatory response ALLOW high temperature denatures enzymes of pathogens / prevents replication of viruses	(2)

Question Number	Answer	Additional guidance	Mark
9(a)(ii)	A description that makes reference to the following • (activated) T (helper) cells release cytokines (1) • B cells stimulated to produce B effector cells (1) • (B effector) cells differentiate into plasma cells (1) • antibodies are released (by plasma cells) (1)	ALLOW activated B cells	(4)

Question Number	Answer	Additional guidance	Mark
9(b)	An answer that makes reference to the following: • glycoprotein binds to a complementary receptor on the liver cell (1) • the viral envelope (of the hepatitis C virus) fuses with the liver cell membrane (1) • (viral) RNA enters the cell (1)	ALLOW GP120 / CD4 IGNORE capsid	(3)

Question Number	Answer	Mark
*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. **Indicative content** Basic information • drugs such as Entecavir and Interferon treat infection • antibodies and vaccine protects against infection • reference to ease of application e.g. vaccine of 3 doses needed / drugs need taking daily or weekly • vaccination leads to production of memory cells Linkages • vaccine provides long lasting protection • drugs provide short term protection • antibodies provide artificial passive immunity • vaccination provides artificial active immunity • vaccination produces memory cells whereas antibodies will not • entecavir prevents virus replicating and spreading to other cells • interferon inhibits protein synthesis / formation of new virus particles Sustained line of scientific reasoning • drugs reduce viral load • vaccine and antibodies lead to destruction of the virus by agglutination • drugs useful if people have potentially been infected / exposed to the virus • vaccine useful for people working in high-risk environment • interferon an option for the 5% not protected by vaccine • antibodies useful for new-born babies whose immunity is limited	(6)

Level	Marks		Additional Guidance
0	0	No awardable content	
1	1-2	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.	Basic information referred to – e.g. which treatments are for active infection or protecting against infection reference to comparative ease of application basic reference to memory cells from vaccines
2	3-4	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.	Linkages made: e.g. mode of action discussed for the two drugs how the vaccination or antibodies protect against infection type of immunity from antibodies and vaccine relevant discussion of a drug and vaccination / antibodies
3	5-6	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.	Sustained reasoning e.g. discussion of how different treatments can be applied depending on need to treat or protecting against infection relevant discussion of all four treatments

Question Number	Answer	Mark
10(a)	The only correct answer is B *A substance that kills bacteria* A is incorrect because antibiotics can be taken internally C is incorrect because bactericidal antibiotics do not prevent reproduction of bacteria D is incorrect because bactericidal antibiotics do not prevent reproduction of viruses	(1)

Question Number	Answer	Additional guidance	Mark
10(b) (i)	• correct conversion from log number to actual number of cells at start (1) • decrease in number of cells divided by four and rate given (1)	<u>Example of calculation</u> Antilog of 6.8 $\log_{10}$ = 6.3 million cells / 6 309 573 cells 6.3 million ÷ 4 = 1.575 million OR 6 309 573 ÷ 4 = 1.577 million ALLOW 1 mark for 6.8 ÷ 4 = 1.7 IGNORE - sign Correct answer with no working gains full marks	(2)

Question Number	Answer	Additional guidance	Mark
10(b)(ii)	An answer that makes reference to the following • (overall) A is more effective against bacteria Q (1) • (overall) B more effective against bacteria P (1) • initially antibiotics A and B are more effective against bacteria Q than bacteria P (1) • the bacteria are not resistant to the antibiotics / presence of low numbers of bacteria Q in antibiotic B (at 25 hours) not enough to indicate resistance (1)		(4)

Question Number	Answer	Mark
*10b(iii)	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** Basic • aseptic technique described • agar plates with bacteria • method to assess effectiveness of antibiotics – zone of inhibition / largest zone is most effective concentration • repeats used for each antibiotic • incubate at same temperature or same lengths of time Linkages • range of antibiotic concentrations • method of applying antibiotics – wells, paper discs • standardised incubation of plates for 24 - 48 hours at 25 - 40°C • variables controlled e.g. species of bacteria, time paper soaked in antibiotic, volume of antibiotic placed in well in agar • measure zone of inhibition e.g. diameter • standardised bacterial cultures tested same volume of bacteria cultures e.g. seeding, bacterial lawn Sustained • calculation of (mean) area of zone of inhibition / calculate mean diameter of zone of inhibition • repeat with smaller concentration intervals around that dose • identification of minimum effective dose	(6)

Level	Marks		Additional Guidance
0	0	No awardable content	
1	1-2	An explanation of how the investigation should be modified may be attempted but with limited analysis, interpretation and/or evaluation of the scientific information. Generalised comments made. The explanation will contain basic information with some attempt made to link knowledge and understanding to the given context.	Basic detail such as: • preparation of agar plates with bacteria • largest zone is most effective concentration • repeats for each antibiotic
2	3-4	An explanation of how the investigation should be modified will be given with occasional evidence of analysis, interpretation and/or evaluation of the scientific information. The explanation shows some linkages and lines of scientific reasoning with some structure.	Specific details of investigation such as: • incubated for standardised time and temperature quoted • method of adding antibiotic • control of variables
3	5-6	An explanation of how the investigation should be modified is given which is supported throughout by evidence from the analysis, interpretation and/or evaluation of the scientific information. The explanation shows a well-developed and sustained line of scientific reasoning which is clear, coherent and logically structured.	Linkages to knowledge as listed in indicative content in addition to the following: • calculation of area of zone of inhibition • determination of minimum effective dose as concentration at which zone of inhibition shows no further increase • repeat with smaller intervals above and below the minimum effective dose to determine the optimum concentration.

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