Biology A (Salters-Nuffield) Advanced Paper 3 (9BN0/03)

Question Number	Acceptable Answer	Additional Guidance	Mark
1(a)	Tonoplast		**(1)**

Question Number	Acceptable Answer	Additional Guidance	Mark
1(b)	• selection of correct points from the graph (1) • calculation of percentage (1) • difference in percentage (1)	0.17 AU , 0.23 AU , 0.26 AU Example of calculation: 35.3% ÷ 13.0% = 22.3% Allow full marks for correct answer with no working	**(3)**

Question Number	Acceptable Answer	Additional Guidance	Mark
1(c)(i)	An explanation that makes reference to the following: • interferes with { tertiary / 3-D } shape of the channel proteins (1) • therefore causes channel proteins to open (1)		**(2)**

Question Number	Acceptable Answer	Additional Guidance	Mark
1(c)(ii)	An answer that makes reference to four of the following: • solutions with a range of pH values (1) • pieces of beetroot of same surface area (1) • control of other named relevant variables (1) • measurement of absorbance of solution using colorimeter (1) • repeats at each pH value to calculate mean (1)	e.g. temperature / volume of solution / time left in solution /	**(4)**

Total for Question 1 = 10 marks

Question Number	Acceptable Answer	Additional Guidance	Mark
2(a)	• correct reading of temperatures (1) • after 24 hours, lowest body temperature 22 minus 5.6^0C (1)	22 ±5.6 Accept calculation of maximum ambient temperature Example of calculation 22 − 5.6 = (lower than / equal to) 16.4^{O}C	**(2)**

Question Number	Acceptable Answer	Additional Guidance	Mark
2(b)	An answer that makes reference to the following: • range smaller at higher temps (1) • only the highest temperature shows no overlap (1)		**(2)**

Question Number	Acceptable Answer	Additional Guidance	Mark
2(c)	An answer that makes reference to two of the following: • body size (1) • fat level (1) • position of body i.e. in fetal position or not (1)		**(2)**

Question Number	Acceptable Answer	Additional Guidance	Mark
2(d)	An explanation that makes reference to the following: • rectal temperature is core temperature / it would be $37^{O}C$ at time of death (1) • skin surface temperature would be more variable (1)		**(2)**

Question Number	Acceptable Answer	Additional Guidance	Mark
2(e)	An answer that makes reference to two of the following: • rigor mortis (1) • degree of decomposition (1) • forensic entomology (1)		**(2)**

Total for Question 2 = 10 marks

Question Number	Acceptable Answer	Additional Guidance	Mark
3(a)(i)	An explanation that makes reference to the following: • there is no concentration gradient present between the chloroplast and the isolation solution (1) • no net loss of water from the chloroplast from osmosis (1)		**(2)**

Question Number	Acceptable Answer	Additional Guidance	Mark
3(a)(ii)	An explanation that makes reference to the following: • low temperature to (temporarily) slow enzyme activity (1) • pH 7.0 so enzymes not denatured (1) • so RUBISCO remains active (1)		**(3)**

Question Number	Acceptable Answer	Additional Guidance	Mark
3(b)(i)	There is no correlation between the concentration of DCMU and the rate of DCPIP colour change		**(1)**

Question Number	Acceptable Answer	Additional Guidance	Mark
3(b)(ii)	7 and 49		**(1)**

Question Number	Acceptable Answer	Additional Guidance	Mark
3(b)(iii)	• Correct calculation of numerator (1) • Correct calculation of denominator (1) • Correct calculation of correlation coefficient (1)	Example of calculation: $(\Sigma d^2 = 996) \div (n(n^2-1) = 504)$ = (-) 0.976 Allow all marks for correct answer with no working	**(3)**

Question Number	Acceptable Answer	Additional Guidance	Mark
3(b)(iv)	An explanation that makes reference to the following: • Selection of appropriate critical value from the table (1) • calculated value is greater (than critical value) (1) • Can reject the null hypothesis / correlation is significant (1)	0.786 , 0.833 , 0.881	**(3)**

Total for Question 3 = 13 marks

Question Number	Acceptable Answer	Additional Guidance	Mark
4(a)(i)	• correct calculation of numerator (1) • correct calculation of denominator (1) • correct calculation of diversity index / correctly plotted on the graph (1)	Example of calculation: (N(N-1) = 427 x 426 = 181 902) ÷ (Σn(n-1) =) 52 320) = 3.48 ; Allow full marks for correct answer with no working	**(3)**

Question Number	Acceptable Answer	Additional Guidance	Mark
4(a)(ii)	An explanation that makes reference to the following points: • succession is the sequence of { species / communities } replacing each other with time (1) • dune 4 is older than dune 1 (1) • no species of plant inhabits all 4 dunes /example from table quoted to show one species inhabiting no more than 3 dunes (1) • plant diversity increases with time (1) • description of increasing diversity index from dune 1 to dune 4 (1)	e.g. species G only found on dunes 3 and 4	**(5)**

Question Number	Acceptable Answer	Additional Guidance	Mark
4(b)	An answer that makes reference to the following points: • systematic sampling (1) • quadrats used at the tops and in between dunes (1) • details of method used for measuring percentage cover (1) • repeats to make a valid comparision (1) • a named relavent statistical test (1)		**(5)**

Total for Question 4 = 13 marks

Question Number	Acceptable Answer	Additional Guidance	Mark
5(a)	A description that makes reference to the following: • no UV (1) • water added but not from tank with fish in it that have eaten snails (1)		**(2)**

Question Number	Acceptable Answer	Additional Guidance	Mark
5(b)(i)	An explanation that makes reference to the following: • calculating increase above control for 'fish' and for 'UV' (1) • adding effects of 'fish' and 'UV' (1)	fish exposure effect is 12% (above control) and (UV is) 28%	**(2)**

Question Number	Acceptable Answer	Additional Guidance	Mark
5(b)(ii)	An explanation that makes reference to the following: • interferes with DNA replication (1) • (potentially) leading to mutations (1)		**(2)**

Question Number	Acceptable Answer	Additional Guidance	Mark
5(c)(i)	A description that makes reference to the following: • transcription factor (1) • Binds to promotor region (1) • RNA polymerase binds (1) • mRNA to be synthesised (1)		**(4)**

Question Number	Acceptable Answer	Additional Guidance	Mark
5(c)(ii)	An answer that makes reference to the following: • DNA methylation (1) • histone modification (1)		**(2)**

Total for Question 5 = 12 marks

Question Number	Acceptable Answer	Additional Guidance	Mark
6(a)(i)	An answer that makes reference to the following: • water (1) • glycosidic bond drawn correctly (1)		**(2)**

Question Number	Acceptable Answer	Additional Guidance	Mark
6(a)(ii)	maltose		**(1)**

Question Number	Indicative content	
6(b)	Answers will be credited according to candidates' 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 offer a range of appropriate examples to support a comment on the roles of phosphorylation in Biology. • Description of phosphorylation as an addition of phosphate. • Examples of phosphorylation in respiration to include glycolysis, oxidative phosphorylation, substrate level phosphorylation. • Examples of phosphorylation in photosynthesis to include RuBP, GP, NADP, non-cyclic photophosphorylation. • Role of phosphorylation of ADP to store energy. • Phosphorylation of lipids to make phospholipids and their roles in membranes. • Addition of phosphates to help form the DNA backbone / involved in phosphodiester bonds. • Appreciation of the consequences of phosphorylation such as activation of molecule for further reactions.	
Level	Mark	Descriptor
	0	No rewardable material
1	1-3	Demonstrates isolated elements of biological knowledge and understanding. Provides little or no references to a range of scientific idea, processes, techniques and procedures. Scientific arguments may be attempted, but fails to link biological concepts and/or ideas in order to support decision/conclusion. Limited attempt to address the question.
2	4-6	Demonstrates adequate biological knowledge and understanding with selection of some biological facts/concepts to support an argument or decision/conclusion being made. 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.
3	7-9	Demonstrates comprehensive knowledge and understanding by selecting and applying relevant knowledge of biological facts/concepts to support an argument or decision/conclusion being made. Scientific reasoning supported throughout by sustained linkage of a range of scientific ideas, processes, techniques and 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 6 = 12 marks

Question Number	Acceptable Answer	Additional Guidance	Mark
7(a)	pyruvate and { reduced coenzyme / reduced NAD }		**(1)**

Question Number	Acceptable Answer	Additional Guidance	Mark
7(b)(i)	A description that makes reference to the following: • Final electron acceptor		**(1)**

Question Number	Acceptable Answer	Additional Guidance	Mark
7(b)(ii)	An explanation that makes reference to the following: • carbon monoxide binds to cytochrome oxidase (1) • prevents oxygen binding to the enzyme (1) • blocks the electron transport chain / prevents oxidation of reduced electron carriers (1)		**(3)**

Question Number	Acceptable Answer	Additional Guidance	Mark
7(c)	An explanation that makes reference to the following: • NO binds to cytochrome oxidase in endothelium (of blood vessels) (1) • diverts oxygen to smooth muscle cells (1) • contraction of muscle cells causes vasoconstriction in arterioles (1)		**(3)**

Question Number	Acceptable Answer	Additional Guidance	Mark
7(d)	An answer that makes reference to three of the following: • free radicals interact with transcription factors (1) • activation of gene for P53 (1) • production of mRNA from activated gene (1) • translation of mRNA resulting in synthesis of P53 on ribosomes (1)		**(3)**

Question Number	Acceptable Answer	Additional Guidance	Mark
7(e)	A description that makes reference to three of the following: • inner membrane { is folded / has a larger surface area / has cristae } (1) • outer membrane is impermeable to H^+ ions (1) • only inner membrane contains { ETC (proteins) / ATP synthase / stalked particles } (1) • only inner membrane contains H^+ pump (1)		**(3)**

Question Number	Acceptable Answer	Additional Guidance	Mark
7(f)	An answer that makes reference to the following: • myocardial infarction causes cell death in the heart (1) • due to lack of oxygenated blood reaching cardiac muscle cells (1) • NIR affects cytochrome oxidase involved in aerobic respiration (1) • diversion of oxygen to cardiac muscle cells would reduce death of these cells (1)		**(4)**

Question Number	Acceptable Answer	Additional Guidance	Mark
7(g)(i)	A description that makes reference to the following: • restriction endonuclease enzyme (1) • extraction of gene that codes for light-sensitive protein (1) • use of a suitable vector (1) • insertion of gene into the { genome / DNA } in the nucleus of the neurone (1)		**(4)**

Question Number	Acceptable Answer	Additional Guidance	Mark
7(g)(ii)	An explanation that makes reference to the following: • { depolarisation / action potential } occurs (1) • (nerve) impulse reaches { synapse / presynaptic membrane } (1) • calcium ion channels open causing calcium ions to enter presynaptic neurone (1) • vesicles containing neurotransmitter fuses with presynaptic membrane (1) • neurotransmitter released (1)		**(5)**

Question Number	Acceptable Answer	Additional Guidance	Mark
7(h)	An explanation that makes reference to three of the following: • fMRI detects changes in blood flow in the brain (1) • MRI signal reflects state of haemoglobin / magnetic fields repelled by oxygen rich blood / deoxygenated haemoglobin more magnetic than oxygenated haemoglobin (1) • allows areas of greater brain activity to be detected as an image created by magnetic resonance (1) • areas of the brain that are involved in an auditory memory task { were using more oxygen / had an increased flow of blood } (1)		**(3)**

Total for Question 7 = 30 marks