Mark Scheme (Results)

Summer 2022

Pearson Edexcel GCE In Biology A Salters Nuffiled (9BN0) Paper 1: The Natural Environment and Species Survival

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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.

Multiple Choice

Question Number	Answer	Mark
1(ai)	The only correct answer is –A *amino acids* B is incorrect because nitrates are not found in cellulose C is incorrect because nitrates are not found in starch D is incorrect because nitrates are not found in sucrose	(1)

Question Number	Answer	Mark
1(a)(ii)	The only correct answer is –C *nucleic acids* A is incorrect because phosphate is not found in cellulose B is incorrect because phosphate is not found in chlorophyll D is incorrect because phosphate is not found in sucrose	(1)

Question Number	Answer	Mark
1(a)(iii)	The only correct answer is – C *chlorophyll* A is incorrect because magnesium is not found in amino acids B is incorrect because magnesium is not found in cellulose D is incorrect because magnesium is not found in starch	(1)

Question number	Answer	Additional guidance	Mark
1(b)	A description that makes reference to the following • (mineral ions) are taken up by active transport (1) • through carrier proteins (1) • this requires {energy / ATP} (1)	IGNORE channel ALLOW protein pumps	(3)

Question Number	Answer	Mark
2(a)	The only correct answer is B *3* Global warming is not caused by a reduction in greenhouse gases Global warming is not affecting only the ice caps	(1)

Question Number	Answer	Additional guidance	Mark
2(b)(i)	An explanation that makes reference to three of the following • because plants produce {organic compounds/biomass} from photosynthesis (1) • plants remove carbon dioxide (from the atmosphere) (1) • because animals produce (more) carbon dioxide by respiration (1) • because (some) animals produce methane (1)	ALLOW named biological molecule e.g. starch, sugar ALLOW plants are carbon neutral ALLOW converse for plants	(3)

Question Number	Answer	Additional guidance	Mark
2(b)(ii)	An explanation that makes reference to the following • (deforestation cuts down) trees which are carbon sinks (1) • {burning / decomposition} of these trees releases carbon dioxide into the atmosphere (1) • without trees there is {less/no} photosynthesis to remove carbon dioxide (from the atmosphere) (1)	ALLOW trees are stores of carbon	(3)

Question Number	Answer	Additional guidance	Mark
3(a)(i)	• using carbon (14) dating	ALLOW the deeper the layer in the peat, the older it is	(1)

Question Number	Answer	Additional guidance	Mark
3(a)(ii)	An explanation that makes reference to three of the following • conditions are anaerobic (1) • therefore less (aerobic) respiration by decomposers (1) • acidic conditions {inhibit /denature} enzymes (1) • therefore (enzymes) cannot {digest / break down} organic material (1)	ALLOW (waterlogging) reduces the oxygen content ALLOW microorganisms / named decomposers ALLOW decomposers respiring anaerobically ALLOW description of denaturing eg change in shape of active site ALLOW break down plants / animals /peat	(3)

Question Number	Answer	Additional guidance	Mark
3(b)	An answer that makes reference to four of the following • use of quadrats for sampling (1) • method of determining co-ordinates for random sampling (1) • record percentage cover of sphagnum (in each quadrat) (1) • several {quadrats/samples} measured and mean calculated (1) • sample at regular time intervals (1) • calculate the rate of change in sphagnum cover (1)	e.g. random number table/mobile phone ALLOW number of sphagnum plants in the quadrat / number of squares in quadrat containing sphagnum e.g. week, month, year e.g. read gradient off graph	(4)

Question Number	Answer	Additional guidance	Mark
4(a)	An answer that makes reference to the following • *Plasmodium* contain two named organelles (1) • (they have) membrane bound organelles (1)	Eg nucleus, mitochondria, Golgi {apparatus/body}, endoplasmic reticulum ALLOW prokaryotes do not contain membrane bound organelles	(2)

Question Number	Answer	Additional guidance	Mark
4(b)(i)	A description that makes reference to the following • sequence of amino acids (1) • joined together by peptide bonds (1)		(2)

Question Number	Answer	Additional guidance	Mark
4(b)(ii)	A description that makes reference to five of the following • folding of protein inside the {rough endoplasmic reticulum / rER } (1) • bonds formed between R groups (1) • rER {forms / packages proteins in} vesicles (1) • vesicles transport the protein to the Golgi apparatus (1) • protein modified in Golgi apparatus (1) • detail of modification (1)	ALLOW formation of named bonds ALLOW processed e.g. carbohydrates/sugar molecules added / prosthetic group	(5)

Question Number	Answer	Additional guidance	Mark
5(a)	An explanation that makes reference to four of the following • a mutation will lead to a change in the sequence of bases (in the DNA) (1) • (therefore a mutation) may lead to {a different amino acid /change in the sequence of amino acids} (1) • so different R groups would change the tertiary structure of the enzyme (1) • therefore the (shape of the) active site is changed (1) • therefore substrate does not fit active site of enzyme / substrate-enzyme complexes cannot form (1)	ALLOW change to triplet code (of DNA) ALLOW reference to STOP codon being produced	(4)

Question Number	Answer	Additional guidance	Mark
5(b)(i)	• (the genotype is) heterozygous and (the phenotype is) affected with the disease (1)	ALLOW any upper case and lower case letter to show heterozygous e.g. Pp IGNORE male/female	(1)

Question Number	Answer	Additional guidance	Mark
5(b)(ii)	The only correct answer is B 0.25 A, C and D are not correct.		(1)

Question Number	Answer	Additional guidance	Mark
5(c)	An answer that makes reference to the following • siRNA binds to the mRNA (from the mutated allele) (1) • mRNA cannot bind to ribosome (1) • tRNA is prevented from binding with mRNA(1) • {polypeptide / protein} not synthesised (1) • (no development of porphyria) as the faulty enzyme is not produced (1)	ALLOW amino acids not brought to mRNA ALLOW functioning gene transcribed instead	(4)

Question Number	Answer	Additional guidance	Mark
6(a)	An answer that makes reference to the following • a drawing of a double membrane with folding of the inner membrane (1) • two parts correctly labelled (1)	e.g. intermembrane space, cristae, matrix, inner membrane, outer membrane, ribosomes, DNA	(2)

Question Number	Answer	Additional guidance	Mark
6(b)	An explanation that makes reference to the following • only the nucleus of the sperm enters the ovum (1) • (therefore) all the mitochondria come from the egg cell (1)	ALLOW during fertilisation only the head of the sperm cell enters the egg ALLOW mitochondria from sperm cell do not enter the egg	(2)

Question Number	Answer	Additional guidance	Mark
6(c)(i)	An explanation that makes reference to two of the following • because all the mitochondria (in the egg / in the embryo) come from the donor (1) • which do not carry the mutation(1)		(2)

Question Number	Answer	Additional guidance	Mark
6(c)(ii)	An answer that makes reference to the following • {DNA/genetic material / chromosomes} in the nucleus comes from (the sperm and egg of) the parents (1) • characteristics determined by DNA in the nucleus will be inherited from the parents (1) • any characteristic controlled by mitochondrial DNA would be inherited from the donor (1)		(3)

Question Number	Answer	Additional guidance	Mark
7(a)(i)	An calculation that shows the following • selection of correct data from table and difference calculated (1) • calculation of percentage to three significant figures (1)	Example of calculation 1855-135 = 1720 92.7 (%) Correct answer with no working gains full marks.	(2)

Question Number	Answer	Additional guidance	Mark
7(a)(ii)	An explanation that makes reference to the following • as the vaccination rate increases the number of cases of measles decreases (in some years) (1) • example from data to show why the conclusion is valid (1) • (the effects of changes in percentage vaccination are seen in the following year) because it takes time for {antibodies / memory cells } to be produced (1) • time taken for herd immunity to develop (1)	ALLOW reference to data from specific years such as 2013 to 2014, 2014 to 2015	(4)

Question Number	Answer	Mark
7(b)(i)	The only correct answer is B *produced when B cells are activated to become plasma cells* A is not correct because B cells do not become killer cells C is not correct because macrophages do not become B cells D is not correct because plasma cells do not become memory cells	(1)

Question Number	Answer	Mark
7(b)(ii)	The only correct answer is A *active artificial immunity* B is not correct because immunity due to vaccination is not natural immunity C is not correct because passive immunity does not lead to the production of antibodies D is not correct because immunity due to vaccination is not natural immunity and passive immunity does not lead to the production of antibodies	(1)

Question Number	Answer	Additional guidance	Mark
7(b)(iii)	An explanation that makes reference to three of the following • due to a loss of memory cells there is no secondary immune response (1) • therefore antibodies cannot be produced quickly (1) • therefore there is less immunity (to diseases previously vaccinated against) (1) • need to repeat vaccinations to produce more memory cells (1)	ALLOW converse for repeat vaccination ALLOW converse for repeat vaccination ALLOW diseases can be contracted that children were previously immune to	(3)

Question Number	Answer	Mark
8 (a)	The only correct answer is B *non-specific response, bacteria are destroyed by phagocytes* A is not correct because killer T-cells are not involved in the initial response C is not correct because the initial response is not the specific response D is not correct because the initial response is not the specific response	(1)

Question Number	Answer	Additional guidance	Mark
8(b)	An explanation that makes reference to three of the following • the bacteria are inside {macrophages /phagocytes} (1) • this bacterium has a (thick) waxy cell wall (1) • lysosomes cannot fuse with phagocytic vacuole / bacteria not destroyed by enzymes (1) • bacteria within tubercles (cannot be destroyed) (1)	ALLOW waxy coat	(3)

Question Number	Answer	Additional guidance	Mark
8(c)(i)	• calculation of the number of TB patients with HIV (1) • calculation of percentage of HIV positive TB patients that died(1)	Example of calculation 15% of 9.4 million = 1.41 million 521 700 ÷ 1 410 000 = 0.37 = 37% Correct answer with no working gains full marks	(2)

Question Number	Answer	Additional guidance	Mark
8(c)(ii)	An answer that makes reference to the following • a greater percentage of patients with HIV die from TB compared with TB patients without HIV (1) • the total number of cases and deaths from TB is greater in those without HIV (1)		(2)

Question Number	Answer	Mark
8(c)(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 • TB is more likely to develop in patients with HIV • Anti-viral drugs reduce the incidence of TB in patients with HIV • HIV binds to CD4 receptors on T-helper cells • HIV replicates inside T-helper cells then destroys the cells as it bursts out • This reduces the number of T helper cells • When a bacterium such as *M. tuberculosis* enters the body, the reduction in T-helper cells means there is no immune response • The patient develops TB • Drugs that prevent viral replication means T-helper cells are not destroyed • The immune system can prevent TB developing • Therefore deaths from TB will decrease in patients with HIV • However, more deaths from TB are in patients without HIV, and therefore antiviral drugs will not reduce this number	(6)

			Additional guidance
Level 0	Marks	No awardable content	
Level 1	1-2	An explanation may be attempted but with limited interpretation or analysis of the scientific information with a focus on mainly just one piece of scientific information. The explanation will contain basic information with some attempt made to link knowledge and understanding to the given context.	Data described from information provided e.g. • TB incidence decreases as T helper cells increase • TB bacteria multiply in body • Use of antiviral drugs increases T helper cell numbers • Basic explanation
Level 2	3-4	An explanation will be given with occasional evidence of analysis, interpretation and/or evaluation of both pieces of scientific information. The explanation shows some linkages and lines of scientific reasoning with some structure.	Explanation of data e.g. Overlapping error bars indicate no difference for T helper cell counts above 300 mm^{-3} HIV infects T helper cells HIV enters T helper cells and reduces the number of T-helper cells This reduces immune response Antiviral drugs prevent replication of HIV Immune response details
Level 3	5-6	An explanation is made which is supported throughout by sustained application of relevant evidence of analysis, interpretation and/or evaluation of both pieces of scientific information. The explanation shows a well-developed and sustained line of scientific reasoning which is clear and logically structured.	Detailed explanation as to how antiviral drugs prevent TB developing by preventing HIV replication inside cells. Relevant immune response detail – T helper cells activate B cells / release cytokine / result in antibody production Explanation that antiviral drugs will only reduce TB deaths in those also infected with HIV. No effect on others as antiviral drugs do not kill bacteria.

Question Number	Answer	Mark
9(a)	The only correct answer is B *the number of different species in a habitat* A is not correct because it is not the number of different genes in a population C is not correct because it is not the number of homozygotes in a population D is not correct because it is not the number of individuals in a population	(1)

Question Number	Answer	Additional guidance	Mark
9(b)	An explanation that makes reference to two of the following • endemic (species) that are only found in that one location (1) • protection of hotspots prevents extinction (of endemic species) (1) • the loss of these species will (significantly) reduce global biodiversity (1)		(2)

Question Number	Answer	Mark
9(c)(i)	The only correct answer is D *there is no significant difference in allele richness between the two populations.* A is not correct because it should not state that allele richness in Finland is higher B is not correct because it should not state that allele richness in the USA is higher C is not correct because the null hypothesis does not concern genetic diversity	(1)

Question Number	Answer	Additional guidance	Mark
9(c)(ii)	• correct completion of table (1) • correct substitution into the equation (1) • correct calculation of chi- squared value (1)	5 / 25 / 2.78 1 / 1 / 0.25 16.50 / 16.5 Correct answer with no working gains full marks ALLOW ecf for 2 marks 16.49 if 2.77, if 2.8 16.52, 16.42 if 2.7 in the table	(3)

Question Number	Answer	Additional guidance	Mark
9(c)(iii)	An answer that makes reference to three of the following • {little / no} effect of small founder population on allele richness (1) • degrees of freedom value is 9 / critical value is 16.919 (1) • therefore stated chi-squared value is below the critical value (16.919) (1) • therefore { there is no significant difference in allele richness between the two populations/ null hypothesis can be accepted} at 0.05 probability (1)	ALLOW converse answer for a stated chi-squared value above the cv if incorrectly calculated ALLOW there is a significant difference at 0.10 probability	(3)

Question Number	Answer	Additional guidance	Mark
9(d)	An explanation that makes reference to the following • North American population is more genetically diverse (therefore more likely to adapt) (1) • (more different alleles) therefore more likely to have an allele that gives advantage (1) • the individuals with an advantageous allele are more likely to survive and breed (1) • the frequency of that allele will increase (1)		(4)

Question Number	Answer	Additional guidance	Mark
10(a)(i)	An answer that makes reference to the following • species D (1) • correct calculation of percentage change as {43.3/ 43} % (1)	Example of calculation (215-150) ÷150 x 100	(2)

Question Number	Answer	Additional guidance	Mark
10(a)(ii)	An explanation that makes reference to four of the following • the rate of growth increases as rate of photosynthesis increases (1) • growth rate is higher for plants grown at a higher light intensity (1) • role of light in light-dependent reactions described (1) • more photosynthesis means more {glucose/carbohydrate} produced (1) • (more carbohydrate produced) means more glucose for {energy/respiration } (1)	ALLOW correlation between rate of growth and rate of photosynthesis e.g. photolysis / photophosphorylation – production of ATP or reduced NADP ALLOW other named product of photosynthesis	(4)

Question Number	Answer	Mark
10(b)	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 • Use shade tolerant and shade intolerant plants • Plants grown in the same conditions e.g. temperature, humidity • Plants grown in either 5% light or 25% light or a range of light intensities • Take same masses of leaf • Add to equal volume of isolation medium • Homogenise (e.g. blend / grind in pestle and mortar) for same length of time • Filter suspensions of plant material (through muslin) or centrifuge to concentrate chloroplasts • Resuspend pellet of chloroplasts if centrifuged • Expose suspensions to 5% and 25% light intensity • Keep temperature controlled • Add DCPIP and record time for DCPIP to decolourise • Carry out repeats to calculate mean time to decolourise the DCPIP • If the difference is due to the light dependent reaction, shade tolerant plants would decolourise more quickly at lower light intensity	(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.	Compare shade tolerant and shade intolerant plants (allow A and C from the table) Control of at least one relevant variable Reference to different light intensities
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.	Growing plants at different light intensities Use of DCPIP to measure rate of photosynthesis Correct description of methodology Sensible number of repeats Correct change in DCPIP/use of colorimeter to measure colour change
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.	Link between change in DCPIP and rate of photosynthesis Link with light dependent reaction How this would support the difference between shade tolerant and shade intolerant plants Use of a named statistical test eg T test