

Mark Scheme (Results)

Summer 2019

Pearson Edexcel Advanced Level
In Biology (9BN0) Paper 01
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.
- In questions marked with an **asterisk** (*), marks will be awarded for the ability to structure answers logically showing how the points are related or follow on from each other where appropriate.

Question Number	Answer	Mark
1(a)(i)	**The only correct answer is D thylakoids** ***A*** *is not correct because the cristae are not found in the chloroplast* ***B*** *is not correct because the matrix is not found in the chloroplast* ***C*** *is not correct because the stroma is not the site of the light-dependent reactions*	**(1)**

Question Number	Answer	Mark
1(a)(ii)	**The only correct answer is D reduced NADP, ATP and oxygen** ***A*** *is not correct because carbon dioxide is not a product of photosynthesis* ***B*** *is not correct because glucose is the end product of the light independent reactions* ***C*** *is not correct because reduced NAD is not a product of the light-dependent reactions*	**(1)**

Question Number	Answer	Mark
1(a)(iii)	**The only correct answer is D water** ***A*** *is not correct because glucose is not the source of hydrogen in the light-dependent reactions* ***B*** *is not correct because reduced NAD is not the source of hydrogen in the light-dependent reactions* ***C*** *is not correct because reduced NADP not the source of hydrogen in the light-dependent reactions*	**(1)**

Question Number	Answer	Additional guidance	Mark
1(b)	An explanation that makes reference to three of the following points • description of carbon dioxide as a limiting factor (1) • carbon dioxide is fixed to produce { GP / GALP } (1) • (therefore increased carbon dioxide) results in more { carbohydrate / polysaccharides / glucose } being produced (1) • which would lead to a greater rate of { growth / cell division } (1)	ALLOW other relevant biological molecule e.g. amino acids, lipids, nucleic acids ALLOW faster growth	**(3)**

Question Number	Answer	Additional guidance	Mark
2(a)(i)	• 9477	<u>Example of calculation</u> Gross productivity – net productivity 14092 - 4615	**(1)**

Question Number	Answer	Additional guidance	Mark
2(a)(ii)	• calculation of energy fixed as biomass by secondary consumers as a percentage of the energy fixed by primary consumers	<u>Example of calculation</u> (464 ÷ 4615) x 100 = 10.1 (same number of decimal places as other values in table)	**(1)**

Question Number	Answer	Mark
2(a)(iii)	**The only correct answer is A - 1.2%** ***B*** *is incorrect because 12% has the decimal point in the incorrect place* ***C*** *is incorrect because 36.6% is NPP divided by GPP* ***D*** *is incorrect because 55.8% is (NPP of producers-energy intake of primary consumers) divided by NPP*	**(1)**

Question Number	Answer	Additional guidance	Mark
2(b)	An explanation that makes reference to three of the following • not all of the light falls on the { leaves / plants / producers } (1) • some of the light is reflected (from the surface of the leaf) (1) • some of the light misses the chloroplasts (and passes through leaf) (1) • some of the light is { the wrong wavelength / not absorbed by the chlorophyll } (1)	ALLOW energy instead of light ALLOW some of the light falls on { bark/parts of the plant that do not photosynthesise} ALLOW chlorophyll / photosystem ALLOW description of not all light wavelengths being absorbed	**(3)**

Question Number	Answer	Additional guidance	Mark
3(a)	• a group of organisms that can interbreed to produce fertile offspring	ALLOW 'breed', 'reproduce', 'mate' for 'interbreed'	**(1)**

Question Number	Answer	Additional guidance	Mark
3(b)	A description that makes reference to four of the following: • DNA obtained from the two types of grass snake (1) • { PCR / restriction enzymes } used to produce fragments of DNA (1) • gel electrophoresis used to analyse the DNA samples (1) • (gel electrophoresis) used to separate the fragments of DNA (1) • more differences in the pattern of bands produced would indicate that the snakes are different species (1)	ALLOW produce different length sections of DNA or target regions of DNA ALLOW description of gel electrophoresis e.g. use of agarose gel and electric current ALLOW similar patterns in the bands would indicate they are the same species	**(4)**

Question Number	Answer	Additional guidance	Mark
3(c)	An explanation that makes reference to four of the following: • mutation leads to { variation within the population of grass snakes / (snakes with) different colour or markings } (1) • (natural selection led to) those snakes which were better camouflaged surviving to reproduce (1) • (therefore) giving rise to two populations with differing allele frequency (1) • (as the result of natural selection) the two populations became reproductively isolated (1) • sympatric speciation (in the context of new species developing in the same habitat) (1)	ALLOW separate gene pools develop or a change in allele frequency ALLOW can no longer breed with each other	**(4)**

Question Number	Answer	Mark
4(a)(i)	**The only correct answer is B 1** The only conclusion that can be valid for these results is that 'each vegetable contains less vitamin C when it is cooked than uncooked' *A is incorrect because there is one valid conclusion* *B is incorrect because there is only one valid conclusion* *C is incorrect because there is only one valid conclusion*	**(1)**

Question Number	Answer	Additional guidance	Mark
4(a)(ii)	• recommended daily value divided by concentration in cooked cauliflower (1) • correct mass of cauliflower calculated (1)	<u>Example of calculation</u> (90 ÷ 20) = 4.5 450 g ALLOW 450 000 mg Correct answer with no working gains full marks	**(2)**

Question Number	Answer	Additional guidance	Mark
4(b)	An answer that makes reference to the following: • cauliflower extract from same mass (of cooked and uncooked cauliflower) (1) • description of titration of cauliflower extract with DCPIP (1) • using same {volume / concentration} of DCPIP (1) • determine the vitamin C content in cooked and uncooked cauliflower by comparing with solution of known vitamin C concentration (1)	ALLOW cauliflower extracts of the same concentration produced e.g. volume of cauliflower extract taken to decolourise the DCPIP ALLOW volume of DCPIP added to cauliflower extract until the DCPIP is no longer decolourised e.g. by using a vitamin C calibration curve	**(4)**

Question Number	Answer	Additional guidance	Mark
5(a)	An explanation that makes reference to the following • an increase in temperature will increase the rate of { decomposition / decay } (1) • (an increase in temperature) increases enzyme activity (1) • an increase in temperature increases growth rate of {bacteria / fungi / decomposers} (1)	ALLOW converse for all points for the effects of a decrease in temperature ALLOW high temperatures may denature enzymes and decrease rate of decomposition ALLOW increases rate of multiplication	**(3)**

Question Number	Answer	Additional guidance	Mark
5(b)	A description that makes reference to three of the following: • (body) temperature falls (1) • rigor mortis / stiffening of the muscles (1) • autolysis / break down of cells by enzymes in the body (1)	ALLOW algor mortis ALLOW breakdown of tissues by enzymes ALLOW accumulation of gases	**(3)**

	• putrefaction / discolouration / bloating (1)		

Question Number	Answer	Additional guidance	Mark
5(c)(i)	A description that makes reference to three of the following: • standardisation of pigs studied (1) • named {environmental condition / abiotic factor} controlled (1) • record the presence of different species (of insects) (1) • at regular intervals of time (1)	 e.g. same {size / breed / mass / type / age /sex} ALLOW example of an abiotic factor being monitored such as temperature e.g. every 24 hours, every day, hourly, weekly	**(3)**

Question	Answer	Additional guidance	Mark

Number			
5(c)(ii)	An explanation that makes reference to three of the following: • record which {insects / species} are present (on the human) (1) • compare with results from investigation (on pigs) to determine time of death (1) • take into account which stages of the lifecycle are present (1) • (when using stage of succession to determine time of death) environmental variables need to be taken into account (1)		**(3)**
Question Number	Answer		Mark
6(a)(i)	**The only correct answer is D - ribosome** ***A*** *is not correct because amyloplasts are only found in plant cells* ***B*** *is not correct because chloroplasts are only found in plant cells* ***C*** *is not correct because mesosomes are only found in bacterial cells*		**(1)**

Question Number	Answer	Mark

6(a)(ii)	**The only correct answer is A-amyloplast** ***B*** *is not correct because Golgi apparatus is found in plant and animal cells* ***C*** *is not correct because mesosomes are found only in bacterial cells* ***D*** *is not correct because some animal cells also have a vacuole*	**(1)**

Question Number	Answer	Mark
6(a)(iii)	**The only correct answer is D-smooth endoplasmic reticulum** ***A*** *is not correct because amyloplasts are only found in plant cells* ***B*** *is not correct because animal cells do not have a cell wall* ***C*** *is not correct because pili are only found in bacterial cells*	**(1)**

Question Number	Answer	Additional guidance	Mark
6(b)	• length of mitochondrion divided by magnification (1) • correct answer with appropriate units (1)	<u>Example of calculation</u> 116 ÷ 20 000 = 0.0058 5.8 µm ALLOW 5.8 x10^{-3} mm / 5.8 x10^{-4} cm / 0.0058 mm / 0.00058 cm Correct answer with units gains full marks ALLOW 5.75 µm for one mark if length measured as 115mm Correct answer with no working gains full marks	**(2)**

Question Number	Answer	Additional guidance	Mark
6(c)	An answer that makes reference to three of the following: <u>Similarities</u> • both have glycosidic bonds (1) • description of every other monomer being inverted (1) <u>Differences</u> • (the monomers of) chitin have eight carbon atoms whereas in cellulose there are six carbon atoms (1) • chitin { has an additional side chain / contains nitrogen but cellulose does not } (1)	IGNORE 1,4 and 1,6 ALLOW every other glucose ALLOW only chitin contains nitrogen / chitin has an amide group	**(3)**

Question Number	Answer	Additional guidance	Mark
7 (a)	A description that makes reference to the following: • (a peptide bond is formed by a) condensation reaction (1) • between the {amine group / NH_2} and the {carboxyl group / COOH} of adjacent amino acids (1)	ALLOW 'amino' for 'amine' and 'carboxylic acid' for 'carboxyl'	**(2)**

Question Number	Answer	Additional guidance	Mark
7(b)	An answer that makes reference to four of the following: • description of production of agar plates with bacteria (1) • description of method used to add plant extract to plates (1) • extracts used separately and in combination (1) • incubate for at 37 °C for an appropriate period of time (1) • measure and compare the sizes of zones of inhibition (1)	ALLOW plates { inoculated / seeded} with bacteria, production of bacterial lawn or streak plates e.g. on filter paper discs or in wells ALLOW time from 24 to 72h and a temperature from 35-38°C e.g. diameter or area ALLOW comparative statements such as the larger the area, the more effective the antimicrobial properties	**(4)**

Question Number	Answer	Mark
7(c)	**The only correct answer is C - preventing the multiplication of bacteria** ***A*** *is not correct because bacteriostatic antibiotics do not destroy bacteria* ***B*** *is not correct because antibiotics are not effective against viruses* ***D*** *is not correct because antibiotics do not prevent the development of antibiotic resistance*	**(1)**

Question Number	Answer	Additional guidance	Mark
7(d)	A description that makes reference to three of the following: • hand wash (stations) (1) • (doctors / nurses) not to wear { ties / watches / long sleeves } (1) • testing patients for the presence of antibiotic resistant bacteria before admission / {isolation / quarantine} of infected patients (1) • increased washing of bedding / disinfection of { beds / surfaces } (1)	ALLOW antibacterial / antiseptic /alcohol gel / hand sanitisers ALLOW use of disposable bedding	**(3)**

Question Number	Answer	Additional guidance	Mark
8(a)(i)	A description that makes reference to the following: • thrombin is an enzyme (1) • (which catalyses) the conversion of fibrinogen into fibrin (1) • a mesh of fibrin traps { platelets / red blood cells } to form a clot (1)	IGNORE 'platelet plug'	**(3)**

Question Number	Answer	Additional guidance	Mark
8(a)(ii)	An explanation that makes reference to the following: • (mutation in the gene) changes the sequence of the amino acids (in the factor V molecule) (1) • (overactive factor V will) increase the production of thrombin (1) • increases blood clotting (1)	ALLOW the mutation results in a change to the {primary structure/ polypeptide chain} ALLOW increased risk of blood clotting	**(3)**

Question Number	Answer	Additional guidance	Mark
8(b)	An answer that makes reference to the following: • percentage incidence (of VTE) higher in {older people /people older than 70 } (1) • in younger people larger percentage (of VTE patients) have the factor V mutation (1) • (therefore) genotype has a greater influence on incidence (of VTE) in younger people (1) • (therefore) greater incidence (of VTE) in older people probably a result of environmental factors (1)	ALLOW converse – incidence of VTE lower in {younger people/ people under 20} ALLOW converse - lower percentage of older people have the factor V mutation ALLOW converse – genotype has less influence on incidence of VTE in older people	**(4)**

Question Number	Answer	Additional guidance	Mark
9(a)(i)	• correct calculation of Q_{10} value	<u>Example of calculation</u> (240 ÷ 80 =) 3	**(1)**

Question Number	Answer	Additional guidance	Mark
9(a)(ii)	An explanation that makes reference to three of the following: • (between 20 °C and 30 °C) there is more kinetic energy available (1) • therefore there will be more frequent collisions (between enzyme and substrate) (1) • more enzyme-substrate complexes formed (1) • (the Q_{10} value indicates) the activity triples with the 10 °C temperature rise (1)	ALLOW more frequent collisions between catalase and hydrogen peroxide	**(3)**

Question Number	Answer	Additional guidance	Mark
9(a)(iii)	An explanation that makes reference to two of the following: • Q_{10} value is less than 1.0 (1) • because the enzyme is denatured (1) • therefore no increase in formation of enzyme-substrate complexes / substrate no longer fits active site (1)	ALLOW Q_{10} value of 0.59 ALLOW fewer enzyme-substrate complexes formed	**(2)**

Question Number	Answer	Additional guidance	Mark
9(b)	An answer that makes reference to four of the following: • climate change could result in { increased temperature / increased humidity / change in rainfall patterns / drought } (1) • increase in temperature could increase the growth of the leaf rust (1) • { increased rainfall / increased humidity } could increase the spread of the leaf rust (1) • a period of drought could reduce the spread of leaf rust (1) • relevant observation about the impact on crop yield (1)	ALLOW increased reproduction of leaf rust (yeast) e.g. decrease in yield of wheat if leaf rust {spread/growth} is increased and vice versa	**(4)**

Question Number	Answer	Additional guidance	Mark
10(a)	An explanation that makes reference to three of the following: • relevant example of human activity (1) • increasing a named greenhouse gas (1) • therefore more {heat energy / infrared radiation} is trapped in the atmosphere (1) • causing a mean increase in the {surface / atmospheric} temperature (1)	e.g. burning fossil fuels / landfill / cattle ranching / deforestation e.g. carbon dioxide / methane ALLOW more heat trapped in the atmosphere	**(3)**

Question Number	Answer
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. <u>Indicative content</u> • Human activity increasing carbon dioxide levels e.g. burning fossil fuels such as oil, coal, gas • Therefore human activity is increasing the level of carbon dioxide in the atmosphere, which then dissolves in the oceans • Graphs show that as carbon dioxide levels increase, pH of the oceans decreases • Reduction in pH increases the percentage of snails with damaged shells • These will not survive therefore less food available for fish / impact on food chains and food webs in the oceans • There may be an initial increase in fish population due to snails becoming more vulnerable to predation • Therefore reduction in fish populations

Level	Mark	Descriptor	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.	One study focussed on Increase in CO_2 / pH in oceans becoming lower or effect of lower pH on snail shells
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.	Reference to effect of pH on shells of snails linked to CO_2 and changes in pH in oceans Links made to effects on food chains due to fewer snails
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.	Analysis of both studies linked to human activity and change in pH of oceans. Explanation of the effect on fish populations. Snails with damaged shells do not survive

Question Number	Answer	Additional guidance	Mark
10(c)	An answer that makes reference to the following: • an inverse relationship described (1) • quantification of the relationship (1)	 e.g. as temperature increases the lifespan decreases ALLOW negative correlation e.g. from 15 to 30ºC decrease of 84% / 109.9 days or a decrease of 7.3 days per degree increase in temperature (130.3 - 20.4) ÷ 15 = 7.3	**(2)**

Question Number	Answer	Additional guidance	Mark
11(a)	An explanation that makes reference to the following: • (a recessive disorder is one) caused by a faulty allele (1) • that is only expressed in the { homozygous condition / absence of a normal allele } (1)	 ALLOW faulty gene ALLOW only expressed if genotype is { homozygous recessive / bb } or if two recessive alleles are inherited	**(2)**

Question Number	Answer	Mark
11(b)(i)	***The only correct answer is B*** Bb and Bb ***A*** *is not correct because the parent who is bb would have Batten disease* ***C*** *is not correct because neither parent has the b allele* ***D*** *is not correct because the parent who is bb would have Batten disease and the parent who is BB would not have the b allele*	**(1)**

Question Number	Answer	Additional guidance	Mark
11(b)(ii)	An answer that makes reference to the following: • correct genetic diagram with reference to offspring genotypes (1) • correct probability of inheriting Batten disease (1)	 e.g. BB, Bb, Bb and bb 1 in 4 / 25% / 0.25 IGNORE ratios	**(2)**

Question Number	Answer
11*(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. <u>Indicative content</u> Adult screening advantages and disadvantages • Identifies risk of developing a particular disease in the future so choices can be made e.g. extra screening for breast cancer or preventative mastectomy/screening and lifestyle changes for some types of CVD • Identification of carriers so choices can be made about family planning – both partners tested, risk can be identified and have prenatal screening • May not want to know if you have a high likelihood of developing a disease, if one person is tested it may give other family members information they would chose not to know, may potentially affect life insurance

	Prenatal screening advantages and disadvantages • Amniocentesis – prepares parents for child with disease/gives choice of abortion • Chorionic villus sampling – as amniocentesis, carried out earlier in pregnancy • Some of the conditions tested for are very unpleasant and may be life limiting • NIPD non-invasive, less traumatic procedure, no increased risk of miscarriage • PGD only implant healthy embryos, do not have to make decision about abortion • Both amniocentesis and CVS carry increased risk of miscarriage, especially CVS (although it can be carried out earlier in the pregnancy) • Can't cure the disease, only choice is to have an abortion-not acceptable to everyone • For conditions such as CF, where there is more than one possible mutation, test is only for most common mutations so there may be false negatives • NIPD currently only available for chromosome disorders such as Down's syndrome • PGD involves IVF, which can be emotionally traumatic and only has about 30% success rate • All pre-natal screening has a risk of false positives with abortion of a healthy fetus. • Procedures involving IVF can be regarded as unethical because many embryos are discarded • Invasive nature of some of the tests

Level	Mark	Descriptor	Additional Guidance
0	Mark	No awardable content	
1	1-2	Limited scientific judgement made with a focus on one side of the argument only. A conclusion may be attempted, demonstrating isolated elements of biological knowledge and understanding but with limited evidence to support the judgement being made.	Only considered one benefit or one risk without further explanation beyond a brief description. A generalised discussion without focusing on the details of specific types of screening
2	3-4	A scientific judgement is made through the application of relevant evidence to both sides of the argument. A conclusion is made, demonstrating linkages to elements of biological knowledge and understanding, with occasional evidence to support the judgement being made.	Considers at least two types of screening One advantage and one disadvantage of each type of screening discussed.
3	5-6	A scientific judgement is made, which is supported throughout by sustained application of relevant evidence from the analysis and interpretation of the scientific information. A conclusion is made, demonstrating sustained linkages to biological knowledge and understanding with evidence to support the judgement being made.	Advantages and disadvantages of blood tests and pre-natal tests discussed fully. Discussion of blood tests to identify adults with genetic disorders. Conclusion or judgement made, e.g. identifying genetic disorders by blood tests in adults is better as the disadvantages have less impact than disadvantages of genetic testing on embryos / fetuses.

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