Mark Scheme (Results)

Summer 2023

Pearson Edexcel GCE
In Biology A (9BN0 01)
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.

Question Number	Answer	Mark
1(a)	The only correct answer is C *a place where an organism lives* A is incorrect because a group of organisms of different species living in the same area is a community B is incorrect because a group of organisms of the same species living in the same area is a population D is incorrect because the role of an organism is its niche	(1)

Question Number	Answer	Additional guidance	Mark
1(b)(i)	A description that makes reference to three of the following • DNA (from bones) is cut into fragments (1) • { radioactive tracers / fluorescent tags} attached to DNA (1) • (fragments of) DNA loaded onto (agarose) gel / samples placed in wells (1) • electric current passed through (the gel) / potential difference set up (through buffer/ across gel) (1)	ALLOW restriction enzymes used on (DNA sample) ALLOW stains such as dye / ethidium bromide ALLOW gel IGNORE agar ALLOW negatively charged fragments move through the gel / DNA fragment moves toward positive electrode IGNORE references to anode or cathode	(3)

Question Number	Answer	Additional guidance	Mark
1(b)(ii)	An explanation that makes reference to the following • (compare) the {size / thickness /position} of bands (1) • if they are closely related there will be (more) similarities (1)		(2)

Question Number	Answer	Mark
2(a)	The only correct answer is B the number of different species and the number of different alleles A is incorrect because it is not the same species C is incorrect because it is not the same alleles D is incorrect because it is not the same alleles or the same species	(1)

Question Number	Answer	Additional guidance	Mark
2(b)(i)	• 156 as n(n-1) for *Ranunculus circinatus* 136 as Total for Number (n) in Pond A 3818 as Total for n(n-1) for Pond A	All three figures correct for one mark	(1)

Question Number	Answer	Additional guidance	Mark
2(b)(ii)	• correct substitution into equation (1) • correct calculation of diversity (1)	Example of calculation (156 x 155) ÷ 9110 = 2.65 /2.654 / 2.7 Correct answer with no working gains full marks.	(2)

Question Number	Answer	Additional guidance	Mark
2(b)(iii)	An answer that makes reference to three of the following • {species richness is lower/fewer species present } (1) • because {most species cannot survive /fewer species can survive} (in the polluted conditions) (1) • adaptations required for polluted conditions (1) • lack of competition in pond B therefore large numbers of those species present (1)	ALLOW 'less biodiversity reduced biodiversity' ALLOW comparison of relative numbers of species in ponds A and B. ALLOW converse for pond A ALLOW pollutants {are toxic / kill organisms}	(3)

Question Number	Answer	Additional guidance	Mark
3 (a)	A description that makes reference to the following • {deoxyribose/pentose sugar}, a (nitrogenous) base and a phosphate (group) (1) • deoxyribose and {adenine / guanine / cytosine / thymine } (1)	ALLOW A, G, C or T DO NOT ALLOW uracil or ribose ALLOW a labelled diagram	(2)

Question Number	Answer	Mark
3(b)(i)	The only correct answer is B *both DNA molecules contain one original DNA strand and one new DNA strand* A is incorrect because it is not RNA C is incorrect because one molecule does not have both parent strands D is incorrect because it is not a mixture	(1)

Question Number	Answer	Additional guidance	Mark
3(b)(ii)	A description that makes reference to four of the following • hydrogen bonds between the {bases/ strands} are broken / the double helix {unwinds/unzips} (1) • (unzipping brought about by) (DNA) helicase (1) • (DNA) nucleotides (line up) along each DNA strand (1) • (by) complementary base pairing (1) • (adjacent nucleotides) joined by DNA polymerase (1)	ALLOW DNA {unwinds / unzips} ALLOW A pairs with T and C pairs with G	(4)

Question Number	Answer	Mark
4(a)(i)	The only correct answer is A *anaphase* B is incorrect because the cytoplasm is not dividing C is incorrect because the chromosomes are not at the equator of the cell D is incorrect because the chromosomes are visible	(1)

Question Number	Answer	Additional guidance	Mark
4(a)(ii)	An answer that makes reference to three of the following • tissue treated with hydrochloric acid (1) • tissue heated (1) • stained with {toluidine blue / (acetic) orcein} (1) • tissue {macerated / squashed } (1)	 ALLOW HCl IGNORE concentration of acid ALLOW other appropriate stains e.g. methylene blue ALLOW description	(3)

Question Number	Answer	Additional guidance	Mark
4(b)	A description that makes reference to four of the following • the chromosomes condense (1) • centrioles move to {each pole / opposite poles} of the cell (1) • to form the spindle / spindle fibres form (1) • the nucleolus breaks down (1) • the nuclear {envelope / membrane} breaks down (1)	 ALLOW chromatids ALLOW become visible / coil ALLOW ends of cell for 'poles'	(4)

Question Number	Answer	Additional guidance	Mark
5(a)(i)	A description that makes reference to the following • the seeds are cleaned / (surface) sterilised (1) • the seeds are dried / seeds stored in dry conditions (1) • they are stored at {cold temperature / -20°C} (1)	ALLOW disinfected IGNORE low humidity ALLOW frozen	(3)

Question Number	Answer	Additional guidance	Mark
5(a)(ii)	An explanation that makes reference to two of the following • (seeds from different plants of the same species) ensures {genetic diversity / a large gene pool / genetic variation} (1) • therefore greater chance of {survival/adaptation} (1) • (if the plants are reintroduced) {conditions may have changed / may be a different habitat} (1)	ALLOW different genotypes / different alleles ALLOW reduces risk of extinction ALLOW examples of change such as presence of disease	(2)

Question Number	Answer	Mark
5(b)(i)	The only correct answer is B *testing on animals, isolated cells and tissues* A is incorrect because it is not tested on humans C is incorrect because it is not tested on humans D is incorrect because placebos are not used at this stage	(1)

Question Number	Answer	Additional guidance	Mark
5(b)(ii)	A description that includes the following • (Stage 1 involves testing on) healthy individuals / {side effects / metabolism} (in humans) (1) • (Stage 2 tests drugs on) small groups of patients (with the condition)/ (Stage 2 tests) to see if the drug is effective (1) • (Stage 3 involves) double-blind testing a large group of patients (1)	ALLOW description – e.g. half given a {placebo / existing drug}	(3)

Question Number	Answer	Additional guidance	Mark
5(c)	An explanation that makes reference to two of the following • acidic conditions in the stomach (1) • (because acidic conditions) denature the enzymes of microorganisms (1) OR • gut flora {outcompete / compete with} other microorganisms (1) • therefore inhibiting {growth / reproduction} of pathogens (1)	ALLOW HCl / hydrochloric acid /low pH ALLOW gut flora produce lactic acid / chemicals to destroy microorganisms ALLOW gut bacteria or microorganisms for gut flora ALLOW bacteria cannot increase in number ALLOW disease causing organisms for pathogens	(2)

Question Number	Answer	Mark
6(a)	The only correct answer is D t*he role of an organism in its environment* A is incorrect because an environment has many niches B is incorrect because a habitat has many niches C is incorrect because it is not population	(1)

Question Number	Answer	Additional guidance	Mark
6(b)(i)	An explanation that makes reference to four of the following points • (many) alveoli provide large surface area for {gas exchange / diffusion } (1) • thin walls of alveoli / alveoli have walls that are one cell thick (1) • therefore short diffusion {distance /pathway} (for gas exchange) (1) • network of capillaries (surrounding alveoli) maintains the concentration gradient (1) • network of capillaries increases surface area for {diffusion / gas exchange } (1)	ALLOW SA:V ALLOW epithelium for wall	(4)

Question Number	Answer	Additional guidance	Mark
6(b)(ii)	A description that makes reference to four of the following • (a gene) mutation leads to some shrews having {different myoglobin / myoglobin with different tertiary structure} (1) • selection pressure described (1) • (shrews with mutation) able to {dive / feed in water} (1) • (therefore more likely to) survive and reproduce (1) • advantageous allele passed on to offspring (1) • the frequency of the {advantageous allele /allele for a different myoglobin} increases over time (1)	IGNORE more myoglobin e.g. availability of food or flooding ALLOW favourable or beneficial for advantageous	(4)

Question Number	Answer	Additional guidance	Mark
6(b)(iii)	An explanation that makes reference to the following • (a change in the base sequence of DNA) causes a change to the triplet code (1) • therefore there will be a change in the amino acids (in the myoglobin) (1) • changing the bonding and therefore the (tertiary) structure (of the protein) (1)	ALLOW a change in codons (in mRNA) ALLOW a change in R groups / primary structure ALLOW example of bonding e.g. hydrogen / ionic / disulfide bridges	(3)

Question Number	Answer	Mark
7(a)	The only correct answer is **D** *plasmid, 70S* ribosome*, circular DNA* A is incorrect because cellulose cell walls are found in plant cells B is incorrect because these are all found in plant and animal cells C is incorrect because plasma membrane and cellulose cell wall are found in plant cells	(1)

Question Number	Answer	Additional guidance	Mark
7(b)(i)	• (a substance that) can kill bacteria		(1)

Question Number	Answer	Additional guidance	Mark
7(b)(ii)	• calculation of increase in cell number (per hour) (1) • answer expressed in standard form (1)	Example of calculation (16000 – 8000) ÷2 = 4000 (per hour) 4.0×10^3 hour $^{-1}$ / 4.0×10^3 hr $^{-1}$ ALLOW 4×10^3 hour $^{-1}$ ALLOW per hour or /hour IGNORE mm or mm^3 4.0×10^3 gains one mark Correct answer with no working gains full marks	(2)

Question Number	Answer	Additional guidance	Mark
7(b)(iii)	An explanation that makes reference to four of the following • histamine is released (1) • (histamine) causes {vasodilation / dilation of arterioles } (1) • (vasodilation) increases the blood flow (1) • capillaries become more permeable (1) • (therefore) {white blood cells / phagocytes} reach the {infected area / bacteria / pathogen} (1)	DO NOT ALLOW vasodilation of other blood vessels ALLOW macrophages or neutrophils for phagocytes	(4)

Question Number	Answer
*7(c)	Answers will be credited according to candidate's 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 of antibiotics is a selection pressure allowing evolution of antibiotic-resistance • Antibiotics kill/stop growth of all non-resistant bacteria • Only bacteria with a mechanism of resistance will survive and reproduce • Examples of mechanisms which have evolved – destruction of antibiotic/ decrease antibiotic uptake/ activation of transport mechanism/ modification of target site • Explanation of how a mechanism would protect the bacteria from the antibiotic – enzyme produced/ reduced cell membrane permeability/ pumps to remove toxic substances / mutations so antibiotic no longer binds to DNA • ~~Bacteria have single DNA molecule so any mutation is expressed~~ • Conjugation/ exchange of plasmids allows mutations to pass between bacteria • Each antibiotic has a specific target in the bacterial cell, so resistant mechanism specific for that bacteria and that antibiotic • Discussion of hospital practices to reduce development of resistance and why they are effective – hygiene / screening and isolation of patients / management of antibiotic use 6 marks

			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.	Description of one mechanism of resistance from the table. One hospital practice to reduce resistance.
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.	Description of more than one mechanism of resistance from the table. Description of at least two hospital practices. Description of how antibiotic resistance evolves linked to {natural selection /selection pressures}.
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.	ALL of level 2 plus: Details of how resistance is spread between bacteria e.g. conjugation. Explanation of how a hospital practice reduce resistance.

Question Number	Answer	Mark
8(a)	The only correct answer is B *found in only one geographical location* A is incorrect because it is not found in many areas C is incorrect because not all endemic species are threatened D is incorrect because endemic species are not hybrid	(1)

Question Number	Answer	Mark
8(b)	The only correct answer is D 9.0 x 10^{7} tonnes $year^{-1}$ A is incorrect because 7.5 × 10^{6} tonnes $year^{-1}$ is the mass produced per year in 100 000 hectares not 1.2 million hectares B is incorrect because 75 tonnes is the mass of carbon stored per year in one hectare and not in 1.2 million hectares C is incorrect because 9.0 × 10^{6} tonnes $year^{-1}$ is the mass produced per year in 120 000 hectares not 1.2 million hectares	(1)

Question Number	Answer	Additional guidance	Mark
8(c)(i)	An explanation that makes reference to three of the following • carbon dioxide dissolves in the (sea) water (1) • this increases the acidity of the water (1) • increased global warming could increase the water temperature (1) • therefore change in {temperature / pH} will denature the enzymes (so less seagrass survives) (1)	ALLOW formation of carbonic acid ALLOW lowers pH ALLOW description of global warming ALLOW { temperature /pH} no longer optimum for the enzymes of the seagrass	(3)

Question Number	Answer	Additional guidance	Mark
8(c)(ii)	An answer that makes reference to four of the following • therefore the number of (aquatic) animals would decrease (1) • (less sea grass) means there is less food for {primary consumers / herbivores } (1) • (less oxygen or food) due to a decrease in photosynthesis (1) • less oxygen for respiration by (aquatic) animals (1) • an impact on {food chains / food webs / energy transfer } described (1)	ALLOW relevant comment about change in biodiversity ALLOW less food for animals to eat ALLOW more predation/ more competition	(4)

Question Number	Answer	Additional guidance	Mark
8(c)(iii)	An explanation that makes reference to the following • seagrass takes up carbon dioxide by photosynthesis (1) • less {decomposition /decay} / not broken down by decomposers (1) • therefore the carbon remains locked in the plant / seagrass is a carbon sink (1)	ALLOW reference to Calvin cycle or light independent reactions ALLOW less respiration by microorganisms (1) ALLOW seagrass sequesters carbon	(3)

Question Number	Answer	Mark
9(a)(i)	The only correct answer is C - Z^bW A is incorrect because Z^BZ^b gives a bar-headed male chicken B is incorrect because Z^bZ^b gives a black-headed male chicken D is incorrect because Z^BW^b is not possible as the characteristic is not carried on the W chromosome	(1)

Question Number	Answer	Additional guidance	Mark
9(a)(ii)	An answer that makes reference to the following • diagram shows (female) gametes Z^B and W, (male) gametes Z^b and Z^b (1) • diagram completed to show correct genotypes of offspring (1) • phenotypes (Z^bW) black-headed females and Z^BZ^b) bar-headed males (1)	Z^BZ^b and Z^bW	(3)

Question Number	Answer	Additional guidance	Mark
9(a)(iii)	An answer that makes reference to three of the following • males (from this cross) are all { Z^BZ^b / heterozygous} (1) • therefore females will inherit either B or b allele (from the male) (1) • females only have one allele for head colour therefore some will be bar-headed and some will be black-headed (1)	ALLOW mp1 and mp2 from genetic cross diagram ALLOW gametes will be {B/bar-headed} and {b/black-headed} ALLOW Bb ALLOW females inherit either a dominant or a recessive allele	(3)

Question Number	Answer	Additional guidance	Mark
9(b)	A description that makes reference to three of the following • introns are removed (1) • exons can then be arranged in several different ways / exons can be removed (1) • this produces different mRNA (from the same gene) (1) • translation (of the mRNA) gives different {amino acid sequences / different polypeptides / different proteins} (1)	ALLOW alternative splicing	(3)

Question Number	Answer	Additional guidance	Mark
10(a)	• suitable trend line drawn on graph (1) • correct date from extrapolated trend line on graph (1)	e.g. a smooth/straight line date correctly read from graph	(2)

Question Number	Answer	Additional guidance	Mark
10(b)	An explanation that makes reference to three of the following • (because) specialist species feed on only one type of plant they may have {less /nothing} to feed on(1) • (food plant for specialist species) may not be available {at all / at the right time} (due to climate change) (1) • other species may be competing with the specialist species for food (1) • generalist species (can survive because they) would be more likely to find alternative food (1)	ALLOW young leaves not available for the larvae / plant may flower earlier	(3)

Question Number	Answer	Additional guidance	Mark
10(c)(i)	An explanation that makes reference to two of the following • (life cycle) depends on metabolic reactions (1) • (increase in temperature) increases the kinetic energy of enzymes (1) • (therefore) there will be {more frequent collisions between enzyme and substrate / faster rate of formation of enzyme-substrate complexes} (1)	ALLOW increases {metabolism / respiration / cell division / protein synthesis } IGNORE rate of these processes ALLOW increases rate of enzyme activity DO NOT ALLOW increase in enzyme activity without reference to rate	(2)

Question Number	Answer
*10(c)(ii)	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 • Independent variable – describe range of temperatures (e.g. 5 – 40°C) • Dependent variable – measure time from egg hatching to pupating • Variables to be controlled : same specialist species, source/age of eggs/larvae, food plant, mass of food, humidity • Details for how variable controlled e.g. use of water baths • Repeats - several eggs/larvae at each temperature • Monitor eggs/larvae at regular intervals of time • Record length of time since hatched • Calculate mean length of time for each temperature • Suitable statistical analysis e.g. SD, Spearman's Rank, T-test (if only 2 temperatures selected) 6 marks

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.	More than one temperature. At least one variable controlled. Repeats at each temperature.
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.	All of Level 1 plus: Incubate at five or more appropriate temperatures. Measure time spent in larval stage / monitor at regular time intervals. Repeats to calculate the mean.
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.	All the above plus: Measure time taken from egg hatching to pupation. Relevant statistical test based on data to be collected.

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