Mark Scheme (Results)

Summer 2017

Pearson Edexcel GCE
In Biology Spec A (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.

Question Number	Answer	Mark
1(a)(i)	**1(a)(i). The only correct answer is D – the sperm cell releases enzymes that digest the zona pellucida** A is not correct because the enzymes are released by the sperm and digest the zona pellucida B is not correct because enzymes are released by the sperm C is not correct because the enzymes digest the zona pellucida	**1**

Question Number	Answer	Mark
1(a)(ii)	**1(a)(ii). The only correct answer is A –** one copy of each gene / different alleles of some genes B is not correct because sperm can contain a different allele of a gene C is not correct because sperm will contain one copy of each gene D is not correct because sperm contain one copy of each gene and can have a different allele of some genes	**1**

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Question Number	Answer	Additional Guidance	Mark
1(b)	A description that makes reference to three of the following: • fusion of sperm cell (membrane) with egg cell membrane (1) • cortical granules release contents (into zona pellucida) (1) • contents of cortical granules react with the zona pellucida / zona pellucida { thickens / hardens } (1) • fusion of { sperm and egg / haploid } nuclei (1)	ALLOW sperm cell binds to egg cell membrane	**3**

Question Number	Answer	Additional Guidance	Mark
2(a)	An explanation that makes reference to the following: • hydrophilic parts associate with water (1) • hydrophobic parts {associate with each other / repel water }(1) • a bilayer forms with hydrophobic parts pointing { in towards the centre of the bilayer / towards each other } (1)	ALLOW converse ALLOW phosphate groups associate with water ALLOW fatty acids face away from water ALLOW annotated diagram to show arrangement of phospholipids	**3**

Question Number	Answer	Mark
2(b)(i)	**2(b)(i). The only correct answer is B -** against a solute concentration gradient | through a partially permeable membrane A is not correct because in osmosis water moves against a solute concentration gradient - through a partially permeable membrane C is not correct because in osmosis water moves against a solute concentration gradient - through a partially permeable membrane D is not correct because in osmosis water moves against a solute concentration gradient - through a partially permeable membrane	**1**

Question Number	Answer	Mark
2(b)(ii)	**2(b)(ii). The only correct answer is A – Active transport** B is not correct because exocytosis s an export process C is not correct because osmosis describes the movement of water (solvent) molecules D is not correct because passive diffusion take place down a concentration gradient	**1**

Question Number	Answer	Mark
2(b)(iii)	**2(b)(iii). The only correct answer is D – Protein** A is not correct because carrier molecules or channel used for facilitated diffusion are proteins B is not correct because carrier molecules or channel used for facilitated diffusion are proteins C is not correct because carrier molecules or channel used for facilitated diffusion are proteins	**1**

Question Number	Answer	Additional Guidance	Mark
2(c)(i)	A description that makes reference to three of the following: • chloride ions leave cells (through the CFTR channel protein) (1) • sodium ions leave the cells (following the chloride ions) (1) • increasing the solute concentration in the mucus (1) • water moves out of the cells by osmosis (into the mucus) (1)	NOT active transport of chloride ions ALLOW chloride ions move into the mucus ALLOW NaCl, Na^+ or Cl^- instead of solute ALLOW description of osmosis	**3**

Question Number	Answer	Additional Guidance	Mark
2(c)(ii)	An explanation that makes reference to the following: • (triplet code) is shown by three bases coding for an amino acid (1) • non-overlapping code e.g. ATT codes for amino acid I and then AAA code for amino acid K (1) • degenerate code as both ATT and ATC code for amino acid I (1)		**3**

Question Number	Answer	Additional Guidance	Mark
3(a)	A description that makes reference to three of the following: • (large) circular DNA (1) • DNA not associated with histone proteins (1) • (small / several) plasmids (1) • located in the cytoplasm / not inside a nucleus (1)	 ALLOW nucleoid NOT two marks for plasmids are circular DNA	**3**

Question Number	Answer	Additional Guidance	Mark
3(b)(i)	 • correct values taken from the graph (1) • correct answer with units (1)	<u>Example of calculation</u> 55 – 45 (= 10) = 2 au min^{-1} ALLOW an answer between 1.6 au and 2 au per minute or 0.0267 to 0.0333 au per second Correct answer with units, with no working gains full marks Correct answer with no units, gains one mark only	**2**

Question Number	Answer	Additional Guidance	Mark
3(b)(ii)	An answer that makes reference to the following: • DNA contents doubles twice / two stages of DNA synthesis (1) • therefore two divisions (1)	 ALLOW two increases in uptake of bases ALLOW twice	 **2**

Question Number	Answer	Additional Guidance	Mark
3(b)(iii)	An explanation that makes reference to two of the following: • because thymine is found only in DNA (1) • other radioactive bases taken up by all nucleic acids (1) • only DNA would be measured (1)	 ALLOW RNA does not contain thymine ALLOW other bases taken up by RNA ALLOW no need to separate DNA from RNA	 **2**

Question Number	Answer	Additional Guidance	Mark
3(c)	An answer that makes reference to the following: • tetracycline { is bacteriostatic / stops bacteria dividing } (because the number of bacteria stays the same) (1) • penicillin {is bactericidal / kills bacteria } (because the number of bacteria decreases) (1)		 **2**

Question Number	Answer	Additional Guidance	Mark
4(a)	A description that makes reference to the following: • use of light (energy) to excite electrons in chlorophyll (1) • {photolysis / splitting of water} to produce oxygen, electrons and hydrogen ions (1) • electrons used { in the electron transport chain / to replace those lost by chlorophyll } (1) • generation of ATP / photophosphorylation (1) • reduction of NADP (1)	ALLOW electrons promoted to higher energy level ALLOW photosystem (PS) I or II for chlorophyll ALLOW correct equation ALLOW electrons used in redox reactions / electrons move along electron carrier proteins	**5**

Question Number	Answer	Mark
4(b)(i)	**4(b)(i). The only correct answer is C – Stroma** A is not correct because light-independent reactions take place in the stroma B is not correct because light-independent reactions take place in the stroma D is not correct because light-independent reactions take place in the stroma	**1**

Question Number	Answer	Mark
4(b)(ii)	**4(b)(ii). The only correct answer is C – RUBISCO (ribulose bisphosphate carboxylase/oxygenase)** A is not correct because RUBISCO (ribulose bisphosphate carboxylase/oxygenase) is the enzyme that fixes carbon dioxide B is not correct because is not correct because RUBISCO (ribulose bisphosphate carboxylase/oxygenase) is the enzyme that fixes carbon dioxide D is not correct because is not correct because RUBISCO (ribulose bisphosphate carboxylase/oxygenase) is the enzyme that fixes carbon dioxide	**1**

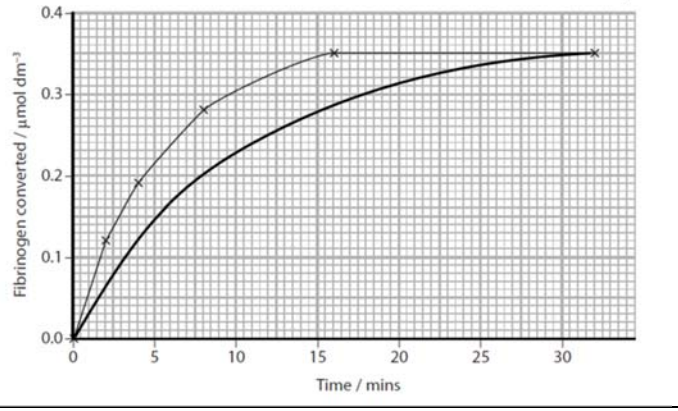
Question Number	Answer	Mark
4(b)(iii)	**4(b)(iii). The only correct answer is B – GP** A is not correct because glucose is made from the products of the light-independent reactions C is not correct because RuBP is the molecule that CO_2 combines with to form molecules of GP D is not correct because starch is formed from glucose	**1**

Question Number	Answer	Additional Guidance	Mark
5(a)	An explanation that makes reference to four of the following: • pollen preserved in peat bogs (1) • a plant species can be identified from its pollen (1) • climate affects the type of plants growing (1) • depth of peat correlates with period of time since pollen was produced (1) • changes in pollen over time indicate changes in climate (1)	ALLOW conditions / temperature in place of climate ALLOW carbon-14 dating ALLOW pollen quantity or type	**4**

Question Number	Answer	Additional Guidance	Mark
5(b)(i)	• correct values for carbon released by boreal forest and deciduous forest respiration (1) • correct use of values to calculate percentage increase (1) • correct answer (1)	<u>Example of calculation</u> 1013 – 322 = 691 (Boreal) 2165 – 1301 = 864 (Deciduous) = 173 ÷ 691 deciduous release 25% (25.04%) more than boreal Correct answer with no working gains full marks	**3**

Question Number	Answer	Additional Guidance	Mark
5(b)(ii)	An answer that makes reference to the following: • the ratio of NPP to GPP is higher in deciduous forests (1) • NPP is higher / more of the carbon (fixed) is used to produce biomass (1) • (in deciduous forests) more carbon (dioxide) removed (by photosynthesis) than returned by respirat ion (1)	ALLOW converse for boreal forests for all points	**3**

Question Number	Answer	Additional Guidance	Mark
6(a)(i)	• correct values taken from the graph (1) • correct answer with correct units (1)	<u>Example of calculation</u> 0.12 ÷ 2 = = 0.06 μmol dm^{-3} min^{-1} = 0.06 μmol per dm^3 per minute or = 0.001 μmol dm^{-3} s^{-1} = 0.001 μmol per dm^3 per second Correct answer with no units gains one mark Correct answer with correct units but no working gains full marks	**2**

Question Number	Answer	Additional Guidance	Mark
6(a)(ii)	• curve that is less steep but reaches the same plateau (1)	e.g.  	1

Question Number	Answer	Additional Guidance	Mark
6(a)(iii)	An explanation that makes reference to the following: • the slower the initial rate of reaction the longer it will take for a clot to form (1) • because fibrin will be produced more slowly (1)	Allow converse arguments	2

Question Number	Answer	Additional Guidance	Mark
6(b)(i)	An explanation that makes reference to the following: • fibrinogen concentration is higher in individuals with CVD (1) • compare an individual's fibrinogen concentration with values in the table (1) • no overlap between fibrinogen concentrations for those with CVD compared with those without CVD (1)	ALLOW females above 321and males above 324 or females above 328 and males above 329 are identified as being at risk ALLOW values above mean without CVD + SD or mean with CVD –SD identified as at risk	**3**

Question Number	Acceptable answer	Additional Guidance	Mark
6(b)(ii)	An explanation that makes reference to the following: • increased concentrations of fibrinogen leading to increased fibrin (1) • increase the risk of blood clotting / more frequent and extensive clotting (1) • blocking lumen of {arteries / capillaries} (1)		**3**

Question Number	Answer	Additional Guidance	Mark
7(a)(i)	A description that makes reference to three of the following: • primary structure described as a repeating amino acid sequence (1) • three polypeptide chains (1) • chains coiled around each other (1) • cross-linking between the chains (1)	ALLOW {proline / glycine / hydroxyproline} rich polypeptide chains IGNORE alpha helix ALLOW {covalent / hydrogen / disulphide} bonding between chains	3

Question Number	Answer	Additional Guidance	Mark
7(a)(ii)	An answer that makes reference to one of the following: • to provide {strength / flexibility} (1) • holds walls of capillaries and alveoli close together (1)	ALLOW to support alveoli IGNORE to support capillaries	1

Question Number	Answer	Additional Guidance	Mark
7(b)	An explanation that makes reference to three of the following: • thinner blood-gas barrier (1) • because of thinner { alveolar walls / capillary walls / extracellular matrix layer } (1) • therefore a reduced diffusion distance (1) • a faster rate of { diffusion / gas exchange } (1)	ALLOW greater rate	3

Question Number	Answer	Additional Guidance	Mark
8(a)	An answer that makes reference to three of the following: • HPV strains 16 and 18 are { more associated with cervical cancer / not associated with genital warts } (1) • HPV strains 6 and 11 are { more associated with genital warts / not associated with cervical cancer } (1) • (for the strains shown) greater percentage of cases of genital warts associated with HPV than cervical cancer (1) • quantitative comparison made to demonstrate the difference (1)	e.g. 89% for genital warts and 68% for cervical cancer	**3**

Question Number	Answer	Additional Guidance	Mark
8(a)(ii)	An explanation that makes reference to four of the following: • Guardasil is developed from four strains of HPV, whereas Cervarix only developed from two (1) • Guardasil provides protection against all four strains of HPV whereas Cervarix provides protection against two strains of HPV (1) • both vaccines will provide immunity against (HPV 16 and 18) viruses that cause cervical cancer (1) • Guardasil will also provide immunity against (HPV 6 and 11) viruses that cause genital warts (1)		**4**

Question Number	Answer	Mark
8(a)(iii)	**8(a)(iii). The only correct answer is A - artificial active immunity** B is not correct because vaccination produces artificial active immunity C is not correct because vaccination produces artificial active immunity D is not correct because vaccination produces artificial active immunity	**1**

Question Number	Answer	Additional Guidance	Mark
8(b)	An explanation that makes reference to three of the following: • a vaccinated person will have memory T cells (1) • (memory T cells) recognise (antigens specific to) the HPV-16 virus (1) • T helper cells that activate {B cells / T killer cells} (1) • (formation of) T killer cells destroy cells infected with virus (1)	ALLOW a response that begins with 'T memory cells …' / or statement that T memory cells are already present ALLOW cytotoxic T cells for T killer cells	**3**

Question Number	Answer	Mark
8(c)(i)	**8(c)(i). The only correct answer is D - from undifferentiated cells by mitosis** A is not correct because a B cell is a specialised cell produced by differentiation of a stem cell B is not correct because a B cell is a specialised cell produced by differentiation of a stem cell C is not correct because a B cell is a specialised cell produced by differentiation of a stem cell	**1**

Question Number	Answer	Additional Guidance	Mark
8(c)(ii)	An answer that makes reference to the following: • {allele / gene} responsible for a trait is located on a sex chromosome (1) • expression of the trait is related to gender / one gender inherits only one allele for a trait (1)	ALLOW X or Y chromosome e.g. males only have one allele but females have two alleles for a trait	**2**

Question Number	Answer	Additional Guidance	Mark
9(a)	An answer that makes reference to the following: • at the start of composting the percentage of organic carbon is less and the percentage of nitrogen is more when cow dung is added (1) • adding cow dung does not change the decrease in organic carbon (1) • adding cow dung causes {a slight / no change} to the increase in nitrogen (1) • adding cow dung has no significant effect on composting (of coffee husks) (1)	e.g. 12.8% and 12.7% e.g. 0.43% compared with 0.47%	**3**

Question Number	Answer
***9(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. • standardisation of composition of compost heaps • identification of species • abundance of each species of organism in the sample • determination of C:N / set up compost heaps with different C:N ratios • time e.g. days / intervals / repetition of sampling • other factors to monitor or control e.g. water / gases / humidity / temperature / aeration / mass • sampling technique e.g. location of sample within compost heap / repetition of sampling

Level	Mark	Descriptor	
0	Marks	No awardable content	
Level 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.	Measure / set up compost heaps with different C:N ratios Observe species present over time
Level 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.	Recording species present / numbers of each species / measuring C:N ratio Monitoring changes over time Control of relevant factors
Level 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.	Description of a suitable sampling technique Linking species present or species density to C:N measurements Use of a statistical test to compare changes of time / C:N ratio Use information on numbers of species and population sizes to demonstrate succession

Question Number	Answer	Additional Guidance	Mark
10(a)(i)	A answer that makes reference to the following: • {alternative form / different form / version / variation} of a gene (1)	IGNORE type of gene	**1**

Question Number	Answer	Additional Guidance	Mark
10(a)(ii)	• correct use of Hardy-Weinberg equation (1) • correct calculation of probability of each homozygote (1) • correct answer (1)	<u>Example of calculation</u> $p^2+2pq+q^2= 1$ p^2= either 0.185 or 0.325 q^2= either 0.325 or 0.185 or 2pq = 0.43 x 0.57 x 2 = 0.4902 frequency = 50.98 % / 51% (which is greater than 50%) Correct answer with no working gains full marks	**3**

Question Number	Answer
***10(b)(i)**	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. • feeding behaviours • anatomy • genetic differences • no information on whether they can interbreed to produce fertile offspring • different locations do not indicate that they are different species • no information on number of elephants used for DNA analysis • GBA alleles K and L are exclusive to one type of elephant / genetic isolation

Level	Mark	Descriptor	
Level 0	Marks	No awardable content	
Level 1	1-2	An answer 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 answer will contain basic information with some attempt made to link knowledge and understanding to the given context.	Makes reference to one of behavioural, phenotypic, anatomical or genetic differences
Level 2	3-4	An answer will be given with occasional evidence of analysis, interpretation and/or evaluation of more than one pieces of scientific information. The answer shows some linkages and lines of scientific reasoning with some structure.	Makes reference to more than one of behavioural, phenotypic, anatomical or genetic differences Also includes an interpretation of allele data **or** considers reasons why may not be different species
Level 3	5-6	An answer is made which is supported throughout by sustained application of relevant evidence of analysis, interpretation and/or evaluation of all pieces of scientific information. The answer shows a well-developed and sustained line of scientific reasoning which is clear and logically structured.	Also includes an interpretation of allele data **and** considers reasons why may not be different species

Question Number	Answer	Additional Guidance	Mark
10(b)(ii)	An explanation that makes reference to three of the following: • two populations are geographically isolated from each other (1) • therefore reduced gene flow between the two populations (1) • which leads to allopatric speciation (1) • different selection pressures leading to natural selection (1)	 ALLOW description of populations separated by a geographical feature ALLOW description of natural selection in context of selection pressures	**3**

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