Mark Scheme (Results)

Summer 2018

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.
- Mark schemes will indicate within the table where, and which strands of QWC, are being assessed. The strands are as follows:

  i) ensure that text is legible and that spelling, punctuation and grammar are accurate so that meaning is clear
  ii) select and use a form and style of writing appropriate to purpose and to complex subject matter
  iii) organise information clearly and coherently, using specialist vocabulary when appropriate

Using the Mark Scheme

Examiners should look for qualities to reward rather than faults to penalise. This does NOT mean giving credit for incorrect or inadequate answers, but it does mean allowing candidates to be rewarded for answers showing correct application of principles and knowledge. Examiners should therefore read carefully and consider every response: even if it is not what is expected it may be worthy of credit.

The mark scheme gives examiners:
- an idea of the types of response expected
- how individual marks are to be awarded
- the total mark for each question
- examples of responses that should NOT receive credit.

/ means that the responses are alternatives and either answer should receive full credit.
( ) means that a phrase/word is not essential for the award of the mark, but helps the examiner to get the sense of the expected answer.
Phrases/words in **bold** indicate that the meaning of the phrase or the actual word is **essential** to the answer.
ecf/TE/cq (error carried forward) means that a wrong answer given in an earlier part of a question is used correctly in answer to a later part of the same question.

Candidates must make their meaning clear to the examiner to gain the mark. Make sure that the answer makes sense. Do not give credit for correct words/phrases which are put together in a meaningless manner. Answers must be in the correct context.

Quality of Written Communication
Questions which involve the writing of continuous prose will expect candidates to:
- write legibly, with accurate use of spelling, grammar and punctuation in order to make the meaning clear
- select and use a form and style of writing appropriate to purpose and to complex subject matter
- organise information clearly and coherently, using specialist vocabulary when appropriate.

Full marks will be awarded if the candidate has demonstrated the above abilities.
Questions where QWC is likely to be particularly important are indicated (QWC) in the mark scheme, but this does not preclude others.

Question Number	Answer	Mark
1(a)(i)	**D** – is correlated with a reduction in CVD *The only correct answer is **D*** ***A** is not correct because the incidence of CVD decreases with increasing magnesium ion intake and it is not possible to infer causation from the data* ***B** is not correct because it is not possible to infer causation from the data in graph* ***C** is not correct because the incidence of CVD decreases with increasing magnesium ion intake*	**(1)**

Question Number	Answer	Mark
1(a)(ii)	**B –** 78 mg day^{-1} *The only correct answer is **B*** ***A** is not correct because 43 is the increase required to achieve a 0.05 reduction in relative risk* ***C** is not correct because 118 is the Mg^{2+} intake that is associated with a 0.25 reduction in relative risk* ***D** is not correct because 347 is the correct column chosen with no subtraction*	**(1)**

Question Number	Answer	Additional Guidance	Mark
1(b)(i)	A description that makes reference to the following: • (LDL / lipoproteins carry) cholesterol in the blood (1) • (cholesterol) is deposited to form atheroma (1) • in the endothelium of an artery (1)	ALLOW LDLs increase blood cholesterol ALLOW plaque formation ALLOW artery wall	**(3)**

Question Number	Answer	Additional Guidance	Mark
1(b)(ii)	An explanation that makes reference to the following: • narrowing of (lumen of) coronary arteries (1) • which reduces {blood flow / oxygen} to the cardiac muscle (1) • which reduces aerobic respiration (1)	ALLOW coronary arteries blocked ALLOW heart muscle ALLOW more anaerobic respiration / build-up of lactic acid	**(3)**

Question Number	Answer	Additional Guidance	Mark
2(a)(i)	• 66	ALLOW 67	**(1)**

Question Number	Answer	Additional Guidance	Mark
2(a)(ii)	• correct values taken from the graph (1) • correct rate calculated from figures used from graph (1)	<u>Example of calculation</u> (12 - 6.8) ÷ (90-60) = or 5.2 ÷ 30 = ALLOW 5.0, 5.1 or 5.2 0.17 (mm hour^{-1}) (0.1667 or 0.167 – one mark only) Correct answer without working gains full marks	**(2)**

Question Number	Answer	Additional Guidance	Mark
2(a)(iii)	An explanation that makes reference to the following: • temperature affects {enzymes / metabolism / reactions} (1) • an increase in temperature increases kinetic energy (1) • producing more (frequent) collisions between enzyme and substrate (molecules) (1)	ALLOW protein synthesis / cell division ALLOW converse statement for temperature decrease ALLOW more (frequent) formation enzyme-substrate complexes	**(3)**

Question Number	Answer	Additional Guidance	Mark
2(b)	A description that makes reference to two of the following: • decomposers break down organic material (from the dead body) (1) • (decomposers) respire (1) • releasing carbon dioxide (into the atmosphere) (1)	ALLOW organic molecules / named organic molecule / organic compounds ALLOW respiration takes place ALLOW methane in context of anaerobic respiration	**(2)**

Question Number	Answer	Mark
3(a)(i)	**B –** plasma cell *The only correct answer is **B*** ***A** is not correct because macrophage does not produce antibodies* ***C** is not correct because red blood cells do not produce antibodies* ***D** is not correct because T cells do not produce antibodies.*	**(1)**

Question Number	Answer	Mark
3(a)(ii)	**D –** natural passive immunity - the immunity is provided by components of the mother's milk produced as part of a natural immune response. The baby has not produced these components so the immunity is passive. *The only correct answer is **D*** ***A** is not correct because the baby has not produced the immunity gained from the mother's milk so it is not active immunity* ***B** is not correct because the immunity from the mother was not generated by artificial exposure to antigens (e.g. immunisation) so it is not artificial immunity* ***C** is not correct because the baby has not produced the immunity gained from the mother's milk so it is not active immunity*	**(1)**

Question Number	Answer	Additional Guidance	Mark
3(b)	An explanation that makes reference to four of the following: • histamine is released (1) • (histamine) causes {arterioles to dilate/ vasodilation} (1) • which increases the blood flow (to the site causing redness) (1) • (histamine) also causes the permeability of capillaries to increase (1) • allowing blood plasma to {leave the capillary / enter the tissues} (causing oedema / swelling) (1)	ALLOW reference to 'leaky' capillaries	**(4)**

Question Number	Answer	Additional Guidance	Mark
3(c)(i)	An explanation that makes reference to the following: • increasing dose of interferon increases the survival time of the mice (1) • because interferon inhibits viral replication (inside cells) (1) • the greater the dose of interferon the fewer virus particles {produced / released} (to infect other cells) (1)	ALLOW positive correlation between interferon dose and survival time ALLOW interferon prevents virus infecting other cells	**(3)**

Question Number	Answer	Additional Guidance	Mark
3(c)(ii)	An explanation that makes reference to two of the following: • bacteria do not possess {rER / Golgi apparatus} (1) • polypeptide chain is not {processed / modified}properly (1) • therefore the protein is {incorrectly folded / carbohydrate is not added} (1)	ALLOW converse statements for each marking point ALLOW Golgi body ALLOW protein ALLOW is not glycosylated	**(2)**

Question Number	Answer	Mark
3(c)(iii)	**B -** exocytosis *The only correct answer is **B*** ***A** is not correct because endocytosis is the process used to take particles into cells* ***C** is not correct because facilitated diffusion is not used to transport proteins* ***D** is not correct because phagocytosis is a process used to engulf large particles such as bacteria*	**(1)**

Question Number	Answer	Additional Guidance	Mark
4(a)(i)	An answer the makes reference to the following: • sequence of {bases / nucleotides} in DNA (1) • that codes for the {primary structure / amino acid sequence / polypeptide} (1)	ALLOW that codes for a protein	**(2)**

Question Number	Answer	Additional Guidance	Mark
4(a)(ii)	A description that makes reference to the following: • tRNA molecules {transport amino acids to the ribosome} (1) • tRNA molecule has an anticodon that {binds to / recognises} a codon on the mRNA (1) • each tRNA carries a particular amino acid (1)	ALLOW the amino acid on the tRNA is determined by the anticodon	**(3)**

Question Number	Answer	Additional Guidance	Mark
4(a)(iii)	A description that makes reference to three of the following: • {primary structure / sequence of the amino acids} determines the folding (of the polypeptide) (1) • forming a globular structure (1) • hydrophobic (R) groups located in the centre of the protein / hydrophilic (R) groups located on the outside of the protein (1) • water forms hydrogen bonds with { protein / hydrophilic groups} (1)	ALLOW position of R groups ALLOW determines tertiary structure ALLOW polar for hydrophilic / non-polar for hydrophobic ALLOW dipole-dipole / hydrophilic interactions (between water and the protein)	**(3)**

Question Number	Answer	Additional Guidance	Mark
4(b)	A description that makes reference to two of the following: • (adding or removing one or two nucleotides) changes the triplet code (1) • introducing a new {start / stop} codon (1) • coding for a shorter sequence of amino acids (1)	ALLOW different codons produced (1) ALLOW one amino acid shorter	**(2)**

Question Number	Answer	Additional Guidance	Mark
5(a)	An explanation that makes reference to three of the following: • fewer stem cells producing sperm (therefore fewer sperm cells produced) (1) • fewer motile sperm therefore fewer sperm will reach the egg (1) • {poor ability to cross the zona pellucida / acrosome reaction inhibited} therefore sperm will not reach the egg cell (membrane) (1) • therefore reducing chance of fertilisation (1)	ALLOW 'mobile' sperm ALLOW fusing with egg cell membrane / fusion of nuclei in place of reaching egg cell	**(3)**

Question Number	Answer	Additional Guidance	Mark
5(b)(i)	An answer that makes reference to two of the following: • a cell that is undifferentiated (1) • that can give rise to specialised cells (1) • that can divide to produce more stem cells (1)	ALLOW unspecialised cell ALLOW differentiated cells ALLOW can divide continuously / have no Hayflick limit	**(2)**

Question Number	Answer	Additional Guidance	Mark
5(b)(ii)	An answer that makes reference to the following: <u>Similarity</u> • both increase the number of cells (1) <u>Differences</u> • mitosis produces diploid cells and meiosis produces haploid cells (1) • meiosis produces cells that are genetically different to each other whereas mitosis produces genetically identical cells (1) • mitosis results in 8 spermatocytes from each stem cell whereas meiosis results in 4 sperm cells from each spermatocyte (1)	ALLOW cells contain { 23 pairs of / 46 } chromosomes after mitosis and 23 chromosomes after meiosis ALLOW mitosis results in 2 daughter cells whereas meiosis results in 4 daughter cells	**(4)**

Question Number	Answer	Mark
6(a)	**B -** smaller than ribosomes in eukaryotes *The only correct answer is **B*** ***A** is not correct because bacterial ribosomes are smaller than eukaryotic ribosomes* ***C** is not correct because bacterial ribosomes are smaller than animal ribosomes* ***D** is not correct because bacterial ribosomes are smaller than plant ribosomes*	**(1)**

Question Number	Answer	Additional Guidance	Mark
6(b)	An answer that makes reference to the following: Any two of • more (new) cases (1) • the total number of cases is relatively constant (1) • and the number of people dying from TB is decreasing (1) And • so {more are being successfully treated / the programme is effective} (1)	ALLOW only slight change in total number of cases	**(3)**

Question Number	Indicative content
***6(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. Basic information • All the treatment combinations were effective at treating TB • All treatments had some { relapses / individuals with TB } 3 years after treatment • { Group 1 / Groups 1 and 2 / Rifampicin + Pyrazinamide / Rifampicin + Isoniazid } had the lowest number of patients with TB (3 years later) Evidence for linkages made • Percentage relapse varies depending on second part of treatment • Combinations involving Rifampicin most effective • The antibiotics tested act on different targets in bacteria • Gaps in information - not all combinations tested, other combinations might be more effective • Other time scales may have been more effective Evidence for sustained scientific reasoning • Could be other reasons for infections with TB 3 years later not due to the antibiotic treatment • No information about dormant TB (only percentage of active cases) • Bacterial RNA polymerase possibly the best target for antibiotics • Antibiotics targeting synthesis of cell wall fatty acids least effective in terms of relapses • Idea of combination of antibiotics with different mode of activity most effective

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.	Reference to effectiveness of different combinations of antibiotics.
Level 2	3-4	An answer will be given with occasional evidence of analysis, interpretation and/or evaluation of both pieces of scientific information. The answer shows some linkages and lines of scientific reasoning with some structure.	Reasons for differences in effectiveness considered.
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 both pieces of scientific information. The answer shows a well-developed and sustained line of scientific reasoning which is clear and logically structured.	Information about action of antibiotics related to effectiveness. Evaluation of study design considered.

Question Number	Answer	Mark
7(a)	**B** - Eukaryota *The only correct answer is **B*** ***A** is incorrect because the electron micrograph has a nucleus and other membrane bound organelles so must be a eukaryote* ***C** is incorrect because the electron micrograph has a nucleus and other membrane bound organelles so must be a eukaryote* ***D** is incorrect because the electron micrograph has a nucleus and other membrane bound organelles so must be a eukaryote*	**(1)**

Question Number	Answer	Mark
7(b)(i)	**C** – humidity *The only correct answer is **C*** ***A** is not correct because resistance to infection is a biotic factor* ***B** is not correct because pathogens are biotic factors* ***D** is not correct because ocean pH is an abiotic factor but not one relevant to plants and their pathogens*	**(1)**

Question Number	Answer	Mark
7(b)(ii)	**B** – global warming *The only correct answer is **B*** ***A** is not correct because increase CO_2 to 1080 ppm does not decrease photosynthesis* ***C** is not correct because increased CO_2 to 1080 ppm does not increase plant respiration* ***D** is not correct because increased CO_2 to 1080 ppm does not cause ozone depletion*	**(1)**

Question Number	Answer	Additional Guidance	Mark
7(b)(iii)	An explanation that makes reference to the following • carbon dioxide (is a greenhouse gas and) causes global warming (1) • a relevant description of a change in the distribution of ash trees (with increasing CO_2 concentrations) (1) • (because increased CO_2) would result in a change in the range for *H. fraxineus* (1) • and ash trees will be found in regions without *H. fraxineus* (1) • change in range of { *H. fraxineus* / ash trees } linked to a relevant aspect of climate change (1)	e.g. an increase to 430 ppm leads to more ash trees in the east or an increase to 1080 ppm leads to more ash trees in the north e.g. temperature increase, change in humidity, change in rainfall patterns	**(5)**

Question Number	Answer	Additional Guidance	Mark
8(a)	• hydrolysis		**(1)**

Question Number	Answer	Additional Guidance	Mark
8(b)	An explanation that makes reference to • determine the sequence of amino acids (for trypsin) (1) • determine the number of {differences / similarities} in sequences (of amino acids) between species (1) • the greater the number of differences the less closely related the species are (1)	ALLOW differences and similarities in primary structure ALLOW more similarities more closely related ALLOW greater difference in sequence longer the time from a common ancestor	**(3)**

Question Number	Answer	Additional Guidance	Mark
8(c)	An explanation that makes reference to three of the following: • variation in the trypsin gene (1) • (some variations / mutations) result in production of a calcium (ion) binding site (1) • a calcium (ion) binding site confers a (selective) advantage (1) • (vertebrates) survive, reproduce and pass on this (trypsin) allele / the frequency of this (trypsin) allele increases (1)	ALLOW (random) mutations in the trypsin gene ALLOW makes the enzyme more effective	**(3)**

Question Number	Answer	Additional Guidance	Mark
8(d)	An explanation that makes reference to two of the following: • use a range of concentrations between 0 and 2.0 (ng cm^{-3}) (1) • so that enzyme concentration is the only limiting factor (1) • because the initial rates of reaction have to be compared (1)		**(2)**

Question Number	Answer	Mark
9(a)(i)	**B -** carbon dioxide is reduced to form organic molecules *The only correct answer is **B*** ***A** is incorrect because carbon dioxide is not oxidised to form organic molecules* ***C** is incorrect because organic molecules are not combusted in photosynthesis* ***D** is incorrect because organic molecules are not decomposed in photosynthesis*	**(1)**

Question Number	Answer	Additional Guidance	Mark
9(a)(ii)	• correct percentage transferred (1) • correct answer (1)	<u>Example of calculation</u> 35 % / 0.35 = 8680 (kJ m^{-2} yr^{-1}) Correct answer without working gains full marks	**(2)**

Question Number	Answer	Additional Guidance	Mark
9(b)	An explanation that makes reference to three of the following • {new / young / growing} trees (1) • resulting in net uptake of carbon dioxide / more carbon dioxide taken in by photosynthesis than released by respiration (1) • therefore reducing carbon dioxide in the atmosphere (1) • which slows the rate of global warming (1)	ALLOW plant more trees ALLOW trees acting as a carbon sink/store ALLOW reduces greenhouse effect	**(3)**

Question Number	Answer	Additional Guidance	Mark
9(c)(i)	A description that makes reference to • (counting) the number of different species (1) • (counting) number of individual per species (1)	ALLOW measure species richness ALLOW determined population sizes	**(2)**

Question Number	Answer	Additional guidance	Mark
9(c)(ii)	An answer that makes reference to • appropriate calculation e.g. percentage of world {plants / vertebrates / total} found in Madagascar or percentage of {plants / vertebrate } in Madagascar that are endemic to Madagascar e.g. or percentage of world {plant / vertebrates / total} endemic to Madagascar or density of {plant / vertebrates / total} on {Madagascar / Earth} (1) • species density of {animals / plants} in Madagascar is higher than for the Earth (1) • many of the species found in Madagascar are not found anywhere else (1)	4% of plants, 3.6% of vertebrates or 4% of the combined total 80.9% plants 78.1% of vertebrates endemic 3.2% of plants, 2.8% of vertebrates or 3.2% of the combined total ALLOW a large number of species relative to the area	**(3)**

Question Number	Answer	Additional Guidance	Mark
10(a)(i)	• correct measurements from the photograph (1) • correct answer (1)	<u>Example of calculation</u> Starch grain 27mm and width of chloroplast 60mm 27000 ÷ 22 = 12 273 60000 ÷ 12 273 = 4.889 (μm) ALLOW 4.9 / 4.89 / 4.8 recurring (μm) (ALLOW one mark for correct calculation from different measurements)	**(2)**

Question Number	Answer	Additional Guidance	Mark
10(a)(ii)	An explanation that makes reference to three of the following: • (granum) is formed from many layers of thylakoid membranes to increase surface area (for absorbing light) (1) • thylakoid membranes contain chlorophyll to absorb light (1) • electron carrier molecules in thylakoid membrane involved in ATP production (1)	ALLOW stacks of thylakoids provide a large surface area ALLOW photosystems / photosynthetic pigments in place of chlorophyll ALLOW for light dependent reaction in place of absorb light ALLOW ATP synthase / photophosphorylation	**(3)**

Question Number	Answer	Additional Guidance	Mark
10(b)	A description that makes reference to the following: • two GALP used to produce a glucose molecule (1) • (glucose molecules are) joined together by glycosidic bonds to form starch (1) • by condensation reactions (1) • producing amylose and amylopectin (1)	ALLOW triose phosphate instead of GALP ALLOW maltose / polysaccharide	**(4)**

Question Number	Indicative content
***10(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. Basic information • Use of all 4 herbicides • Control of a variable e.g. temperature, pH or light intensity • Variable related to barnyard grass considered e.g. age of plant Evidence of linkages • Sensible herbicide concentration selected, either a range from 0 to 10 μg cm^{-3} or 0.1 μg cm^{-3} • Hill reaction / use of DCPIP to measure light dependent reactions • Isolate chloroplasts • Method for controlling abiotic variables Evidence for sustained scientific reasoning • Suitable control described e.g. tubes in the dark • Description of how the reaction would be quantified e.g. time taken to decolourise DCPIP / use of a colorimeter • Statistical analysis to compare effectiveness of herbicides on photosynthesis • Measure of effectiveness described e.g. the more effective the herbicide the longer the time taken to decolourise the DCPIP, the herbicide that had most effect on decolourisation of DCPIP at the lowest concentration

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.	Description of use of herbicides Control of a variable e.g. temperature, pH or light intensity Variable related to barnyard grass considered e.g. age of plant
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.	Sensible range of herbicide concentrations between 0 and 100 μg cm^{-3} Hill reaction / use of DCPIP to measure light dependent reactions Isolate chloroplasts Method for controlling abiotic variables
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.	Focus on range of herbicide concentrations between 0 and 1 μg cm^{-3} Suitable control described e.g. tubes in the dark Description of how the reaction would be quantified e.g. time taken to decolourise DCPIP / use of a colorimeter Statistical analysis to compare effectiveness of herbicides on photosynthesis

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