Mark Scheme (Results)

Summer 2018

Pearson Edexcel GCE
In Biology Spec A (9BN0) Paper 02
Energy, Exercise and Coordination

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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	Additional Guidance	Mark
1(a)(i)	A description that makes reference to two of the following: • carrier protein (in cell surface membrane) (1) • (glucose moves from) high to low concentration (1) • glucose binds to (carrier) protein / (carrier) protein changes shape to move glucose (across the membrane) (1)	IGNORE channel protein ALLOW 'down a concentration gradient'	**(2)**

Question Number	Answer	Additional Guidance	Mark
1(a)(ii)	An explanation that makes reference to three of the following: • polymer of glucose (1) • to provide glucose for respiration (1) • {branched / contains 1,6-glycosidic bonds / has many terminal ends} for rapid hydrolysis (1) • compact to allow large amount (of glucose / energy) to be stored in a small space / insoluble therefore no osmotic effect on cells (1)	ALLOW polysaccharide /made of many glucose monomers DO NOT ALLOW β- glucose IGNORE 'easy to hydrolyse' ALLOW break down instead of hydrolyse	**(3)**

Question Number	Answer	Additional Guidance	Mark
1(b)	An explanation that makes reference to the following: • interaction between transcription factors and promoter (region on gene) (1) • RNA polymerase binds (to promoter region) (1) • { transcription /mRNA produced } (for insulin gene) (1)	ALLOW 'regulatory' instead of 'promoter' or reference to transcription initiation complex ALLOW transcription initiation complex binds (to promoter region) if RNA polymerase described as part of the complex	**(3)**

Question Number	Answer	Mark
2(a)(i)	**C** – location of a gene on a chromosome *The only correct answer is **C*** ***A** is incorrect because locus is not the genetic code for a protein* ***B** is incorrect because a centromere holds together sister chromatids and not a locus* ***D** is incorrect because a locus is not the paternal part of a genome*	**(1)**

Question Number	Answer	Additional Guidance	Mark
2(a)(ii)	An answer that makes reference to three of the following: Similarities • both have a carboxylic acid group (1) • both have { hydrocarbon chains / chains formed from only hydrogen and carbon } (1) Differences • saturated fatty acids have { no carbon to carbon double bonds / only have carbon to carbon single bonds } (1) • saturated fatty acids are straight chains and unsaturated fatty acids have { bent chains / a kink in the chain } (1)	ALLOW annotated diagrams used show similarities and differences ALLOW COOH ALLOW description of hydrocarbon chains ALLOW converse for unsaturated fatty acids	**(3)**

Question Number	Answer	Additional Guidance	Mark
2(b)	An answer that makes reference to the following: • { FTO^T / saturated fat diet } is associated with increased BMI (1) • FTO^T (allele) is recessive / FTO^C (allele) is dominant (1) • highest increase in BMI was for individuals homozygous for FTO^T on a saturated fat diet (1)	ALLOW FTO^T FTO^T genotype	**(3)**

Question Number	Answer	Additional Guidance	Mark
3(a)	An explanation that makes reference to three of the following: • { warm conditions / water / glucose / amino acids / ideal pH } available (1) Plus 2 of the following: • suitable { temperature / pH } for bacterial enzymes (1) • glucose used for {respiration / energy} (1) • amino acids used for growth (1)	ALLOW 37°C ALLOW optimum	**(3)**

Question Number	Answer	Additional Guidance	Mark
3(b)	An explanation that makes reference to two of the following: • lumen of capillaries blocked (1) • preventing supply of {oxygen / glucose} (to tissues or cells) (1) • therefore respiration stops (and tissues die) / anaerobic respiration causes build-up of lactic acid (1)	ALLOW build-up of carbon dioxide	**(2)**

Question Number	Answer	Additional Guidance	Mark
3(c)(i)	An explanation that makes reference to two of the following: • tendons attach muscles to bones (1) • (flexor and extensor) muscles act as an antagonistic pair (1) • when the {extensor muscle contracts, it pulls on the tibia to extend the leg / flexor muscle contracts, it pulls on the fibula flexing the leg} (1)	ALLOW marks for correctly annotated diagram ALLOW reference to a tendon attaching a named muscle to a named bone ALLOW quadriceps for extensor and hamstring for flexor	**(2)**

Question Number	Answer	Additional Guidance	Mark
3(c)(ii)	• the muscles are still attached to (bones in) the lower leg and the prosthetic limb is attached to the lower leg (allowing movement)	ALLOW reference to tibia and/or fibula instead of lower leg. No marks if reference made to muscle attachment to prosthetic limb.	**(1)**

Question Number	Answer	Mark
4(a)(i)	**C** - retinal *The only correct answer is **C*** ***A** is incorrect because IAA is auxin* ***B** is incorrect because opsin is the protein part and not the non-protein* ***D** is incorrect because rhodopsin is the pigment*	**(1)**

Question Number	Answer	Mark
4(a)(ii)	**A** *The only correct answer is **A*** ***B** is incorrect because it is the hypothalamus* ***C** is incorrect because it is the medulla oblongata* ***D** is incorrect because it is the cerebellum*	**(1)**

Question Number	Answer	Additional Guidance	Mark
4(a)(iii)	An explanation that makes reference to the following: • (fMRI) detects { blood flow / oxygen use } in the brain (1) • increased brain activity results in increased { blood flow / demand for oxygen / aerobic respiration } in the area of activity (1) • oxyhaemoglobin absorbs fewer radio waves / fMRI detects areas where less signal absorbed (1)	ALLOW signal reflected by oxyhaemoglobin	**(3)**

Question Number	Answer	Additional Guidance	Mark
4(b)	A description that makes reference to three of the following: • ocular dominance columns (develop in visual cortex) (1) • neurones form synapses with these { cells / columns } (1) • { stimuli / action potentials / impulses } along neurones required to strengthen connections (with cells of ocular dominance columns) (1) • stimulation during the critical period is needed to form (effective) connections in the visual cortex (1)	ALLOW columns of (target) cells ALLOW more synapses for stronger connections OR connections become weaker if stimuli not received	**(3)**
Question	Answer	Additional Guidance	Mark

Number			
5(a)	A description that makes reference to four of the following: • thermoreceptors (in hypothalamus or skin) detect increase in temperature (1) • { heat loss / thermoregulatory } centre in hypothalamus stimulated (1) • (hypothalamus) sends impulses to sweat glands (1) • increased blood flow to surface of skin by {vasodilation / constriction of shunt vessels} (1) • decreased metabolic rate (1)	ALLOW impulses sent to thermoregulatory centre in hypothalamus ALLOW action potential IGNORE dilation of capillaries	**(4)**

Question Number	Answer	Additional Guidance	Mark
5(b)	An answer that makes reference to the following: • (an increase in body temperature causes) a greater increase in rate of sweating in males than in females (1) • males lose heat faster because they produce sweat at a faster rate (1) • females have larger SA to body mass ratio that allows for { faster / more effective } heat loss (1) • males have less { body fat / insulation } which may allow { faster / more effective } heat loss (1)	ALLOW converse for any marking point ALLOW 'males sweat more' ALLOW SA:volume	**(4)**

Question Number	Answer	Additional Guidance	Mark
5(c)(i)	• correct calculation of both cardiac outputs (1) • correct calculation of difference and converted to dm^3 (1)	<u>Example of calculation</u> 70 x 55 = 3850 (cm^3) / 3.85 (dm^3) 110 x 160 = 17600 (cm^3) /17.6 (dm^3) An increase of 13.75 (dm^3 min^{-1}) Correct answer with no working gains full marks. If correct answer not given ALLOW 13750 for 1 mark Or 13.64 to 13.86 for 1 mark	**(2)**

Question Number	Answer	Additional Guidance	Mark
5(c)(ii)	An explanation that makes reference to two of the following: • increase supply of oxygenated blood (to muscles) (1) • to allow aerobic respiration (1) • to provide more energy (to meet the increased demands) (1)	ALLOW more oxygen (to the muscles)	**(2)**

Question Number	Answer	Additional Guidance	Mark
6(a)(i)	An answer that makes reference to two of the following: • increase in cross sectional area with testosterone (and not with placebo) (1) • greatest increase with testosterone and exercise (1) • significant difference for { testosterone plus exercise / group D } as the SDs (for start and after 10 weeks) do not overlap (1)	ALLOW increase in size (of triceps muscle)	**(2)**

Question Number	Answer	Mark
6(a)(ii)	**D** - show that testosterone has an effect *The only correct answer is **D*** ***A** is incorrect because a placebo does not make measurements more accurate* ***B** is incorrect because placebos do not make data more reproducible* ***C** is incorrect because the placebo does not show that exercise has an effect*	**(1)**

Question Number	Answer	Additional Guidance	Mark
6(b)(i)	• correct figures from graph used to calculate total cholesterol (1) • value for ratio correctly calculated (1)	<u>Example of calculation</u> 28 + 136 = 164 5.9:1 / 5.86:1 One mark for 164:28	**(2)**

Question Number	Indicative content	
***6(b)(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. Basic information • testosterone increases production of { LDL / cholesterol } • testosterone {increases breakdown of / reduces } HDL • { high cholesterol / LDL } associated with increased risk of {CVD / atherosclerosis} Evidence for linkages • role of HDL in transporting cholesterol from the bloodstream to the liver • role of LDL in accumulation of cholesterol and development of atherosclerosis Evidence for sustained scientific reasoning • testosterone associated with increased synthesis of the enzyme HMGCR which is involved in cholesterol production • { performance enhancing drugs / testosterone } can harm the health of an athlete by increasing risk of CVD	

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Level	Mark	Descriptor	
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.	Increase in CVD due to increase in cholesterol/LDL due to increase in production/ rate of breakdown
Level 2	3-4	An explanation will be given with occasional evidence of analysis, interpretation and/or evaluation of both pieces of scientific information. The explanation shows some linkages and lines of scientific reasoning with some structure.	Explanation of the role of LDL Development of atherosclerosis
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.	Links made between all data. Explanation of the role of HMGCR Detailed description of the effect on atherosclerosis

Question Number	Answer	Mark
7(a)	**C -** anatomical, behavioural and physiological *The only correct answer is **C*** ***A** is incorrect because there is also a physiological adaptation* ***B** is incorrect because there is also a behavioural adaptation* ***D** is incorrect because there is also an anatomical adaptation*	**(1)**

Question Number	Answer	Additional Guidance	Mark
7(b)(i)	• change in metabolic rate calculated for the ground squirrel (1) • difference calculated for one day (1) • value correctly converted from cm^3 to dm^3 (1)	<u>Example of calculation</u> 0.18 at -16 ºC and 0.02 at 4 ºC =0.16 0.16 x 850 = 136 136 x 24 = 3264 3.264 / 3.26 / 3.3 Correct answer with no working gains full marks ALLOW 2 marks for 0.136 (if not calculated for one day)	**(3)**

Question Number	Answer	Mark
7(b)(ii)	**C –** lipid and protein *The only correct answer is **C*** ***A** is incorrect because RQ value is too low for carbohydrate* ***B** is incorrect because RQ value is too high for lipid only* ***D** is incorrect because RQ value is too low for protein only*	**(1)**

Question Number	Answer	Additional Guidance	Mark
7(b)(iii)	An answer that makes reference to four of the following: • use of {potassium hydroxide / sodium hydroxide / soda lime} to remove carbon dioxide (1) • measure volumes of air entering and leaving the chamber (1) • decrease in volume of air represents oxygen taken up (by ground squirrel for respiration) (1) • control the temperature / measure mass of squirrel / measure for a stated period of time (1) • divide volume of oxygen used in a unit of time by the body mass of the ground squirrel to calculate its metabolic rate (1)	ALLOW a sensible specified time ALLOW volume of oxygen ÷ (mass × time)	**(4)**

Question Number	Answer	Mark
8(a)(i)	**B -** X *The only correct answer is **B*** ***A** is incorrect because W is a relay neurone* ***C** is incorrect because Y is a motor neurone* ***D** is incorrect because Z is a multipolar neurone*	**(1)**

Question Number	Answer	Mark
8(a)(ii)	**D -** sugar molecules which are joined by glycosidic links *The only correct answer is **D*** ***A** is incorrect because glycolipids are not made of amino acids* ***B** is incorrect because glycolipids are not made of amino acids* ***C** is incorrect because sugar molecules are not joined by ester bonds*	**(1)**

Question Number	Answer	Additional Guidance	Mark
8(a)(iii)	An answer that makes reference to three of the following: • { form synapses / connections } with other neurones (1) • { integrate / receive } impulses from other neurones (1) • involved in summation (1) • { propagate a signal / initiate an action potential } to the {cell body / axon} (1)		**(3)**

Question Number	Answer	Additional Guidance	Mark
8(b)	• appropriate figures in formula for calculating speed distance divided by time (1) • correct conversion of units (1)	<u>Example of calculation</u> 25 ÷ time (ALLOW any time from 3.7 to 4.3 milliseconds) The answer multiplied by 1000 to give answer in cm s^{-1} Examples of acceptable answers: 3.7ms gives 6757 cm s^{-1} 3.8 6579 3.9 6410 4.0 6250 4.1 6098 4.2 5952 4.3 5814 Correct answer without working gains full marks	**(2)**

Question Number	Answer	Additional Guidance	Mark
8(c)	An explanation that makes reference to the following: • no difference in action potential between individual with and individual without GBS (1) • motor neurone conduction speed is reduced (1) • due to { loss of myelin / demyelination } of the (motor) neurone (1) • (and therefore) loss of saltatory conduction (1)	IGNORE reference to sensory neurone ALLOW reference to loss of Schwann cells DO NOT ALLOW destroy ALLOW impulse cannot pass between the nodes of Ranvier	**(4)**

Question Number	Answer	Additional Guidance	Mark
9(a)	An explanation that makes reference to the following: • fibrin forms a mesh that collects {platelets / red blood cells} (1) • (tranexamic acid) { prevents plasmin digesting fibrin / stops the breakdown of fibrin } (1) • allowing clots to remain in place (1)	ALLOW fibrin is involved in forming blood clots	**(3)**

Question Number	Answer	Additional Guidance	Mark
9(b)	An answer that makes reference to the following: • tranexamic acid has a (very) similar {structure / shape} to lysine (1) • tranexamic acid { binds to the active site on plasmin / acts as a competitive inhibitor } (1) • stopping plasmin binding to { fibrin / lysine } (1)	ALLOW preventing plasmin and fibrin forming enzyme –substrate complex	**(3)**

Question Number	Answer	Mark
9(c)(i)	**D -** positive correlation *The only correct answer is **D*** ***A** is not correct because an increase in concentration of plasmin increases the digestion of fibrin* ***B** is not correct because an increase in concentration of plasmin increases the digestion of fibrin* ***C** is not correct because an increase in concentration of plasmin increases the digestion of fibrin*	**(1)**

Question Number	Indicative content	
***9(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. Basic information • detail of method e.g. cut wells in agar, control temperature, leave for stated period of time • repeats to { calculate averages / identify anomalies } • observe size of clear zones in fibrin plates Evidence of linkages • use of tranexamic acid and the new inhibitor • control of the concentration and volume of plasmin used • mix plasmin and inhibitor / add inhibitor to fibrin plate • comparison of new inhibitor with tranexamic acid Evidence of sustained scientific reasoning • explanation as to how comparison of activities could be made – inhibitor producing the smallest clear zone would be the most effective • statistical analysis of data to determine if the difference is significant e.g. standard deviations	

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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 the preparation of plates with addition of inhibitor(s)
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.	IV DV Repeats Control variables Measurement of clear zone
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.	Detailed explanation of method. Explanation of how the comparison could be made Statistical analysis

Question Number	Answer	Mark
10(a)	**B -** lowering the activation energy of a reaction *The only correct answer is **B*** ***A** is incorrect because enzymes do not increase activation energy* ***C** is incorrect because enzymes do not provide energy to reactants* ***D** is incorrect because enzymes do not remove energy from reactants*	**(1)**

Question Number	Answer	Additional Guidance	Mark
10(b)	An answer that makes reference to the following: • lysosome fuses with the cell (surface) membrane (1) • contents of lysosome released from the cell / exocytosis (1)		**(2)**

Question Number	Answer	Additional Guidance	Mark
10(c)(i)	An explanation that makes reference to the following: • changing a base results in a change in the triplet code (1) • this changes the codon(s) in the mRNA (1) • resulting in a different { amino acid / amino acid sequence } (in the primary structure) (1)	ALLOW deletion / substitution / insertion / frameshift. ALLOW illustration of change in triplet code e.g. ATT to ATG ALLOW introducing a stop codon / terminating translation	**(3)**

Question Number	Answer	Additional Guidance	Mark
10(c)(ii)	An explanation that makes reference to the following: • sequence the genome of people with MPS1 (1) • sequence the genome of a number of people without the condition (1) • compare the base sequences to identify mutations found only in individuals with the condition (1)	ALLOW comparison of base sequences of people with MPS1 and people without MPS1	**(3)**

Question Number	Answer	Additional Guidance	Mark
10(d)(i)	An answer that makes reference to two of the following: • transcription (of the DNA containing the mutation) / transcribe to produce { mRNA / RNA } (1) • using { RNA nucleotides / RNA polymerase } (1)	IGNORE translation	**(2)**

Question Number	Answer	Additional Guidance	Mark
10(d)(ii)	An explanation that makes reference to the following: • individuals have different mutations / targets an individual's specific mutation (1) • the RNA molecule used will be specific to { each mutation / individual } (1)	ALLOW mutations at different loci	**(2)**

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