Mark Scheme (Results)

Summer 2017

Pearson Edexcel GCE

In Biology Spec A (9BN0) Paper 02

Energy, Exercise and Co-ordination

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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	Additional guidance	Mark
1(a)	A description that makes reference to two of the following points: • serotonin is a neurotransmitter / there will be less neurotransmitter (1) • (less serotonin) results in fewer depolarisations of post synaptic membranes (1) • threshold not achieved / less chance of action potential being produced (in post-synaptic neurone) (1)	 ALLOW no serotonin or no neurotransmitter ALLOW no depolarisations ALLOW no action potential produced	(2)

Question number	Answer	Additional guidance	Mark
1(b)(i)	A description that makes reference to two of the following points: • MDMA { stimulates release / prevents re-uptake / increases concentration } of serotonin (1) • blocking pre-synaptic receptors / binding to post synaptic receptors (1) • nerve pathways using serotonin are more likely to be stimulated / more action potentials produced (1)	 ALLOW reference to dopamine instead of serotonin ALLOW more impulses generated	(2)

Question number	Answer	Additional guidance	Mark
1(b)(ii)	An explanation that makes reference to two of the following points: • MDMA use results in depletion of serotonin (1) • post synaptic membrane becomes less responsive to serotonin / loss of receptors on post synaptic membrane (1) • serotonin levels affect mood / lack of serotonin associated with depression (1)	ALLOW dopamine instead of serotonin for all points	(2)

(Total for Question 1 = 6 marks)

Question number	Answer	Mark
2(a)	**2(a). The only correct answer is C – Myogenic** ***A*** *is not correct because autonomic refers to the nervous system* ***B*** *is not correct because cardiac refers to the whole heart* ***D*** *is not correct because systolic describes a stage in the cardiac cycle*	(1)

Question number	Answer	Additional guidance	Mark
2(b)	A description that makes reference to two of the following points: • more { stimulation / depolarisation } of the SAN (from the sympathetic nervous system) / more impulses to the SAN (1) • (causing) more frequent waves of depolarisation from the SAN (to the atria) (1) • leading to more frequent { contraction of atria / stimulation of AVN } (1)		(2)

Question number	Answer	Additional guidance	Mark
2(c)	An explanation that makes reference to three of the following points: • pressure increases in the ventricles (1) • greater pressure (in the ventricles) than in the { atria / arteries } (1) • causing atrioventricular valves to close (1) • causing the semilunar valves to open / forcing blood into the arteries (1)	IGNORE reference to events during atrial systole	(3)

(Total for Question 2 = 6 marks)

Question number	Answer	Additional guidance	Mark
3(a)	An explanation that makes reference to three of the following: • { thick / sticky / viscous } mucus (1) • (accumulation of mucus) which cannot be moved by cilia (1) • restricting air flow through { bronchioles / bronchi } (1) • {increases diffusion distance / reduces surface area for gas exchange } in the alveoli (1)	IGNORE 'airways' ALLOW narrowing of bronchioles	(3)

Question number	Answer	Mark
3(b)(i)	**3(b)(i). The only correct answer is D – spirometer** ***A*** *is not correct because a colorimeter measures light* ***B*** *is not correct because a photometer measures evaporation* ***C*** *is not correct because a respirometer measures the rate of respiration*	(1)

Question number	Answer	Mark
3(b)(ii)	**3(b)(ii). The only correct answer is B – tidal volume** ***A*** *is not correct because alveolar volume is not shown on the trace* ***C*** *is not correct because total lung volume is not shown on the trace* ***D*** *is not correct because ventilation rate requires a calculation involving time*	(1)

Question number	Answer	Mark
3(b)(iii)	**3(b)(iii). The only correct answer is B – 9 breaths min^{-1}** ***A*** *is not correct because 6 is the number of breaths in the 40 second time interval* ***C*** *is not correct because 12bpm is incorrect* ***D*** *is not correct because 16bpm is incorrect*	(1)

Question number	Answer	Additional guidance	Mark
3(b)(iv)	• volume divided by time to produce rate (1) • conversion of volume measured from graph from dm^3 to cm^3 (1) • calculation of rate per minute (1)	<u>Example of calculation</u> 0.65 ÷ 40 Multiplied by 1000 = 16.25 e.g. 16.25 x 60 Answer = **900- 975** 90.0-97.5 or 9000-9750 gains two marks as only one step incorrect Correct answer with no working gains full marks	(3)

(Total for Question 3 = 8 marks)

Question number	Answer	Additional guidance	Mark
4(a)(i)	A description that makes reference to the following: • condensation (1) • involving OH groups (on both molecules) / water is formed (1)		(2)

Question number	Answer	Additional guidance	Mark
4 (a)(ii)	An answer that makes reference to the following: • both are formed from two molecules of (α)glucose / both contain a glycosidic bond (1) • maltose has (α-)1,4 linkage and trehalose has (α-)1,1 linkage / in trehalose one of the glucose monomers is inverted (1)	ALLOW both are disaccharides of glucose DO NOT ALLOW β - glucose	(2)

Question number	Answer	Mark
4(b)(i)	**4(b)(i). The only correct answer is D – hydrolysis** ***A*** *is not correct because anabolism is associated with forming more complex molecules* ***B*** *is not correct because catalysis is a general term for enzyme controlled reactions* ***C*** *is not correct because glycolysis is a sequence of reactions in respiration*	(1)

Question number	Answer	Additional guidance	Mark
4(b)(ii)	An explanation that makes reference to the following: • glucose used in respiration to provide { energy / ATP } (1) • glycogen is a polymer of glucose (1) • glycogen has lots of { branches / terminal ends } so it can release glucose rapidly (1) • breakdown of trehalose { makes two molecules of glucose available / provides a more immediate source of glucose } (1)	ALLOW glycogen contains lots of glucose ALLOW quickly hydrolysed	(4)

(Total for Question 4 = 9 marks)

Question number	Answer	Mark
5(a)(i)	**5(a)(i). The only correct answer is D -** X | either X or Y ***A*** *is not correct because eggs do not contain a Y chromosome* ***B*** *is not correct because eggs do not contain a Y chromosome and sperm do not always contain X* ***C*** *is not correct because eggs do not contain a Y chromosome*	(1)

Question number	Answer	Additional guidance	Mark
5(a)(ii)	An explanation that makes reference to two of the following points: • X chromosome carries { genes / loci } not present on the Y chromosome (1) • males have only one { copy / allele } of some genes (1) • (if only one allele inherited) it will be expressed (1)	ALLOW Y chromosome does not carry { a copy /alleles } of some genes	(2)

Question number	Answer	Additional guidance	Mark
5(b)(i)	An explanation that makes reference to the following points: • (genetic diagram shows) male genotype X^b Y, female genotype X^BX^B (1) • genetic diagram to show correct genotypes of offspring (1) • all offspring have blue feathers (1)	<u>Example of diagram:</u> | | X^b | Y | | --- | --- | --- | | X^B | $X^B X^b$ | X^B Y | | X^B | $X^B X^b$ | X^B Y | (Diagram correct gains two marks) Alleles must be associated with the sex chromosomes	(3)

Question number	Answer	Additional guidance	Mark
5(b)(ii)	An answer that makes reference to the following points: • females must have inherited b from their father (because they are red) (1) • female offspring only inherit one allele (or they would be blue) (1) • (in birds) females have different sex chromosomes and males have the same sex chromosomes (1)	Full marks can be gained from a labelled genetic diagram, e.g. males females | | X^b | X^b | | --- | --- | --- | | X^B | $X^B X^b$ | $X^B X^b$ | | Y | X^b Y | X^b Y | ALLOW the opposite to mammals or females ZW and males are ZZ	(3)

(Total for Question 5 = 9 marks)

Question number	Answer	Additional guidance	Mark
6 (a)	An explanation that makes reference to the following points: • (muscles cells release lactate into blood) due to anaerobic respiration (1) • insufficient oxygen for aerobic respiration / aerobic respiration cannot meet the demand for energy (1)		(2)

Question number	Answer	Additional guidance	Mark
6 (b)	A description that makes reference to three of the following points: • { increased / sufficient } oxygen supply (1) • for aerobic respiration (1) • because { heart rate / breathing rate } increases (1) • lactate is broken down by the liver / rate of lactate production is balanced by rate of lactate breakdown (1)	ALLOW lactic acid for lactate	(3)

Question number	Answer	Additional guidance	Mark
6 (c)	An answer that makes reference to the following points: • (athlete) P should exercise at an intensity of 300 watts (1) • (athlete) Q should exercise at an intensity of 330 watts (1) • (athlete) R should exercise at an intensity of 360 watts (1) • as there would be an increase in lactate at the next level of intensity of exercise (1)		(4)

(Total for Question 6 = 9 marks)

Question number	Answer	Mark
7(a)	**5(a)(i). The only correct answer is A – actin** ***B*** *is not correct because myosin is not found in a thin myofilament* ***C*** *is not correct because tropomyosin is a fibrous protein* ***D*** *is not correct because troponin binds calcium ions as shown in the diagram*	(1)

Question number	Answer	Additional guidance	Mark
7(b)(i)	A description that makes reference to the following points: • tropomyosin is moved (by troponin) (1) • myosin binding sites (on actin) are exposed (1)	 ALLOW tropomyosin moves ALLOW actin-myosin binding site	(2)

Question number	Answer	Additional guidance	Mark
7 (b)(ii)	An explanation that makes reference to four of the following points: • myosin heads can bind to binding sites (1) • (bound) myosin changes shape (1) • actin filaments { slide / pulled } over the myosin (1) • (therefore) { muscle fibres / myofibril / sarcomeres } shorten (1) • ATP hydrolysed / ADP and { inorganic phosphate / Pi } released (1)	ALLOW actin – myosin bridges form ALLOW description of head 'nodding' or 'dipping' forward ALLOW actin moves towards the M line ALLOW Ca^{2+} activates ATPase	(4)

Question number	Answer	Additional guidance	Mark
7(c)	A description that makes reference to three of the following points: • calcium ions released from sarcoplasmic reticulum (1) • in response to { nerve impulse / action potential / depolarisation } (at neuromuscular junction) (1) • calcium channels open (to allow calcium ions to cross the membrane / enter the sarcoplasm) (1) • calcium ions taken back up into the sarcoplasmic reticulum by active transport (1)	ALLOW Ca^{2+} for calcium ions ALLOW calcium ions moving through channel protein	(3)

(Total for Question 7 = 10 marks)

Question number	Answer	Mark
8(a)	**8(a). The only correct answer is B – habituation** ***A*** *is not correct because co- ordination is a general term not restricted to changes given* ***C*** *is not correct because inhibition does not describe a change in response* ***D*** *is not correct because it is not a term with meaning in the context of change of response*	(1)

Question number	Answer	Additional guidance	Mark
8(b)	An explanation that makes reference to four of the following: • potential difference across axon changing (1) • due to increased permeability to sodium ions / (voltage gated) sodium channels open (1) • sodium ions { move into the axon / cause depolarisation } (1) • (followed by) an increased permeability to potassium ions / potassium channels open (1) • potassium ions { move out of the axon / cause repolarisation of the membrane } (1)	e.g. when depolarised from negative to positive or from -70mV to +40mV or repolarised from +40mV to -70mV	(4)

Question number	Answer
***8(c)(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. Indicative content from table: • stimulated at just one point (V or W) – response lost after repeated stimulation • if the repeated stimulation is alternated between two points (V and W) the worm still responds by contracting its muscles / no habituation when stimuli alternated between different locations • different nerves / neurones / stimulated (by V and W) from diagrams: • there is a response at X every time the neurone is stimulated • { repeated stimulation / after three stimuli } there is no longer an impulse recorded at Y • electrode X is close to where the stimulus is applied and it detects an impulse each time • electrode Y is further from where the stimulus is applied • there is a synapse between the stimulus and the neurone monitored at Y Knowledge and understanding of habituation: • after repeated stimulation the impulse cannot cross the synapse • lack of neurotransmitter / not enough time to produce more neurotransmitter • calcium ion channels not opening when impulse arrives at the synapse • threshold not reached on the post-synaptic neurone and no action potential produced

Level	Mark	Descriptor	Additional Guidance
0	0	No awardable content	
1	1-2	Limited scientific judgement made with a focus on mainly just **one** study. A conclusion may be attempted, demonstrating isolated elements of biological knowledge and understanding but with limited evidence to support the judgement being made.	One study focused on – probably the table of data Idea of different nerves involved
2	3-4	A scientific judgement is made through the application of relevant evidence from **both** studies. A conclusion is made, demonstrating linkages to elements of biological knowledge and understanding, with occasional evidence to support the judgement being made.	Analysis refers to the table of data – idea of difference when stimulus at one place or alternating **and** the diagrams showing effects of stimulating nerves X and Y. Links made to impulses not present post synapse and an explanation for that
3	5-6	A scientific judgement is made, which is supported throughout by sustained application of relevant evidence from the analysis and interpretation of the scientific information. A conclusion is made, demonstrating sustained linkages to biological knowledge and understanding with evidence to support the judgement being made.	Analysis of both studies **linked** to knowledge and understanding of habituation, **links** made to location of synapse and reasons why neurotransmitter not released.

Question number	Answer	Additional guidance	Mark
8 (c)(ii)	An answer that makes reference to the following points: • description of suitable range of (at least five) frequencies (1) • a method for making application of stimuli consistent / control of recovery time between tests (1) • a method for checking for habituation in earthworms (1) • repeats with other earthworms of same { species / size } (1)	ALLOW range of five different frequencies above and below 20 per minute e.g. (touch with a cotton bud) to same place each time e.g. give 2 minutes between each test e.g. observing for no response to touch / finding no change in length of earthworm (Maximum of 2 marks if investigation described in context of snails)	(4)

(Total for Question 8 = 15 marks)

Question number	Answer	Additional guidance	Mark
9(a)(i)	• conversion of surface area from m^2 to cm^2 (1) • correctly dividing surface area by volume to determine ratio (1)	<u>Example of Calculation:</u> 97 x 10000 = 970 000 divided by lung volume of 6232 Correct ratio of **155.6 : 1** (ALLOW 155.65 :1) ALLOW one mark only for **0.0155 : 1 / 0.156 : 1 / 155.6** Correct answer with no working gains full marks	(2)

Question number	Answer	Mark
9(a)(ii)	**9(a)(ii). The only correct answer is D – Student's t-test** ***A*** *is not correct because chi- squared does not test difference between means* ***B*** *is not correct because there is no correlation to test* ***C*** *is not correct because SD does not compare means*	(1)

Question number	Answer	Additional guidance	Mark
9(a)(iii)	An answer that makes reference to two of the following points: • different { height / weight / mass } (1) • different { gender / sex } (1) • different age (1)	IGNORE 'size' ALLOW 'men have larger lungs than women'	(2)

Question number	Answer	Additional guidance	Mark
9(a)(iv)	• to allow (valid) comparison / show differences (1)		(1)

Question number	Answer	Additional guidance	Mark
9(b)(i)	• values substituted into the equation (1) • correct answer (1)	<u>Example of calculation:</u> (30 x 9) ÷ 0.5 = 540 Correct answer with no working gains full marks	(2)
9(b)(ii)	• calculation of the difference using the value from (b)(i) (1) • correct answer (1)	<u>Example of calculation:</u> 2124 – 540 (= 1584) 1584/ 2124 x 100 = 74.6% or 75% **ECF** full marks if calculated correctly for value other than 540 Correct answer with no working gains full marks	(2)

Question number	Answer	Additional guidance	Mark
9(c)	An explanation that makes reference to three of the following points: • { smaller surface area / increased diffusion distance } for gas exchange (1) • therefore reduction in oxygen uptake (1) • therefore less oxygen for aerobic respiration (1) • leading to more anaerobic respiration (causing fatigue) (1)	ALLOW smaller SA:vol	(3)

(Total for Question 9 = 13 marks)

Question number	Answer	Additional guidance	Mark
10(a)	An explanation that makes reference to the following points: • because 7 come from (the gametes of) { goatgrass / *Aegilops tauschii* }(1) • because 14 come from (the gametes of) {durum wheat / *Triticum turgidum* } (1)	ALLOW *A.tauschii* ALLOW *T.turgidum*	(2)

Question number	Answer	Mark
10(b)	**10(b). The only correct answer is B -** 7 | 28 | 21 ***A*** *is not correct because column 2 shows the number for a gamete and column three for a normal cell* ***C*** *is not correct because columns one and three show numbers for normal cells* ***D*** *is not correct because column one shows the number for a normal cell and column two shows the number for a gamete*	(1)

Question number	Answer	Additional guidance	Mark
10(c)	An explanation that makes reference to two of the following points: • there is an odd number of chromosomes (1) • therefore it does not have homologous pairs of chromosomes (1) • therefore meiosis cannot take place / meiosis requires chromosome pairs (1)	 ALLOW uneven number ALLOW non-homologous chromosomes	(2)

Question number	Answer	Additional guidance	Mark
10 (d)	An explanation that makes reference to three of the following: • chromosomes copied before mitosis / interphase occurs and DNA replicates (1) • without spindle fibres { the chromatids are not separated / both copies of chromosomes remain in same cell } (1) • therefore producing cells with { chromosomes pairs / double the chromosome number } (1) • allows production of haploid gametes / adult plants with diploid cells (1)		(3)

Question number	Answer
10 (e)	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. Indicative content: Benefits Described: • crops have increased yield due to pest control or resistance to disease • reduced need to use pesticides • crops can be grown in a wider range of conditions, e.g. harsh conditions, drought etc Discussed: • hybridisation could allow crop plants to have genes for tolerance to harsh conditions from genome D • crops have higher nutrient content, or produce a greater range of useful chemicals e.g. pharmaceutical products • genetic modification can be beneficial if crops are resistant to herbicides - crops can be sprayed with herbicide without { being harmed / causing reduction in yield } Risks Hybridisation: • hybridisation can lead to pest species which have ability to grow in wide range of conditions • hybridisation could allow genes for tolerance to harsh conditions from genome D to enter pest species GM: • genetic modification may result in genes entering pest species, making control difficult or into food chains • GM can introduce antibiotic resistant genes to other species Selective breeding • selective breeding reduces { genetic diversity / size of gene pool }, or causes genetic drift • leading to loss of useful alleles / reducing the ability of the crops to adapt to environmental change

Level	Mark	Descriptor	Additional Guidance
0	0	No awardable content	
1	1-2	Limited scientific judgement made with a focus on **one** side of the argument only. A conclusion may be attempted, demonstrating isolated elements of biological knowledge and understanding but with limited evidence to support the judgement being made.	Only considered one benefit **or** one risk without further explanation beyond a brief description.
2	3-4	A scientific judgement is made through the application of relevant evidence to **both** sides of the argument. A conclusion is made, demonstrating linkages to elements of biological knowledge and understanding, with occasional evidence to support the judgement being made.	Considers at least one risk **and** one benefit with some discussion.
3	5-6	A scientific judgement is made, which is supported throughout by sustained application of relevant evidence from the analysis and interpretation of the scientific information. A conclusion is made, demonstrating sustained linkages to biological knowledge and understanding with evidence to support the judgement being made.	Benefits generally described and specific risks discussed. Conclusions described for each of the three methods – hybrids, GM and selective breeding.

(Total for Question 10 = 14 marks)

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