Pearson Edexcel

Mark Scheme (Results)

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Pearson Edexcel Advanced Level
In Biology A Salters Nuffield (9BN0)
Paper 03: General and Practical Applications in Biology

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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)	An answer that makes reference to the following: • (strong) positive correlation	ALLOW velocity of blood flow is (directly) proportional to the lumen diameter ALLOW description of relationship e.g. as lumen diameter increases velocity of blood flow increases	**(1)**

Question number	Answer	Additional guidance	Mark
1(b) (i)	An explanation that makes reference to the following: • atheroma {reduces the diameter of / narrows} the lumen of arteries (1) • therefore reducing (the velocity of) blood flow (1)	ALLOW {atherosclerosis / plaques} reduce the diameter of the lumen of arteries ALLOW {atheroma / atherosclerosis / plaques} partially block the arteries	**(2)**

Question number	Answer	Additional guidance	Mark
1(b) (ii)	An explanation that makes reference to two of the following: • reduce supply of oxygen to the heart muscle (1) • resulting in reduced aerobic respiration (1) • resulting in {weaker heart muscle contraction / death of heart tissue} (1)	ALLOW less oxygen for respiration ALLOW more anaerobic respiration ALLOW causing heart muscle to contract more frequently ALLOW heart muscle contracts more slowly	**(2)**

Question number	Answer	Additional guidance	Mark
1(c)	An explanation that makes reference to the following: • capillary lumen diameter is small so blood flow will be slow (1) • allowing (time) for the {process of diffusion / exchange between blood and tissue fluid} (1)		**(2)**

Question number	Answer	Additional guidance	Mark
2(a)	An answer that makes reference to the following: • niche is the way an organism interacts with its environment (1) • habitat is the place (with distinct set of conditions) where an {organism lives / community of organisms live} (1)	 ALLOW niche is the role an organism plays in its {habitat / environment / where it lives} ALLOW the {environment / place} where organisms live	**(2)**

Question number	Answer	Additional guidance	Mark
2(b)	An answer that makes reference to the following: • {C^B / C^P} is dominant and C^Y is recessive • the order of dominance is C^B over C^P over C^Y	 ALLOW C^B is dominant over C^P / C^P is dominant over C^Y / C^B is dominant over C^Y ALLOW brown is dominant to yellow and pink / pink is dominant to yellow ALLOW both marks if correct order of dominance stated	**(2)**

Question number	Answer	Additional guidance	Mark
2(c)(i)	An explanation that makes reference to three of the following: • the frequency of the different shell patterns in different habitats is an example of adaptation (1) • provides camouflage (appropriate to the habitat) (1) • reducing predation (in different habitats) / providing protection from predators (1) • therefore increasing the chance of (surviving to) reproduce (1)	ALLOW other reasonable suggestions e.g. temperature regulation IGNORE increasing survival rate	**(3)**

Question number	Answer	Additional guidance	Mark
2(c)(ii)	An answer that makes reference to the following: • use a statistical test such as the (Student) t-test (1) • if the test value is greater than the {critical / table} value at p=0.05 the difference is significant (1)	ALLOW using a critical value of p = 0.05 and a suitable number of degrees of freedom	**(2)**

Question number	Answer	Additional guidance	Mark
3(a)(i)	An answer that makes reference to the following: • stroma of the chloroplast (1)		**(1)**

Question number	Answer	Additional guidance	Mark
3(a)(ii)	An answer that makes reference to the following: • (the products) ATP and reduced NADP (1) • ATP is used (by the enzyme) converting {GP to GALP / GALP to RuBP} (1) • reduced NADP used to convert GP to GALP (1)	ALLOW $NADPH_2$ or NADPH for reduced NADP IGNORE $NADPH^+$ and reduced NAD ALLOW ATP is used to provide energy for the Calvin cycle	**(3)**

Question number	Answer	Additional guidance	Mark
3(b)(i)	An answer that makes reference to the following: • organisms and {non-living components / abiotic factors} (1)		**(1)**

Question number	Answer	Additional guidance	Mark
3(b)(ii)	Choose an item. • correct value for respiration (1) • respiration value calculated subtracted from gross productivity value (1)	Example of calculation 10.5 x (34.3 ÷ 100) = 3.6 10.5 – 3.6 = 6.9 (g m^{-2} day^{-1}) Correct answer with no working gains full marks	**(2)**

Question number	Answer	Additional guidance	Mark
3(b)(iii)	An answer that makes reference to three of the following: • tropical rain forests use a greater percentage (of gross productivity) in respiration (1) • tropical rain forests occupy a larger surface area (1) • therefore (tropical rain forests) release more carbon dioxide (1) • which is a greenhouse gas / making a greater contribution to global warming (1)	ALLOW converse arguments for salt marsh for mps 1, 2 and 3	**(3)**

Question number	Answer	Additional guidance	Mark
3(c)	An answer that makes reference to two of the following: • fixes (inorganic) carbon (1) • allowing formation of organic molecules (by the Calvin cycle) (1) • these organic molecules allow transfer of energy to next trophic level (1)	 ALLOW fixes CO_2 / combines RUBP and CO_2 ALLOW suitable examples of organic molecules e.g. GP / GALP / glucose / hexose sugars / amino acids ALLOW these organic molecules can be converted into biomass	**(2)**

Question number	Answer	Additional guidance	Mark
4(a)(i)	An answer that makes reference to the following: • treatment of seeds with sodium chloride or sodium chloride and gibberellin has no effect on the number of seeds that germinate (1)		**(1)**

Question number	Answer	Additional guidance	Mark
4(a)(ii)	Choose an item. • correct expected value calculated (1) • $(O - E)^2$ values calculated (1) • Sum of $(O - E)^2$ values divided by expected value (1)	Example of calculation: = 42 36, 81 and 9 126 ÷ 42 = 3 ALLOW calculations based on E value of 48 or 50 Obs Exp $(O - E)^2$ $(O - E)^2/E$ 48 **42** **36** 0.857143 33 42 **81** 1.928571 45 42 **9** 0.214286 **3** 48 **50** **4** 0.08 33 50 **289** 5.78 45 50 **25** 0.5 **6.36** 48 **48** **0** 0 33 48 **225** 4.6875 45 48 **9** 0.1875 **4.875**	**(3)**

		Correct answer with no working gains full marks	

Question number	Answer	Additional guidance	Mark
4(a)(iii)	An answer that makes reference to the following: • calculated value is significant at p = 0.05 (1) • at 2 degrees of freedom (1)		**(2)**

Question number	Answer	Additional guidance	Mark
4(b)	An answer that makes reference to four of the following: • seeds treated with sodium chloride and with sodium chloride and gibberellin (1) • description of how an abiotic factor can be controlled (1) • extract amylase from the seeds (1) • description of assay (1) • description of how quantitative results will be obtained to enable comparison (1)	ALLOW with sodium chloride and different concentrations of gibberellin e.g. use a water bath to control the temperature ALLOW method of standardising quantity of amylase e.g. same volume of {amylase extract / seed extract} / same {mass / number / type / size} of seed e.g. iodine starch test or Benedict's test to measure reducing sugars e.g. length of time to remove starch or use of a colorimeter ALLOW a description of how gibberellin might affect the result e.g. 'if giberrellin increases amylase activity time for iodine solution to go colourless will be shorter'	**(4)**

Question number	Answer	Additional guidance	Mark
5(a)(i)	A description that makes reference to the following: • the allele (G20210A) increases the risk of suffering a deep vein thrombosis / two copies of the allele (G20210A) increases risk (1) • there is a { 2.5 fold increase in risk with one allele / 20 fold increase in risk with two alleles / 8-fold increase in risk with two alleles compared to one allele} (1)	ALLOW abbreviations for G20210A ALLOW DVT IGNORE 1.5 x, 17.5 x and 19 x as these come from incorrect subtractions of risk factors	**(2)**

Question number	Answer	Additional guidance	Mark
5(a)(ii)	Choose an item. • correct proportion of homozygous individuals calculated (1) • correct probabilities (p and q) determined for Hardy-Weinberg equation (1) • correct number of heterozygotes determined (1)	Example of calculation P^2 or q^2 = 0.005 p =0.0707 q = 0.9293 or 2pq = 0.1314 = 10 000 x 0.1314 = 1314 ALLOW p = 0.071 and q = 0.929 or 2pq = 0.1319 = 10 000 x 0.1319 = 1319 ALLOW three marks for 1302 ALLOW two marks for 1300 Correct answer with no working gains full marks	**(3)**

Question number	Answer	Additional guidance	Mark
5(b)(i)	An explanation that makes reference to two of the following: • primers have a specific base sequence (1) • bind to complementary bases (at either end) of the DNA be amplified (1) • therefore, provide a site for the DNA polymerase to bind (1)	IGNORE contain complementary bases ALLOW primers attach to the start of the STR sequence ALLOW anneal for bind ALLOW allowing DNA polymerase to create a complementary strand	**(2)**

Question number	Answer	Additional guidance	Mark
5(b)(ii)	An explanation that makes reference to three of the following: • the base sequences of the alleles are different (1) • the restriction enzyme {recognises / cuts} at a specific {site / DNA base sequence} (1) • that is only present in the G20210A allele (1) • therefore, a shorter fragment is produced for the G20210A allele (1)	ALLOW they have different numbers of base pairs e.g. wild type 345bp and the G20210A has 322bp	**(3)**

Question number	Answer	Additional guidance	Mark
5(b)(iii)	An answer that makes reference to four of the following: • identify an appropriate reagent to be provided (in excess) (1) • identify appropriate conditions (to control) (1) • change the number of cycles (1) • use gel electrophoresis (to determine quantity of DNA produced) (1) • choose the smallest number of cycles that produces an observable band (1)	e.g. DNA, polymerase, primers, mononucleotides e.g. temperatures used are 95, 55 and 70^{o}C / duration of steps in cycle ALLOW a description of gel electrophoresis ALLOW choose the number of cycles giving the {thickest / clearest} band	**(4)**

Question number	Answer	Additional guidance	Mark
6(a)	An explanation that makes reference to two of the following: • water is a component of blood (1) • ions are charged (1) • dipole nature of water allows it to {surround / bond to / interact with} ions (1)	IGNORE water and ions form hydrogen bonds	**(2)**

Question number	Answer	Mark
6(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. Reference to role of ions in • nerve conduction • release of neurotransmitters • muscle contraction Mention of • passive diffusion through ion channels • active transport against concentration gradients Examples of ion transport • active transport – sodium potassium pump • hydrogen ions in chemiosmosis • calcium channels in pre-synaptic knob • sodium and potassium channels in neurones Idea that ions moving down a concentration gradient can do work • ATP synthase in chemiosmosis • cotransporters Ion channels in disease • chloride channels in cystic fibrosis • credit any other sensible suggestions Ideas around control • lots of different genes/proteins involved in transporting ions across membranes	**(9)**

	• specificity of channels for particular ions • control of opening and closing of different channels		
Level	**Marks**		**Additional Guidance**
0	0	No awardable content	
1	1-3	Demonstrates isolated elements of biological knowledge and understanding to the given context with generalised comments made. Vague statements related to consequences are made with limited linkage to a range of scientific ideas, processes, techniques and procedures. The discussion will contain basic information with some attempt made to link knowledge and understanding to the given context.	simple description of data provided or discussion of one aspect from specification e.g. role of ions in action potentials / muscle contraction / mucus production
2	4-6	Demonstrates adequate knowledge and understanding by selecting and applying some relevant biological facts/concepts. Consequences are discussed which are occasionally supported through linkage to a range of scientific ideas, processes, techniques and procedures. The discussion shows some linkages and lines of scientific reasoning with some structure.	Level 1 criteria plus disscussion of another aspects from specification including consideration in {disease / ill-health} in at least one
3	7-9	Demonstrates comprehensive knowledge and understanding by selecting and applying relevant knowledge of biological facts/concepts. Consequences are discussed which are supported throughout by sustained linkage to a range of scientific ideas, processes, techniques or procedures. The discussion shows a well-developed and sustained line of scientific reasoning which is clear and logically structured.	Level 2 criteria plus appropriate use of data from tables linked to health or disease or attempt at higher level reasoning e.g explaining role of {ion gradients / active transport of ions}

			expanding on role of mutations in disease beyond cystic fibrosis / discussion of channel specificity or evolution of variety of channels with many functions

Question number	Answer	Additional guidance	Mark
7(a)	A description that makes reference to five of the following: • light is detected by rod cells (1) • rod cell membrane is hyperpolarised (1) • stopping the release of the inhibitory neurotransmitter glutamate (1) • bipolar neurone is depolarised (1) • impulse transmitted along {ganglion neurone / optic nerve} (1) • (impulse transmitted) to visual cortex of the brain (1)	ALLOW description of role of rhodopsin ALLOW occipital lobe	**(5)**

Question number	Answer	Additional guidance	Mark
7(b)	An explanation that makes reference to the following: • (give) {a precursor of dopamine / L-dopa} which can cross the blood brain barrier (1) • L-dopa is converted into dopamine (in the brain) (1) OR • (give) a {drug that stops the breakdown of dopamine / MAO inhibitor} (1) • that can cross the blood brain barrier (1)	ALLOW • use of {electrode / deep brain stimulation} • to stimulate basal ganglia to produce dopamine	**(2)**

Question number	Answer	Additional guidance	Mark
7(c)	An explanation that makes reference to four of the following: • (cytokines / histamine) increases permeability of the capillaries (1) • (cytokines / histamine) cause vasodilation (1) • increasing blood flow to site of inflammation (1) • allowing white blood cells to {migrate / move } from the blood into the tissue space (1) • cytokines attract white blood cells (1)	ALLOW cause arterioles to dilate MP4 and 5 ALLOW immune cells / phagocytes / macrophages / monocytes ALLOW chemicals in place of cytokines	**(4)**

Question number	Answer	Additional guidance	Mark
7(d)	An answer that makes reference to two of the following: • the integrin binds to receptors • on (the surface of capillary) endothelial cells (1) • holding the immune cell in place / stopping the immune cell moving with the blood (1) • giving the immune cells time to squeeze between the endothelial cells (into the brain) (1)	ALLOW (complementary) proteins in placxe of receptors IGNORE activates (capillary) endothelial cells ALLOW trapping the immune cell ALLOW allowing immune cells to cross {the basement membrane / capillary wall}	**(2)**

Question number	Answer	Additional guidance	Mark
7(e)	An answer that makes reference to the following: • the benefits of the research outweigh any harm done (1) • need to carry out experiments on animals with a well-developed CNS (1)	ALLOW CNS and spinal cord injuries are difficult to treat / CNS and spinal cord injuries have serious impact on people's lives / important research ALLOW experiments on tissues or invertebrates would not be sufficient IGNORE better than using humans / humans have more rights etc IGNORE have similar immune system / have less well developed nervous system	**(2)**

Question number	Answer	Additional guidance	Mark
7(f)	A description that makes reference to the following: • { phagocytes / macrophages } engulf antigens (1) • antigen is presented on the surface of antigen presenting cells (1) • lymphocytes with receptors that are (specific / complementary) to (particular) antigens bind to APC (1)	ALLOW reference to production of APCs / antigen presenting cells ALLOW CD4 receptors ALLOW T cells for lymphocytes	**(3)**

Question number	Answer	Additional guidance	Mark
7(g)	An explanation that makes reference to four of the following: • cytokine can bind to receptor on synaptic membrane (1) • effect on an ion channel (1) • therefore affecting the movement of ions across the membrane (1) • affecting the depolarisation of the membrane (1) • therefore affecting action potentials (in the neural circuit) (1)	ALLOW inhibitory or stimulatory effects ALLOW binds to acetylcholinesterase e.g. opens chloride ion channel ALLOW other described effects on membrane e.g. chloride ions moving in or potassium ions moving out e.g. threshold potential is not reached	**(4)**

Question number	Answer	Additional guidance	Mark
7(h)	An answer that makes reference to the following: Similarities • both have a cell body containing a nucleus (1) • both have an axon (1) • both have dendrites at one end of neurone and terminal branches at the other end (1) Difference • location of cell body (1)	IGNORE descriptions of function ALLOW motor neurone cell body is at one end of the axon whereas in the sensory neurone the cell body is located along the axon	**(4)**

Question number	Answer	Additional guidance	Mark
7(i)	A description that makes reference to two of the following: • period of time during early development (1) • when the nervous system must obtain specific experiences to develop properly (1) • so that synapses are strengthened / unstimulated synapses are removed (1)	 ALLOW retina needs to be exposed to light ALLOW when visual columns are organised	**(2)**

Question number	Answer	Additional guidance	Mark
7(j)	An explanation that makes reference to two of the following: • {immunise / infect} animals at different times during early development (1) • investigate animals later in life for { effects on learning / the development of neurological conditions } (1)	ALLOW compare animals with intact and with deficient (innate) immune systems ALLOW test animals' senses at different stages in development	**(2)**

Question number	Answer	Additional guidance	Mark
7(k)	A description that makes reference to four of the following: • (isolate) the gene for ~~the~~ cytokine (from human DNA) (1) • use a bacterial plasmid (as a vector) (1) • cut the human DNA and the plasmid using the same restriction enzyme (1) • splice the gene and plasmid together using (DNA) ligase (1) • put the (modified) plasmids into bacterial cells (1)	e.g. ue a restriction enzyme to cut the DNA and the plasmid ALLOW 'join' for 'splice' ALLOW produce lots of bacteria {with the plasmid / expressing the cytokine gene}	**(4)**

Question number	Answer	Additional guidance	Mark
7(l)	An explanation that makes reference to the following: • bone marrow provided by a donor (1) • bone marrow will contains stem cells (1) • which can be differentiate into white blood cells (1)	ALLOW white blood cells are produced in the bone marrow ALLOW examples of white blood cells e.g. lymphocytes, T cells, B cells, etc	**(3)**

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