Mark Scheme (Results)

Summer 2017

Pearson Edexcel International Advanced Level
In Biology (9BI01) Paper 01
Advanced Biochemistry, Microbiology and Genetics

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

Question Number	Answer	Mark
1(a)	**1(a). The only correct answer is A** ***B*** *is not correct because there are 5 monocytes and 8 neutrophils* ***C*** *is not correct because there are 3 lymphocytes, 5 monocytes and 8 neutrophils* ***D*** *is not correct because there are 3 lymphocytes*	**(1)**

Question Number	Answer	Mark
1(b)	**1(b). The only correct answer is C** ***A*** *is not correct because erythrocytes transport oxygen and platelets prevent entry of bacteria* ***B*** *is not correct because erythrocytes transport oxygen and platelets prevent entry of bacteria* ***D*** *is not correct because leucocytes are involved in defence*	**(1)**

Question Number	Answer	Additional Guidance	Mark
1(c)	An explanation that makes reference to two of the following: • (bone marrow / body / patient / person) produces more cells / more released into blood (1) • because patient has {an allergy / allergic inflammation} (1) • because patient has a parasitic infection e.g. worms (1)	**Accept any two from :** asthma /tropical pulmonary eosinophilia / Loeffler syndrome / Churg-Strauss syndrome / atopic dermatitis / eosinophilic oesophagitis / hypereosinophilic syndromes / some malignancies / adverse drug reactions / allergic rhinitis / atopic asthma / atopic dermatitis	**(2)**

Total for Question 1 = 4 MARKS

Question Number	Answer	Mark
2(a)	**2(a). The only correct answer is C** ***A*** *is not correct because order goes between class and family* ***B*** *is not correct because order goes between class and family* ***D*** *is not correct because order goes between class and family*	**(1)**

Question Number	Answer	Additional Guidance	Mark
2(b)	An explanation that makes reference to three of the following: • dolphins and (minke) whales are the most closely-related as they evolved from the same {species / (recent) common ancestor} **(1)** • the common ancestor of dolphins and minke whales evolved from the same common ancestor as cows **(1)** • pigs are the most distantly-related because they were the {first / earliest} animals to diverge **(1)** • the more closely-related the animals are the {more similar their DNA will be / fewer mutations} **(1)**	**Accept** an account that talks about branching points or speciation **Accept** because their (shared) common ancestor is furthest away **Accept** converse	**(3)**

Question Number	Answer	Additional Guidance	Mark
2(c)	• total number of dolphin's gene families and number of shared gene families **(1)** • percentage of gene families shared **(1)**	Example of calculation 12 678 and 11 189 = 88.26 / 88.3 / 88 **Accept** ecf if one value incorrect	**(2)**

Question Number	Answer	Additional Guidance	Mark
2(d)	An explanation that makes reference to the following: • because dolphins and killer whales are separate species so should not be able to interbreed to produce fertile {offspring / hybrids} **(1)** • but {Kekaimalu / the offspring from the mating of the whale and dolphin} was fertile **(1)**	**Accept** separate species are not able to interbreed to produce fertile offspring **Accept** but Kekaimalu {reproduced / produced offspring}	**(2)**

Total for Question 2 = 8 MARKS

Question Number	Answer	Additional Guidance	Mark
3(a)(i)	An explanation that makes reference to three of the following: • because the food poisoning was happening {after one hour /within a few hours} of the meal **(1)** • indicating that exotoxins caused the food poisoning **(1)** • because endotoxins are only present after {about 12 hours / several hours / when the bacterial cells are estroyed} **(1)** • *Staphylococcus* releases exotoxins / endotoxins come from *Salmonella* **(1)**	**Accept** soon after meal / quickly / by {12 / 1} o clock **Do not accept** *Staphylococcus* is an exotoxin / *Salmonella* is an endotoxin	**(3)**

Question Number	Answer	Additional Guidance	Mark
3(a)(ii)	A description that makes reference to any four of the following: • isolate the bacteria from the {food / patient / faeces / vomit} **(1)** • look at the colonies to see if they have a {characteristic / named characteristic} (of *Staphylococcus*) **(1)** • use Gram stain to show presence of Gram positive bacteria **(1)** • grow on selective media that identify {*Staphylococcus* / eliminates other bacteria} **(1)** • use antibodies against *Staphylococcus* **(1)**	**Accept** a description of how this is done e.g. streak plating from a faecal sample **Accept** *Staphylococci* will appear purple with Gram stain **Accept** differential media **/** selective agar / named example e.g. mannitol salt agar / with antibiotics	**(4)**

Question Number	Answer	Mark
3(b)(i)	**3(b)(i). The only correct answer is C** ***A*** *is not correct because not all RNA viruses have envelopes and only the retroviruses contain reverse transcriptase* ***B*** *is not correct because only the retroviruses contain reverse transcriptase* ***D*** *is not correct because not all RNA viruses have envelopes and they are not all helical*	**(1)**

Question Number	Answer	Mark
3(b)(ii)	**3(b)(ii). The only correct answer is A** ***B*** *is not correct because λ phage has DNA* ***C*** *is not correct because λ phage has DNA* ***D*** *is not correct because λ phage has DNA*	**(1)**

Total for Question 3 = 9 MARKS

Question Number	Answer	Additional Guidance	Mark
4(a)	An explanation that makes reference to two of the following: • more men than women are affected and heart disease increases with age **(1)** • gender because {presence of oestrogen in women / more men than women smoke} **(1)** • age because {more time to develop atherosclerosis / less active lifestyle / higher blood pressure / less elastic arteries} **(1)**	**Accept** pieced together answer	**(2)**

Question Number	Answer	Additional Guidance	Mark
4(b)	An explanation that makes reference to two of the following: • the { atheroma / plaque / (blood) clot} blocks the (coronary) artery **(1)** • therefore the heart {cells / muscle} are deprived of {oxygen / glucose} **(1)** • therefore respiration cannot take place **(1)**	**Accept** atherosclerosis results in the (coronary) artery being blocked **Accept** they (heart cells) are deprived of oxygen / less oxygen {reaches / transported to} the cells / ischaemia / reduction in flow of oxygenated blood	**(2)**

Question Number	Answer	Additional Guidance	Mark
4(c)	An answer that makes reference to five of the following, including at least one similarity or one difference : <u>Similarities</u>: • both have the potential to divide indefinitely **(1)** • both have the potential to differentiate into a number of cell types **(1)** <u>Differences</u>: • iPS cells were {adult cells / named example of adult cell} but embryonic stem cells are cells taken from the {morula / inner cell mass} **(1)** • iPS have a {gene / named gene} added but embryonic cells do not **(1)** • there are {no / less / different} ethical issues surrounding the use of iPS cells **(1)** • iPS cells can form adult cells whereas embryonic cells form younger cells **(1)** • iPS cells will produce patient-matched cells but embryonic stem cells will be antigenic **(1)**	**NB** do not piece together **Accept** have no Hayflick limit **Accept** to specialise e.g. fibroblasts, keratinocytes, kidney epithelium, blood cells **Accept** blastomeres / early embryo (up to 14 days) e.g. Oct4, Sox2, cMyc, KIf4 **Accept** there will be rejection issues using embryonic stem cells but not using iPS cells	**(5)**

Total for Question 4 = 9 MARKS

Question Number	Answer	Mark
5(a)(i)	**5(a)(i). The only correct answer is B** ***A*** *is not correct because chi squared test compares expected result to the actual result* ***C*** *is not correct because standard deviation measures scatter about the mean* ***D*** *is not correct because Student's t test compares the means of two sets of data*	**(1)**

Question Number	Answer	Additional Guidance	Mark
5(a)(ii)	• $6\sum d^2$ calculated **(1)** • $n(n^2-1)$ calculated **(1)** • correct r_s value given **(1)**	<u>Example of calculation</u> 6 × 108 = 648 7(49-1) =336 1 - (648 ÷ 336) = -0.93 / 0.93 / -0.929 / 0.929 **Accept** ecf from $6\sum d^2$ and $n(n^2-1)$ calculations **Correct answer gains full marks, with no working shown**	**(3)**

Question Number	Answer	Additional Guidance	Mark
5(a)(iii)	An explanation that makes reference to the following: • critical value found at {p = 0.05 / 95% level confidence level / 5% significance level} **(1)** • because if {calculated / r_s} value is greater than critical value there is a {strong / significant} {relationship / correlation} **(1)**	**Accept** 0.01 / 99 % **Accept** converse	**(2)**

Question Number	Answer	Additional Guidance	Mark
5(b)	An explanation that makes reference to four of the following: • because 30 °C is an appropriate temperature for one species and provides enough oxygen for the other species **(1)** • because if the temperature was above {30 / 40} °C there would be less oxygen dissolved in it **(1)** • so there would not be enough oxygen for {respiration / metabolism / ATP production} **(1)** • because if the temperature was above {25 / 30} °C the enzymes would be denaturing **(1)** • because the temperature was below {25 / 30} °C the enzymes would not have enough {kinetic energy / collisions / enzyme substrate complexes} **(1)**	**Accept** because 30 °C satisfies the requirements of both fish **Do not accept** start to denature **Accept for 1 mark** 30 °C is close to the optimum temperature for the enzymes	**(4)**

Total for Question 5 = 10 MARKS

Question Number	Answer	Additional Guidance	Mark
6(a)(i)	An explanation that makes reference to the following: • because different types of lipid are found in the mitochondria and chloroplasts **(1)** • because mitochondria are associated with { respiration / oxidative phosphorylation} whereas chloroplasts are associated with {photosynthesis / light-dependent reactions / photophosphorylation} **(1)** • because mitochondria contain {electron transport proteins / cytochromes / cristae / stalked particles} whereas chloroplasts contain {grana / chlorophyll / photosystems / carotenoids} **(1)**	**Accept** a description of the differences e.g. a lipid high in mitochondria is low in chloroplast, only two of the lipids are found in both organelles **Do not accept** a list of values from the table without some sort of comparison **Accept** any other membrane difference	**(3)**

Question Number	Answer	Additional Guidance	Mark
6(a)(ii)	A diagram that shows the following: • a glycosidic bond between C 1 on galactose and C 6 on MGDG **(1)** • rest of molecules complete **(1)** • water molecule **(1)**	ecf if glycosidic bond drawn between C1 and C 4 **Accept** H_20 / water	**(3)**

Question Number	Answer	Mark
6(a)(iii)	**6(a)(iii). The only correct answer is B** ***A*** *is not correct because DGDG is larger than MGDG so will not travel as far and sulfolipid is the smallest quantity so will be the smallest spot* ***C*** *is not correct because DGDG is larger than MGDG so will not travel as far and sulfolipid is the smallest quantity so will be the smallest spot* ***D*** *is not correct because sulfolipid is the smallest quantity so will be the smallest spot*	**(1)**

Question Number	Answer	Additional Guidance	Mark
6(b)(i)	1×10^{11}	**Accept** 10^{11} / 100 000 000 000 / 10×10^{10} / any other equivalent ways of expressing this answer	**(1)**

Question Number	Answer	Additional Guidance	Mark
6(b)(ii)	An explanation that makes reference to two of the following: • because the number of carbon (atoms) in the cell has been under-estimated (1) • because not all the ATP is used in (light-dependent reaction / Calvin cycle / carbon fixation} (1) • because {photons differ in energy / not all wavelengths of light are absorbed by the plant} **(1)**	**Accept** there are more carbons in the cell **Accept** cyclic photophosphorylation is happening **Accept** process is not 100% efficient / some light is reflected / not all photons of light are absorbed	**(2)**

Question Number	Answer	Additional Guidance	Mark
6(b)(iii)	A description that makes reference to three of the following: • carbon dioxide diffuses into stroma **(1)** • carbon dioxide binds to {ribulose bisphosphate / RuBP} **(1)** • using {ribulose bisphosphate carboxylase / RUBISCO} **(1)** • resulting in the formation of {(intermediate) 6C compound / GP} **(1)**	**Accept** attaches / joins / reacts / added to **Accept** rubisco	**(3)**

Total for Question 6 = 13 MARKS

Question Number	Answer	Additional Guidance	Mark
7(a)	An explanation that makes reference to the following: • because nuclear DNA is present in both the male and female {gametes / sex cells } **(1)** • because mitochondria are present in the { female gamete / ovum / secondary oocyte / egg cell} and not the sperm head **(1)**	 **Accept** in male and female nuclei in the context of fertilisation **Accept** mitochondria are present in sperm {neck / mid piece} / mitochondria (DNA) not released by the sperm	**(2)**

Question Number	Answer	Mark
7(b)(i)	**7(b)(i). The only correct answer is C** ***A*** *is not correct because an insertion adds an additional base* ***B*** *is not correct because monosomy is a chromosome mutation* ***D*** *is not correct because translocation is a chromosome mutation*	**(1)**

Question Number	Answer	Additional Guidance	Mark
7(b)(ii)	An explanation that makes reference to three of the following: • it will change the {amino acid sequence / primary structure } of ATP synthase **(1)** • therefore the ATP synthase active site could be a different {structure / shape } so ADP cannot {bind / bind as well} **(1)** • therefore the {channel / ATP synthase} the wrong {structure / shape} so {hydrogen ions / protons} cannot {pass through / pass through as well} **(1)** . therefore { no / less} {ATP made / oxidative phosphorylation} **(1)**	**Accept** a stop codon could result changing the {length / shape / structure} of the protein	**(3)**

Question Number	Answer	Additional Guidance	Mark
7(c)	An explanation that makes reference to the following: • the mutation may produce a stop codon **(1)** • therefore translation will stop {sooner / when the stop codon is reached} **(1)** **Or** • {one / several} bases deleted **(1)** • therefore the mRNA is shorter **(1)**	**Accept** no more amino acids added to the peptide / peptide synthesis stops sooner	**(2)**

Question Number	Answer	Additional Guidance	Mark
7(d)	An explanation that makes reference to three of the following: • mutation may prevent {electrons being passed down the electron transport chain / ATPase from working properly} **(1)** • therefore {NADH / reduced NAD} cannot be oxidised **(1)** • therefore pyruvate and {NADH / reduced NAD} will produce lactate **(1)** • lactate produced at a faster rate than it can be removed **(1)**	**Accept** reformed / converted back	**(3)**

Total for Question 7 = 11 MARKS

Question Number	Answer	Mark
8(a)	**8(a). The only correct answer is D** ***A*** *is not correct because there is no cytoplasm inside the chloroplast* ***B*** *is not correct because the matrix is found inside mitochondria* ***C*** *is not correct because nucleoplasm is found inside the nucleus*	**(1)**

Question Number	Answer	Additional Guidance	Mark
8(b)(i)	• maximum width × magnification **(1)** • correct gap width with appropriate units **(1)**	$20 \times 10^{-3} \times 12\,000 = 240$ = 0.24 mm / 240 µm / 240 000 nm / 24×10^{4} nm **Accept** correct minimum gap width with appropriate units for 1 mark	**(2)**

Question Number	Answer	Additional Guidance	Mark
8(b)(ii)	An explanation that makes reference to the following: • because the resolution of the microscope is {not high enough / is too low} **(1)** • as the membranes are too close together to be distinguished as separate structures **(1)**	**Do not accept** magnification **Accept** as separate lines **Do not accept** magnification	**(2)**

Question Number	Indicative content
***8(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. **Descriptions of graph or diagram:** • as the leaf size increases so does the number of chloroplasts per cell • as the leaf size increases cpDNA per chloroplast increases then decreases • as the leaf continues to grow the number of chloroplasts per cell continues to increase but the number of cpDNA per cell drops **Explanations of graph or diagram:** • as the leaf increases in size more chloroplasts needed for photosynthesis • cpDNA replicates to provide the cpDNA for newly made chloroplasts • this ensures that the new chloroplasts have identical genetic information • the cpDNA per chloroplast begins to drop as the leaf cells get older, since there are more chloroplasts per cell **Interpretation of the genes found in the cpDNA :** • cpDNA codes for RNAs and ribosomal proteins that will be needed for transcription and translation of proteins needed in the new chloroplasts • cpDNA codes for proteins needed in photosynthesis e.g.RUBISCO

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. **Description given of the changes shown in the graph in the number of chloroplasts, cpDNA and increase in leaf size**
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. **An explanation given for these changes**
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 the genes in the cpDNA and the processes of photosynthesis and protein synthesis**

Total for Question 8 = 11 MARKS

Question Number	Answer	Mark
9(a)	**9(a). The only correct answer is D** ***A*** *is not correct because macrophages do not produce antibody* ***B*** *is not correct because memory cells do not produce antibody* ***C*** *is not correct because neutrophils do not produce antibody*	**(1)**

Question Number	Answer	Additional Guidance	Mark
9(b)	A description that makes reference to the following: • changes that affect gene {expression / activation} **(1)** • credit an example of epigenetic modification **(1)** • involved in {differentiation / change in function / change in proteins synthesised } **(1)**	**Do not accept** altering the DNA / base sequence / genetic code e.g. DNA methylation, histone {modification / methylation / acetylation} / chromatin remodelling / non-coding RNA / transcription factors **Accept** when a B cell becomes a plasma cell	**(3)**

Question Number	Answer	Additional Guidance	Mark
9(c)	An explanation that makes reference to two of the following: • to produce lots of {genetically identical / hybridoma} cells **(1)** • so that lots of antibodies (of one type) can be produced (by hybridoma cells) **(1)** • so that the hybridoma cells can divide **(1)**	**Accept** because a {fully-differentiated / antibody-producing / plasma} cell cannot divide	**(2)**

Question Number	Answer	Additional Guidance	Mark
9(d)(i)	An explanation that makes reference to the following: • humanised antibodies will not trigger an immune response / mouse antibodies could trigger an immune response **(1)** • antibodies would {bind to cancer cells so that macrophages could destroy the cancer cells / opsonise the cancer cells} **(1)** • the antibodies are target specific **(1)** • reducing the need for other {treatments / named treatment} **(1)**	**Accept** humanised antibodies will not be recognised as {foreign / as an antigen} / mouse antibodies could be recognised as {foreign / as an antigen} **Accept** antibodies will bind only to cancer cells **Accept** have less {side effects / named side effects}	**(3)**

Question Number	Indicative content
***9(d)(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. **Description:** • mouse antibody is made of all mouse components • humanised antibody consists mostly of human components • mouse antibody recognised by the patient's immune system (rejection) • mouse protein acts as an antigen **Consequence:** • mouse antibody could be destroyed • mouse antibodies would not persist in the body • macrophages may not bind to mouse antibody • so phagocytosis of the cancer cells would not be enhanced • humoral / B cell immune response could be initiated • macrophages may phagocytose the mouse antibody **Immunology:** • details of how macrophage destroys antibody • macrophage becomes an antigen-presenting cell • T helper cells become activated • antibodies against the mouse antibodies could be produced (by plasma cells) **Accept converse for humanised antibody throughout**

Level 0	0	No awardable content
Level 1	1-2	Demonstrates isolated elements of biological knowledge and understanding to the given context with generalised comments made. The explanation will contain basic information with some attempt made to link knowledge and understanding to the given context. **Description of mouse antibody resulting in rejection (Accept converse for humanised antibody throughout)**
Level 2	3-4	Demonstrates adequate knowledge and understanding by selecting and applying some relevant biological facts/concepts to provide the explanation being presented. Lines of argument occasionally supported through the application of relevant evidence (scientific ideas, processes, techniques and procedures). The explanation shows some linkages and lines of reasoning with some structure. **Details given on why the mouse antibodies may not be effective in treating the cancer (Accept converse for humanised antibody throughout)**
Level 3	5-6	Demonstrates comprehensive knowledge and understanding by selecting and applying relevant knowledge of biological facts/concepts to provide the explanation being presented. Line(s) of argument supported throughout by sustained application of relevant evidence (scientific ideas, processes, techniques and procedures). The explanation shows a well-developed and sustained line of reasoning which is clear, coherent and logically structured. **Explanation of how the mouse antibody could be destroyed by the immune system (Accept converse for humanised antibody throughout)**

Total for Question 9 = 15 MARKS

TOTAL FOR PAPER = 90 MARKS

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