Unit 4 - Mark scheme

Question number	Answer	Mark
1(a)(i)	B human immunodeficiency virus (HIV) and tobacco mosaic virus (TMV)	(1)

Question number	Answer	Mark
1(a)(ii)	D tobacco mosaic virus (TMV) only	(1)

Question number	Answer	Mark
1(a)(iii)	D protein	(1)

Question number	Answer	Additional guidance	Mark
1(a)(iv)	• calculation of volume of TMV (1) • calculation of size difference (1) Example of calculation: 3.14 × 40 × 40 × 300 = 1 507 200 19 / 19.4 / 19.42	Allow ecf Correct answer with no working shown gains full marks	(2)

Question number	Answer	Mark
1(b)(i)	• reverse transcriptase and integrase	(1)

Question number	Answer	Mark
1(b)(ii)	An explanation that includes the following points: • because these enzymes are not present in the host cell (1) • because reverse transcriptase is needed to make a DNA copy of the viral RNA (1) • because integrase is needed to incorporate the DNA copy into the host cell genome (1)	(3)

Question number	Answer	Mark
2(a)	An explanation that includes the following points: • each antibody can bind to two bacteria resulting in agglutination (1) • antibody {can bind to both the phagocyte and the bacteria / causes opsonisation} (1) • therefore phagocytosis is enhanced (1) • toxins are neutralised (1)	(4)

Question number	Answer	Mark
2(b)(i)	A description that includes the following points: • IgG produced by mother increases in months before birth and then decreases after birth (1) • IgG produced by child increases rapidly after birth (1) • IgA increases slowly after birth (1)	(3)

Question number	Answer	Mark
2(b)(ii)	D natural passive	(1)

Question number	Answer	Mark
2(b)(iii)	An answer that includes the following points: • child has not been exposed to all types of antigen (1) • no {IgM / other classes of antibody} produced yet (1)	(2)

Question number	Answer	Mark
3(a)	An explanation that includes the following points: • GP is formed once carbon dioxide has bound to RuBP in the Calvin cycle (1) • and ATP is required to provide energy to convert GP to GALP (1) • and reduced NADP is used to reduce GP to GALP (1)	(3)

Question number	Answer	Additional guidance	Mark
3(b)(i)	• tangent drawn to curve at 12 00 hours (1) • values to calculate gradient given (1) • answer with units (1)	Allow ecf Award full marks for correct numerical answer without working	(3)

Question number	Answer	Mark
3(b)(ii)	An answer that includes any three of the following points: • light intensity falls (1) • so less ATP is generated from light-dependent reaction (1) • temperature falls (1) • so enzymes are working slower (1)	(3)

Question number	Answer	Mark
3(b)(iii)	An answer that includes any three of the following points: • light intensity was low (1) • so {less / no} photosynthesis was taking place (1) • glucose was being used (1) • because respiration was taking place (1)	(3)

Question number	Answer	Mark
4(a)	An answer that includes the following points: • changes to {weather patterns / global temperatures} over a long period of time (1) • due to human activity (1)	(2)

Question number	Answer	Additional guidance	Mark
4(b)(i)	Any two from: • carbon dioxide • methane • water vapour • nitrogen oxides • CFCs	Accept correct chemical formulae	(1)

Question number	Answer	Mark
4(b)(ii)	An explanation that includes the following points: • accumulated gases in the atmosphere trap infrared radiation (1) • resulting in an increase in the temperature of the Earth's {atmosphere / surface} (1)	(2)

Question number	Answer	Mark
4(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 indicated as relevant. Additional content included in the response must be scientific and relevant. **Indicative content** • carbon dioxide is released into atmosphere • because agriculture requires farm machinery powered by burning fossil fuels • because industry burns fossil fuels for energy • because homes and business buildings use fossil fuels for heating • transport uses fossil fuels • fossil fuels are burnt to produce electricity • forestry may decrease the number of trees • so less carbon dioxide removed from air by photosynthesis	(6)

Level	Marks	Descriptor
	0	No awardable content.
1	1-2	An explanation may be attempted but with limited interpretation or analysis of the scientific information and 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.
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.
3	5-6	An explanation is made that 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.

Question number	Answer	Mark
5(a)	An answer that includes the following points: • can differentiate into all cell types (1) • have no Hayflick limit / can divide indefinitely (1)	**(2)**

Question number	Answer	Mark
5(b)(i)	B negatively-charged fragments move towards the positive end of the gel	**(1)**

Question number	Answer	Mark
5(b)(ii)	A 1	**(1)**

Question number	Answer	Mark
5(b)(iii)	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 indicated as relevant. Additional content included in the response must be scientific and relevant. **Indicative content** • Bands 1, 2, 5, 9 and 11 in the embryo are also found in the mother • therefore, they must have been present in the nucleus of the egg cell from the mother • Bands 4, 6, 7, 8 and 10 in the embryo are also found in the father • therefore they must have been present in the nucleus of the sperm from the father • Bands 3 and 12 in the embryo are not found in either the mother or the father • therefore they must have been the mitochondrial DNA from the donor • both mother and father have bands not found in the embryo • the bands in the mother could be her mitochondrial DNA	(6)

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3	5-6	An explanation is made that 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.

Question number	Answer	Mark
6(a)	B fatty acid	(1)

Question number	Answer	Mark
6(b)(i)	• bacteria make cell walls only following cell division	(1)

Question number	Answer	Mark
6(b)(ii)	An explanation that includes the following points: • if there is no mycolic acid the lysozymes will be able to digest the bacteria (1) • therefore antigens will be produced (1)	(2)

Question number	Answer	Mark
6(b)(iii)	An explanation that includes the following points: • if there is no mycolic acid in the cell wall, they will be more susceptible to lysozyme action (1) • the membrane structure will be affected (1) • therefore the cell will lose control of molecules entering and leaving (1)	(3)

Question number	Answer	Mark
6(b)(iv)	An explanation that includes the following points: • transcription will be inhibited (1) • therefore bacteria will not be able to synthesise proteins (1) • therefore {structure / function} of cell will be affected (1)	(3)

Question number	Answer	Mark
6(b)(v)	An explanation that includes any two of the following points: • greater exposure to antibiotics increases chances of resistance (1) • therefore bacteria could become resistant to a greater number of antibiotics (1) • greater chance that patients will not take antibiotics correctly (1)	(2)

Question number	Answer	Mark
7(a)	An explanation that includes the following points: • above 60 °C the enzymes are denatured (1) • so there will be no metabolic reactions (1) • because between 50 °C to 60 °C the enzymes are working slowly (1) • because the enzymes are denaturing (1)	(4)

Question number	Answer	Additional guidance	Mark
7(b)(i)	• $\log_{10}$ of 5×10^3 and 1.3×10^5 stated (1) • denominator calculated (1) • answer (1) Example of calculation: 3.7 and 5.1 $0.301 \times 4 = 1.204$ 1 / 1.2 / 1.16	Allow ecf Award full marks for correct numerical answer without working	(3)

Question number	Answer	Mark
7(b)(ii)	B exponential	(1)

Question number	Answer	Mark
7(c)(i)	An explanation that includes the following points: • decomposition will be slower (1) • because the enzymes will be less active (1) • as there is less {heat / kinetic} energy (1)	(3)

Question number	Answer	Mark
7(c)(ii)	An explanation that includes the following points: • cytoplasm will be frozen (1) • therefore enzymes and substrates will not be able to {move / collide} (1)	(2)

Question number	Answer	Mark
8(a)(i)	B 2	(1)

Question number	Answer	Mark
8(a)(ii)	An explanation that includes the following points: • glucose increases as glycogen decreases (1) • because glycogen is being hydrolysed (1)	(2)

Question number	Answer	Mark
8(b)(i)	• calculation of percentage difference Example of calculation: ((106 − 28) ÷ 28) × 100 = 279 / 278.6 / 278.57	(1)

Question number	Answer	Mark
8(b)(ii)	An explanation that includes the following points: • data from the wood frog from Alaska are more reliable as standard deviation is relatively smaller (1) • 9.43% compared to 17.86% of mean (1)	(2)

Question number	Answer	Mark
8(b)(iii)	An explanation that includes the following points: • solutes lower the freezing point of the plasma (1) • prevents damage to the cells by {freezing / ice crystals} (1)	(2)

Question number	Answer	Mark
8(c)	An explanation that includes any five of the following points: • natural selection (1) • because a mutation in DNA occurred (1) • resulting in alleles for increased solutes in plasma (1) • therefore these wood frogs could survive in colder areas (1) • reducing competition with other wood frogs (1) • therefore survived and reproduced passing on these alleles (1)	(5)