Question Number	Answer	Additional Guidance	Mark
1(a)(i)	B (Q)		**(1)**

Question Number	Answer	Additional Guidance	Mark
1(a)(ii)	B (4 μm)		**(1)**

Question Number	Answer	Additional Guidance	Mark
1(a)(iii)	B (haploid)		**(1)**

Question Number	Acceptable Answer	Additional Guidance	Mark
1(b)	An explanation that makes reference to the following: • the {egg / oocyte} membrane is protected by the zona pellucida (and follicle cells) (1) • (if acrosome reaction defective) enzyme not released (1) • { digestive enzymes / acrosin } will not break down the zona pellucida (1) • sperm will not be able to { fuse with the oocyte membrane / fertilise the oocyte } (1)	Allow egg cell for oocyte	**(4)**

Question Number	Acceptable Answer	Additional Guidance	Mark
1(c)	A description that makes reference to the following: • variation is produced in meiosis (1) • as a result of { crossing over / recombination } of alleles between chromatids (1) • the independent assortment of chromosomes (1)		**(3)**

Total for Question 1 = 10 Marks

Question Number	Acceptable Answer	Additional Guidance	Mark
2(a)	A description that makes reference to the following: • fluid refers to the movement of the phospholipids in the plane of the membrane (1) • mosaic refers to the random association of proteins (of different shapes and sizes) within the membrane (1)		**(2)**

Question Number	Acceptable Answer	Additional Guidance	Mark
2(b)(i)	An explanation that makes reference to the following: • mucus contained in membrane bound vesicles inside the cell (1) • (these vesicles) fuse with the cell membrane releasing the mucus (1)		**(2)**

Question Number	Acceptable Answer	Additional Guidance	Mark
2(b)(ii)	An explanation that makes reference to the following: • partially permeable membrane is a barrier to some solutes but not water (1) • enables a concentration gradient of { solutes / water } (1)		**(2)**

Question Number	Acceptable Answer	Additional Guidance	Mark
2(b)(iii)	A description that makes reference to the following: • increased diffusion distance / decreased surface area (1) • reduced (rate of) gas exchange (1)		**(2)**

Total for Question 2 = 8 marks

Question Number	Acceptable Answer	Additional Guidance	Mark
3(a)(i)	$2H^+ + \frac{1}{2}O_2$	Allow 'hydrogen ions', 'protons' and 'oxygen'	**(1)**

Question Number	Answer	Additional Guidance	Mark
3(a)(ii)	C (photolysis)		**(1)**

Question Number	Answer	Additional Guidance	Mark
3(a)(iii)	C (chlorophyll)		**(1)**

Question Number	Answer	Additional Guidance	Mark
3(a)(iv)	B (chloroplast stroma)		**(1)**

Question Number	Acceptable Answer	Additional Guidance	Mark
3(a)(v)	A description that makes reference to two of the following: • electron transport (1) • movement of hydrogen ions across thylakoid membrane (1) • ATP production / photophosphorylation (1)		**(2)**

Question Number	Acceptable Answer	Additional Guidance	Mark
3(b)(i)	• appropriate x and y axis values identified (1) • correct answer 4.5 (1)	Example of Calculation: (1800 − 900) ÷ 200 = 4.5 Allow full marks for correct answer with no working	**(2)**

Question Number	Acceptable Answer	Additional Guidance	Mark
3(b)(ii)	An answer that makes reference to two of the following: • maize produce more above ground dry mass for a particular amount of incident radiation (1) • maize fix more carbon for a particular leaf nitrogen concentration (1) • maize will grow in less optimum conditions so better for biofuel production (1)		**(2)**

Question Number	Acceptable Answer	Additional Guidance	Mark
3(b)(iii)	An answer that makes reference to the following: • { select / plant } a field of sugar cane (1) • sample, at suitable time intervals, using randomly placed quadrats (1) • measure light intensity (1) • harvest, dry and weigh sugar cane (1) • { monitor / record } other abiotic factors (1)		**(5)**

Total for Question 3 = 15 marks

Question Number	Acceptable Answer	Additional Guidance	Mark
4(a)	A description that makes reference to the following: • response that is effective against (wide) range of infectious agents (1) • does not involve recognition of infectious agent (1) • does not react to specific antigens (1)		**(3)**

Question Number	Acceptable Answer	Additional Guidance	Mark
4(b)(i)	• positive correlation		**(1)**

Question Number	Acceptable Answer	Additional Guidance	Mark
4(b)(ii)	• correct diameter or radius measured (1) • correct answer (1)	14 mm <u>Example of Calculation</u> $3.14 \times 7^2 = 154\ mm^2$ Allow full marks for correct answer with no working	**(2)**

Question Number	Acceptable Answer	Additional Guidance	Mark
4(c)	An explanation that makes reference to the following: • use of buffers of different pH (1) • control other variables e.g. temperature (1) • { compare / measure } diameter of clear zone (1)		**(3)**

Total for Question 4 = 9 marks

Question Number	Acceptable Answer	Additional Guidance	Mark
5(a)(i)	• species found only in one geographical location		**(1)**

Question Number	Acceptable Answer	Additional Guidance	Mark
5(a)(ii)	A description that makes reference to the following: • the variety of species (in an ecosystem / community / habitat) (1) • the variety of alleles in a { gene pool / population / species } (1)		**(2)**

Question Number	Acceptable Answer	Additional Guidance	Mark
5(a)(iii)	An explanation that makes reference to three of the following: • record the number of species of lemur and the number of individuals of each species (1) • calculate the diversity index (for each location) (1) • so the higher the index, the greater the biodiversity (1) • DNA profiling / gel electrophoresis / molecular phylogeny / proteomics (1)		**(3)**

Question Number	Acceptable Answer	Additional Guidance	Mark
5(b)	An explanation that makes reference to three of the following: • deforestation results in (geographical) isolation of the populations of Aye-ayes (1) • resulting in reduced gene flow between the populations (1) • different selection pressures leading to natural selection (1) • leading to sympatric speciation (1)		**(3)**

Total for Question 5 = 9 marks

Question Number	Acceptable Answer	Additional Guidance	Mark
6(a)	An explanation that makes reference to the following: • antibiotics target { organelles / structures / processes } found in bacteria (1) • viruses therefore unaffected by antibiotics (1)		**(2)**

Question Number	Acceptable Answer	Additional Guidance	Mark
6(b)	An explanation that makes reference to the following: • survivors will have antibodies specific to the virus in their plasma (1) • antibodies given to individuals infected with Ebola will provide passive immunity (1) • the antibodies provided will therefore { agglutinate / opsonise } the virus particles (1)		**(3)**

Question Number	Acceptable Answer	Additional Guidance	Mark
6(c)	An explanation that makes reference to the following: • vaccine stimulates immune response to make antibodies specific to viral proteins (1) • mutations in the virus nucleic acid (1) • results in a change in the shape of the viral proteins (1) • therefore antibodies can no longer bind to the virus (1)	Accept reference to antigens Ebola is an RNA virus but allow reference to mutations in DNA	**(4)**

Total for Question 6 = 9 marks

Question Number	Acceptable Answer	Additional Guidance	Mark
7(a)	A description that makes reference to the following: • a cell that can continue to divide (1) • has the potential to give rise to specialised cells (1)	Allow 'no Hayflick limit'	**(2)**

Question Number	Answer	Additional Guidance	Mark
7(b)(i)	C (significant and positive)		**(1)**

Question Number	Acceptable Answer	Additional Guidance	Mark
7(b)(ii)	An explanation that makes reference to the following: • greater number of cell divisions means more opportunities for errors in DNA replication (1) • more mutations result in greater chance of cancer (1)		**(2)**

Question Number	Acceptable Answer	Additional Guidance	Mark
7(b)(iii)	• correct risks identified (1) • correct calculation (1)	0.08 and 0.004 <u>Example of calculation:</u> 0.08 ÷ 0.004 = 20.0 Allow full marks for correct answer with no working	**(2)**

Question Number	Acceptable Answer	Additional Guidance	Mark
7(b)(iv)	An explanation that makes reference to two of the following: • cigarettes { are an environmental risk factor / contain carcinogens } (1) • that increases the number of mutations in cells (1) • resulting in uncontrolled cell division (1)	Accept description of how mutations arise	**(2)**

Total for Question 7 = 9 marks

Question Number	Acceptable Answer	Additional Guidance	Mark
8(a)(i)	net (primary) productivity = gross (primary) productivity - respiration	Allow NPP = GPP - R	**(1)**

Question Number	Acceptable Answer	Additional Guidance	Mark
8(a)(ii)	correctly plotted value	2.3 at 0 1.4 at 6 0.9 at 18	**(1)**

Question Number	Acceptable Answer	Additional Guidance	Mark
8(a)(iii)	An explanation that makes reference to three of the following: • there will be a large decrease in net productivity as depth increases (1) • (due to) large decrease in gross productivity as depth increases (1) • lower light intensity results in less photosynthesis (1) • and (only a) small decrease (in utilisation of carbon) in respiration as depth increases (1)		**(3)**

Question Number	Indicative content		
***8(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. • burning fossil fuels increases atmospheric concentrations of CO_2, a greenhouse gas leading to rising sea levels, increased surface temperatures and increased CO_2 concentration in oceans • small changes in sea level have limited effect on the crustose coralline algae • algae are adversely affected by increased carbon dioxide concentrations • there is a greater effect of increased carbon dioxide at higher temperatures • continued burning of fossil fuels may reduce productivity of crustose coralline algae • reefs will grow more slowly, become more susceptible to damage resulting in loss of habitat		
Level	Mark	Descriptor	
Level 0	Marks	No awardable content	
1	1-2	An answer 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 answer will contain basic information with some attempt made to link knowledge and understanding to the given context.	
2	3-4	An answer will be given with occasional evidence of analysis, interpretation and/or evaluation of both pieces of scientific information. The answer shows some linkages and lines of scientific reasoning with some structure.	
3	5-6	An answer 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 answer shows a well-developed and sustained line of scientific reasoning which is clear and logically structured.	

Question Number	Answer	Additional Guidance	Mark
9(a)(i)	A (K)		**(1)**

Question Number	Acceptable Answer	Additional Guidance	Mark
9(a)(ii)	C (M)		**(1)**

Question Number	Acceptable Answer	Additional Guidance	Mark
9(a)(iii)	D (N)		**(1)**

Question Number	Acceptable Answer	Additional Guidance	Mark
9(a)(iv)	• measures width on diagram (1) • correct answer (1)	<u>Example of calculation</u> (500 x width of K) ÷ length of bar = 940 nm Allow full marks for correct answer with no working	**(2)**

Question Number	Acceptable Answer	Additional Guidance	Mark
9(b)	An explanation that makes reference to four of the following: • three { polypeptide / collagen } chains tightly coiled around each other (1) • due to every third amino acid { being glycine / having a small R group } (1) • chains are held together by { hydrogen bonding / covalent cross links } (1) • flexible without stretching (due to triple helix) (1) • chains of collagen associate together to form fibrils (1) • (fibrils) have a high tensile strength (and function to support tissues) (1)		**(4)**

Question Number	Acceptable Answer	Additional Guidance	Mark
9(c)(i)	An answer that makes reference to any two of the following: • alcohol intake increases collagen synthesis (1) • combined intake has greatest effect (1) • a greater level of collagen indicates a greater amount of fibrosis (1) AND • therefore the higher the alcohol intake the greater the level of fibrosis (1)		**(3)**

Question Number	Acceptable Answer	Additional Guidance	Mark
9(c)(ii)	An explanation that makes reference to the following: • exposure to alcohol may result in { changes of methylation of DNA / modification of histones } (1) • so that the collagen gene is more likely to be { activated / expressed / transcribed } (1)	Allow reference to other correct epigenetic modifications	**(2)**

Total for Question 9 = 14 marks

<table>
<tr><th>Question Number</th><th colspan="2">Indicative content</th></tr>
<tr><td>*10</td><td colspan="2">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.

• the CVID group is more susceptible to bacterial infections
• the CVID group produces fewer antibodies to bacterial antigens
• have a reduced percentage of B cells
• have a similar ratio of T helper to T killer cells
• have a normal percentage of T lymphocytes
• can defend themselves against viruses but not bacteria
• (therefore) antiviral medication not required
• could prescribe (prophylactic) antibiotics
• could provide passive immunity by giving them antibodies / immunoglobulins</td></tr>
<tr><th>Level</th><th>Mark</th><th>Descriptor</th></tr>
<tr><td>0</td><td>0</td><td>No awardable content</td></tr>
<tr><td>1</td><td>1-2</td><td>Limited scientific judgement made with a focus on mainly just one method, with a few strengths/weaknesses identified.

A conclusion may be attempted, demonstrating isolated elements of biological knowledge and understanding but with limited evidence to support the judgement being made.</td></tr>
<tr><td>2</td><td>3-4</td><td>A scientific judgement is made through the application of relevant evidence, with strengths and weaknesses of each method identified.

A conclusion is made, demonstrating linkages to elements of biological knowledge and understanding, with occasional evidence to support the judgement being made.</td></tr>
<tr><td>3</td><td>5-6</td><td>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.</td></tr>
</table>

Total for Question 10 = 6 marks