

## Biology B Paper 1 Mark Scheme

Question Number	Acceptable Answer	Additional guidance	Mark
<b>1(a)</b>	D		<b>(1)</b>

Question Number	Acceptable Answer	Additional Guidance	Mark
<b>1(b)</b>	<p>A description that makes reference to three of the following:</p> <ul style="list-style-type: none"> <li>• compartmentalisation from stroma (1)</li> <li>• site of light-dependant reactions (1)</li> <li>• they contain {chlorophyll / photosynthetic pigments / electron carrier proteins} (1)</li> <li>• membranes increase the number of {pigments / proteins} that can be held (1)</li> <li>• contain ATP synthase / ATP synthesised (1)</li> </ul>		<b>(3)</b>

(Total for Question 1 = 4 marks)

Question Number	Answer	Additional guidance	Mark
<b>2(a)</b>	D		<b>(1)</b>

Question Number	Acceptable Answer	Additional Guidance	Mark
<b>2(b)</b>	<p>A description that makes reference to the following:</p> <ul style="list-style-type: none"> <li>• {fibroblasts / non-pluripotent cells / somatic cells} are used (1)</li> <li>• {specific / reprogramming } {genes / transcription factors / miRNAs} are put into the cells (1)</li> </ul> <p>Plus one of the following:</p> <ul style="list-style-type: none"> <li>• credit named gene, e.g. Oct4 (Pou5f1), Sox2, cMyc, or Klf4 (1)</li> <li>• using a {vector / virus} (1)</li> <li>• cells are cultured (1)</li> </ul>		<b>(3)</b>

Question Number	Acceptable Answer	Additional guidance	Mark
<b>2(c)</b>	<p>A description that makes reference to the following:</p> <ul style="list-style-type: none"> <li>• replace the dysfunctional cells with functional cells derived from iPS cells (1)</li> <li>• iPS cells are injected into the retina and then develop into normal retinal cells (1)</li> </ul>		<b>(2)</b>

(Total for Question 2 = 6 marks)

Question Number	Acceptable Answer	Additional guidance	Mark
<b>3(a)</b>	C		<b>(1)</b>

Question Number	Acceptable Answer	Additional guidance	Mark
<b>3(b)</b>	B		<b>(1)</b>

Question Number	Acceptable Answer	Additional guidance	Mark
<b>3(c)</b>	<p>An explanation that makes reference to the following:</p> <ul style="list-style-type: none"> <li>virus can {bind to / infect} cells of {throat / lung} (1)</li> <li>virus has {haemagglutinin / glycoprotein / receptors} (on its surface) (1)</li> </ul> <p>Plus two from:</p> <ul style="list-style-type: none"> <li>detail of viral replication (1)</li> <li>leads to cell {lysis / tissue} damage (1)</li> <li>immune response is triggered which results in symptoms that include {fever / headaches / fatigue / sore throat} (1)</li> </ul>		<b>(4)</b>

(Total for Question 3 = 6 marks)

Question Number	Acceptable Answer	Additional guidance	Mark
<b>4(a)(i)</b>	<ul style="list-style-type: none"> <li>length of cell = 20 (mm) (1)</li> <li>conversion into <math>\mu\text{m}</math> = <math>20000 \div 23.5</math> (1)</li> <li>magnification = 851 (1)</li> <li>[ecf applies for mp 2 and 3]</li> </ul>	Accept $\pm 1$ mm  Accept other appropriate calculation, e.g. measure in cm or converting $23.5 \mu\text{m}$ to mm or cm  Correct answer gains full marks	<b>(3)</b>

Question Number	Acceptable Answer	Additional guidance	Mark
<b>4(a)(ii)</b>	A description that makes reference to the following: <ul style="list-style-type: none"> <li>centromeres have separated (1)</li> <li>spindle fibres have {shortened / contracted} (1)</li> <li>chromatids pulled apart (1)</li> <li>chromatids have moved to opposite poles (1)</li> </ul>		<b>(4)</b>

Question Number	Acceptable Answer	Additional guidance	Mark
<b>4(b)(i)</b>	C		<b>(1)</b>

Question Number	Acceptable Answer	Additional guidance	Mark
<b>4(b)(ii)</b>	Because E is {in cytokinesis / in late telophase / dividing its cytoplasm} but G is still in {anaphase / mitosis} (1)		<b>(1)</b>

(Total for Question 4 = 9 marks)

Question Number	Acceptable Answer	Additional guidance	Mark
<b>5(a)</b>	C		<b>(1)</b>

Question Number	Acceptable Answer	Additional guidance	Mark
<b>5(b)</b>	B		<b>(1)</b>

Question Number	Acceptable Answer	Additional guidance	Mark
<b>5(c)</b>	C		<b>(1)</b>

Question Number	Acceptable Answer	Additional guidance	Mark
<b>5(d)</b>	<p>A description that makes reference to the following:</p> <ul style="list-style-type: none"> <li>• it is transported into the (matrix) mitochondria (1)</li> <li>• link reaction oxidises pyruvate to form NADH + H<sup>+</sup> (1)</li> <li>• carbon dioxide is removed (1)</li> <li>• molecule combines with acetyl CoA to form coenzyme A (1)</li> </ul>		<b>(4)</b>

(Total for Question 5 = 7 marks)

Question Number	Acceptable Answer	Additional guidance	Mark
<b>6(a)</b>	<p>A description that makes reference to the following:</p> <ul style="list-style-type: none"> <li>• bactericidal kills by affecting structure of the cell membrane/cell wall (1)</li> <li>• bacteriostatic prevents reproduction by affecting DNA replication (1)</li> </ul>		<b>(2)</b>

Question Number	Acceptable Answer	Additional guidance	Mark
<b>6(b)</b>	<p>An explanation that makes reference to the following:</p> <ul style="list-style-type: none"> <li>• there is a zone of inhibition around the penicillin disc / because penicillin only affects Gram positive bacteria (1)</li> </ul> <p>Plus two from the following points:</p> <ul style="list-style-type: none"> <li>• because it has a thick cell wall (1)</li> <li>• because penicillin interferes with formation of cross links (1)</li> <li>• during synthesis of new cell wall (1)</li> <li>• this results in bacteria being susceptible to osmotic shock (1)</li> </ul>		<b>(3)</b>

Question Number	Acceptable Answer	Additional guidance	Mark
<b>6(c)</b>	<p>An explanation that makes reference to five of the following:</p> <ul style="list-style-type: none"> <li>• the gene of interest is inserted into plasmids (1)</li> <li>• this plasmid has a marker gene for antibiotic resistance (1)</li> <li>• the recombinant bacteria will be resistant to this antibiotic (1)</li> <li>• the bacteria are grown on agar containing that antibiotic (1)</li> <li>• only the recombinant bacteria will grow (1)</li> <li>• use of replica plating to transfer recombinant bacteria to fresh medium (1)</li> </ul>		<b>(5)</b>

(Total for Question 6 = 10 marks)

Question Number	Acceptable Answer	Additional guidance	Mark
<b>7(a)</b>	$  \begin{array}{c}  \text{R} \\    \\  \text{NH}_2 - \text{C} - \text{COOH} \\    \\  \text{H}  \end{array}  $ <ul style="list-style-type: none"> <li>central carbon atom bonded to NH<sub>2</sub> and COOH group (1)</li> <li>central carbon atom bonded to R group and H atom (1)</li> </ul>	Allow opposite orientation with R group and R may be replaced with appropriate group	<b>(2)</b>

Question Number	Acceptable Answer	Additional guidance	Mark
<b>7(b)(i)</b>	UUA		<b>(1)</b>

Question Number	Acceptable Answer	Additional guidance	Mark
<b>7(b)(ii)</b>	<p>An explanation that makes reference to the following:</p> <ul style="list-style-type: none"> <li>18 bases code for six amino acids (1)</li> </ul> <p>plus any two from:</p> <ul style="list-style-type: none"> <li>because genetic code is made up of triplets of bases (1)</li> <li>because the code is degenerate, some amino acids can have more than one code (1)</li> <li>because of non-overlapping code (1)</li> </ul>		<b>(3)</b>

Question Number	Indicative content	
<b>* 7 (b) (iii)</b>	<p>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.</p> <p>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.</p> <ul style="list-style-type: none"> <li>• Frame shift effect due to addition / deletion</li> <li>• Replace amino acid due to substitution</li> <li>• No effect on amino acids due to substitution</li> <li>• Degeneracy of code due to substitution</li> <li>• Shorter due to stop codon</li> <li>• Consequence for protein structure explained</li> </ul>	
Level	Mark	Descriptor
	0	No awardable content
<b>Level 1</b>	1-2	<p>Demonstrates isolated elements of biological knowledge and understanding to the given context with generalised comments made.</p> <p>Vague statements related to consequences are made with limited linkage to a range of scientific ideas, processes, techniques and procedures.</p> <p>The discussion will contain basic information with some attempt made to link knowledge and understanding to the given context.</p>
<b>Level 2</b>	3-4	Demonstrates adequate knowledge and understanding by selecting and applying some relevant biological facts/concepts.

		<p>Consequences are discussed, which are occasionally supported through linkage to a range of scientific ideas, processes, techniques and procedures.</p> <p>The discussion shows some linkages and lines of scientific reasoning with some structure.</p>
<b>Level 3</b>	5-6	<p>Demonstrates comprehensive knowledge and understanding by selecting and applying relevant knowledge of biological facts/concepts.</p> <p>Consequences are discussed, which are supported throughout by sustained linkage to a range of scientific ideas, processes, techniques or procedures.</p> <p>The discussion shows a well-developed and sustained line of scientific reasoning which is clear and logically structured.</p>

(Total for Question 7 = 12 marks)

Question Number	Acceptable Answer	Additional guidance	Mark
<b>8(a)</b>	B		<b>(1)</b>

Question Number	Indicative content
<b>*8(b)</b>	<p>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.</p> <p>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.</p> <ul style="list-style-type: none"> <li>• Dilution plating takes longer to obtain a result but optical methods are quicker</li> <li>• Because incubation period needed for dilution plating</li> <li>• Because need to do serial dilutions to find correct concentration for dilution plating</li> <li>• Dilution plating counts living cells but optical methods measure living and dead cells</li> <li>• Dilution plating gives direct count but optical methods give turbidity reading</li> <li>• To calculate original concentration of bacterial cells, the volume of diluted suspension added to each agar plate needs to be known / optical methods require use of calibration curves</li> <li>• Dilution plating requires easily available apparatus but optical methods require colorimeter / spectrophotometer</li> <li>• Dilution plating has risk of error if colonies run into each other but optical methods produce error if tube not shaken</li> </ul>

Level	Mark	Descriptor
	0	No awardable content
<b>Level 1</b>	1-2	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.
<b>Level 2</b>	3-4	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.
<b>Level 3</b>	5-6	A scientific judgement is made that 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.

Question Number	Acceptable Answer	Additional Guidance	Mark
<b>8(c)</b>	<ul style="list-style-type: none"> <li>• <math>\log_{10} N_t = 8</math> and <math>\log_{10} N_o = 2</math> (1)</li> <li>• <math>\log_{10} N_t - \log_{10} N_o = 6</math> (1)</li> <li>• <math>t = 9</math> (1)</li> <li>• <math>k = 2.215</math> (1)</li> </ul> <p>[ecf applies for mps 2, 3 and 4]</p>	Correct answer gains full marks with no working	<b>(4)</b>

(Total for Question 8 = 11 marks)

Question Number	Acceptable Answer	Additional guidance	Mark
<b>9(a)</b>	$(10^6 - 10^2) \div 10^2$ x 100 (1)  999900 % (1)	Correct answer gains full marks with no working	<b>(2)</b>

Question Number	Acceptable Answer	Additional guidance	Mark
<b>9(b)</b>	<p>An explanation that makes reference to the following:</p> <ul style="list-style-type: none"> <li>• overall the T helper cell count falls from {week 0 / initial HIV infection} and the amount of viral RNA increases (1)</li> <li>• between week 6 and week 12 the amount of viral RNA falls, therefore the T helper cell count increases (1)</li> </ul> <p>plus any three of the following:</p> <ul style="list-style-type: none"> <li>• virus attaches to (CD4) surface receptors (1)</li> <li>• virus genetic material / RNA enters T helper cell (1)</li> <li>• virus genetic material produces virus proteins / new virus particles (1)</li> <li>• T helper cells lyse (1)</li> <li>• T killer cells attack infected T helper cells / phagocytosis by macrophages (1)</li> </ul>		<b>(5)</b>

Question Number	Acceptable Answer	Additional guidance	Mark
<b>9(c)(i)</b>	B		<b>(1)</b>

Question Number	Acceptable Answer	Additional guidance	Mark
<b>9(c)(ii)</b>	<p>A description that makes reference to the following:</p> <ul style="list-style-type: none"> <li>DNA polymerase to join nucleotides / bases / formation of phosphodiester bonds (1)</li> <li>ligase to join DNA sections (1)</li> </ul>		<b>(2)</b>

Question Number	Acceptable Answer	Additional guidance	Mark
<b>9(d)</b>	<p>An explanation that makes reference to the following:</p> <ul style="list-style-type: none"> <li>HIV mutates (1)</li> <li>resistance to one drug but not to {all / others} (1)</li> </ul>		<b>(2)</b>

(Total for Question 9 = 12 marks)

Question Number	Acceptable Answer	Additional guidance	Mark
<b>10(a)</b>	<p>An explanation that makes reference to the following:</p> <ul style="list-style-type: none"> <li>light (intensity) will not be a limiting factor (1)</li> <li>therefore carbon dioxide (concentration) is (only) limiting factor (1)</li> <li>so the effect of carbon dioxide concentration can be seen (1)</li> </ul>	<p>Accept:</p> <p>{ATP / NADPH / eq} produced during light dependent reactions</p>	<b>(3)</b>

Question Number	Acceptable Answer	Additional guidance	Mark
<b>10(b)(i)</b>	<p>An explanation that makes reference to four of the following:</p> <ul style="list-style-type: none"> <li>reducing the carbon dioxide concentration causes the RuBP to increase (1)</li> <li>(at higher carbon dioxide concentration) RuBP is low because it is converted to carbohydrate / used to fix carbon dioxide (1)</li> <li>RuBP rises because being regenerated / eq (1)</li> <li>RuBP falls as being used to {fix / eq} carbon dioxide (1)</li> <li>RuBP level remains constant once (new) equilibrium reached (1)</li> </ul>	<p>Accept correct manipulation of figures</p> <p>Correct answer gains full marks</p>	<b>(4)</b>

Question Number	Acceptable Answer	Additional guidance	Mark
<b>10(b)(ii)</b>	<p>An explanation that makes reference to the following:</p> <ul style="list-style-type: none"> <li>the rate of GP production falls for 150 s after carbon dioxide decreased (1)</li> <li>drops because less carbon dioxide available to convert into GP / less carbon fixation / carbon dioxide is limiting / eq (1)</li> <li>levels out at a lower level as carbon dioxide still available but at lower level (1)</li> </ul>	<p>Accept correct manipulation of figures</p> <p>Accept sophisticated answers based on reduction of photosynthesis</p>	<b>(3)</b>

Question Number	Acceptable Answer	Additional guidance	Mark
<b>10(c)</b>	<p>An explanation that makes reference to the following:</p> <ul style="list-style-type: none"> <li>RuBP concentration would be lower (1)</li> <li>because low temperature reduces activity of {RUBISCO / Calvin cycle} (1)</li> <li>because there is less carbon dioxide fixation / less GP or GALP available to regenerate RuBP (1)</li> </ul>	Accept sophisticated answers based on an initial increase in RuBP concentration	<b>(3)</b>

(Total for Question 10 = 13 marks)