

Question	Answers	Extra information	Mark	AO / Specification reference
01.1	any <b>four</b> from: <ul style="list-style-type: none"> <li>• first select plants that produce a high yield of tomatoes, and that produce sweet tomato fruits</li> <li>• cross-pollinate the plants / breed plants</li> <li>• use the seeds from the fruits of the plants produced to grow new plants</li> <li>• select again from these plants to further select for high-yielding plants with sweet-tasting tomatoes</li> <li>• continue over several generations</li> </ul>		4	AO2 4.6.2.3
01.2	any <b>two</b> from: <ul style="list-style-type: none"> <li>• crops all have similar characteristics, so customers will return for more (known) product</li> <li>• greater mass of tomatoes produced so more profit</li> <li>• more fruit produced per plant means less land required to produce same number of tomatoes</li> <li>• sweeter tomatoes more in demand so higher price can be charged</li> </ul>	to award 4 marks, answers should include two suggestions with linked reasons  do not accept simply 'higher yield' accept other reasonable suggestion with linked reasoning for two marks	4	AO3 4.6.2.3
01.3	disease resistance / pest resistance because a natural resistance would be required as no use of fungicides / pesticides / artificial chemicals will be permitted		1 1	AO3 4.6.2.3

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<b>02.1</b>	x-axis: height (cm – (as categories, e.g. 120 139 – with linear scale	ignore any best fit line added award 2 marks for all bars correct, 1 mark for 3 bars correct	1	AO2 4.6.2.1 MS 2c, 4a, 4c
	bar chart drawn		1	
	all bars plotted to $\pm 1$ mm tolerance		2	
<b>02.2</b>	genetic and environmental for a person to reach their potential (inherited) height, they must eat an appropriate diet		1 1	AO2 4.6.2.1
<b>02.3</b>	midpoints 110, 130, 150, 170, 190		1	AO2 4.6.2.1 MS 2b, 2f
	midpoint $\times$ number of students: 1320, 2340, 5400, 3740, 1140		1	
	mean = $\frac{13940}{94}$ = 148 cm		1	
<b>02.4</b>	agree – shape approximately corresponds to expected normal (population) distribution		1	AO3 4.6.2.1
	<b>or</b> disagree – actual heights are lower than those for the whole population		1	

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03.1	<p><b>Height</b> – mostly genetic / little effect due to environment  <b>Reason:</b> little variation between identical twins (same genes) brought up in same and in different environments / large difference between non-identical twins (different genes) in same environment</p> <p><b>Mass</b> – no conclusion can be formed / equally affected by genes and environment  <b>Reason:</b> large variation between identical twins (same genes) in different environment <u>and</u> large variation between non-identical twins (different genes) in same environment</p> <p><b>IQ</b> – mostly environment / little difference due to genes  <b>Reason:</b> little variation between identical twins (same genes) in same environment / little difference between non-identical twins (different genes) in same environment <u>and</u> large difference in identical twins (same genes) brought up in different environment</p>		1 1  1 1  1 1	AO2 4.6.2.1
03.2	<p>use a larger sample size</p> <p>include other groups who would share the same characteristics, e.g. triplets (same genes), siblings (same environment)</p>		1 1	AO3 4.6.2.1

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04.1	new genes introduced / DNA modified to give desired traits		1 1	AO1 4.6.2.4
04.2	C→E→D→A→B	award 3 marks for 3 correct 2 marks for 2 correct 1 mark for 1 correct	4	AO1 4.6.2.4
04.3	any <b>one</b> from: <ul style="list-style-type: none"> <li>quicker (than selective breeding) / only takes one generation</li> <li>can be sure of trait becoming present in crop</li> </ul>		1	AO2 4.6.2.4
05.1	<b>Selection:</b> <ul style="list-style-type: none"> <li>higher milk yield / better quality milk / bigger body mass / more meat / better quality meat</li> </ul> <b>Breeding process</b> – any <b>three</b> from: <ul style="list-style-type: none"> <li>(cattle) with desired characteristics mated / bred</li> <li>offspring with desired traits selected</li> <li>bred / mated again</li> <li>repeated over many generations</li> </ul>		1  3	AO2 4.6.2.3

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05.2	any <b>four</b> from: for: <ul style="list-style-type: none"> <li>• increased yield</li> <li>• reduced use of pesticides / fungicides / artificial chemicals</li> <li>• no known negative health effects on humans</li> </ul> against: <ul style="list-style-type: none"> <li>• genes may end up in / affect non-targeted organisms</li> <li>• unknown long-term human health effects</li> <li>• genes may mutate with unknown effects</li> </ul>	accept other reasonable arguments for or against GM crops  allow no more than three reasons for or three reasons against genetic engineering	4	AO3 4.6.2.4
06.1	reduces blood glucose / sugar levels by causing glucose to move into the cells / to be converted into glycogen		1 1	AO1 4.5.3.2

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06.2	any <b>six</b> from: <ul style="list-style-type: none"> <li>• insulin gene identified / located / isolated</li> <li>• cut out using enzymes</li> <li>• plasmid ring cut using enzyme</li> <li>• gene inserted into plasmid</li> <li>• plasmid put into bacteria</li> <li>• bacteria reproduce</li> <li>• insulin gene switched on</li> <li>• insulin harvested</li> </ul>		6	AO2 4.6.2.4
06.3	any <b>two</b> from: <ul style="list-style-type: none"> <li>• pigs do not need to be killed</li> <li>• bacteria require far less space to culture</li> <li>• large quantities can be produced, more quickly</li> <li>• lower cost</li> <li>• ethical / religious reasons</li> </ul>	accept any other reasonable suggestions	2	AO3 4.6.2.4
07.1	74		1	AO2 4.6.2.1 MS 2b, 2f
07.2	(±) 10 cm <sup>2</sup>	award 1 mark for calculation of range = 20	2	AO2 4.6.2.1

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07.3	<p>only looked at samples from two locations</p> <p>rule for these plants may not apply to other plants</p> <p>uncertainty of shaded leaf surface area was larger than the difference between the results</p> <p>so the true value for shaded leaves may be smaller than for unshaded leaves</p>		<p>1</p> <p>1</p> <p>1</p> <p>1</p>	<p>AO2</p> <p>4.6.2.1</p> <p>MS 2d</p>
07.4	<p>any <b>one</b> from:</p> <ul style="list-style-type: none"> <li>convert complex shape into approximate simple shapes, e.g. rectangles and triangles – measure and calculate surface area of these shapes</li> <li>measure mass of leaves. assume same thickness, mass will be proportional to surface area</li> </ul>	accept other reasonable suggestion	1	<p>AO3</p> <p>4.6.2.1</p>
08.1	enzyme		1	<p>AO2</p> <p>4.6.2.4</p>

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08.2	<p>any six from:</p> <p><b>advantages:</b></p> <ul style="list-style-type: none"><li>• enables previously incurable disorders to be cured</li><li>• only requires single procedure (versus on-going management / treatment)</li><li>• offers the potential for no side effects / no on-going drug treatments</li></ul> <p><b>disadvantages:</b></p> <ul style="list-style-type: none"><li>• injection of a vector / bacteria / virus may cause infection / side effects</li><li>• gene therapy may cause cancer / uncontrolled cell growth</li><li>• some people have religious objections to altering genes</li><li>• high cost may make treatments only available to the wealthy</li><li>• long-term effects on the patient are unknown</li></ul>		6	AO3 4.6.2.4



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09.1	any <b>two</b> from: <ul style="list-style-type: none"> <li>longer growing season</li> <li>energy saved not heating a greenhouse</li> <li>money saved not heating a greenhouse</li> <li>greater variety of locations in which the tomatoes can be grown</li> </ul>	accept any other reasonable suggestions	2	AO3 4.6.2.4
09.2	any <b>six</b> from: <ul style="list-style-type: none"> <li>gene that codes for antifreeze chemical located</li> <li>cut out using an enzyme</li> <li>placed into a vector</li> <li>vector is a bacterium or a virus</li> <li>plant infected with vector</li> <li>transfers gene into tomato plant</li> <li>at an early stage of development</li> <li>tomato plants produced have frost-resistant properties</li> </ul>		6	AO2 4.6.2.4
10.1	differences in the characteristics of individuals within a population		1	AO1 4.6.2.1
10.2	fur colour / eye colour / number of spots		1	AO2 4.6.2.1

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10.3	Size / height / body mass cruipies have the potential to grow to a certain size, but their size is also affected by how much they eat		1 1	AO2 4.6.2.1
10.4	paused likelihood of genetically inherited disorders / defects / health problems / reduction in genetic diversity / increased chance of inbreeding		1	AO1 4.6.2.3
11.1	the process by which humans breed plants and animals for particular genetic characteristics		1	AO1 4.6.2.3
11.2	selective breeding decreases variation in a population		1	AO1 4.6.2.3
11.3	bigger grains / seeds		1	AO2 4.6.2.3
11.4	plants with larger grains selected cross-pollinated / bred seeds collected and offspring grown process repeated over many generations		1 1 1 1	AO2 4.6.2.3

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12.1	any six from: <b>Light microscope</b> <b>Advantages</b> <ul style="list-style-type: none"> <li>• cheap to buy and operate</li> <li>• small and portable</li> <li>• simple to prepare a sample</li> <li>• natural colour of sample can be seen</li> <li>• specimens can be living or dead</li> </ul> <b>Disadvantages</b> <ul style="list-style-type: none"> <li>• (relatively) low resolution</li> <li>• if staining used, natural colour cannot be seen</li> </ul> <b>Electron microscope</b> <b>Advantages</b> <ul style="list-style-type: none"> <li>• (very) high resolution</li> <li>• false colour can be added to image</li> </ul> <b>Disadvantages</b> <ul style="list-style-type: none"> <li>• expensive to buy and operate</li> <li>• requires high degree of skill to operate</li> <li>• very large and difficult to move</li> <li>• complex sample preparation</li> <li>• only black and white images produced</li> <li>• specimens being viewed must be dead</li> </ul>	to award 6 marks, answers should include at least one advantage and one disadvantage for both electron microscopes and light microscopes	6	AO1 4.1.1.5

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12.2	bacterial cell		1	AO1 4.1.1.1
12.3	small rings of DNA which code for a particular characteristic		1 1	AO1 4.1.1.1
12.4	$\frac{7 \times 10^{-7}}{5 \times 10^{-9}}$ = 140× greater	accept correct answer with no working shown	1 1	AO2 4.1.1.1