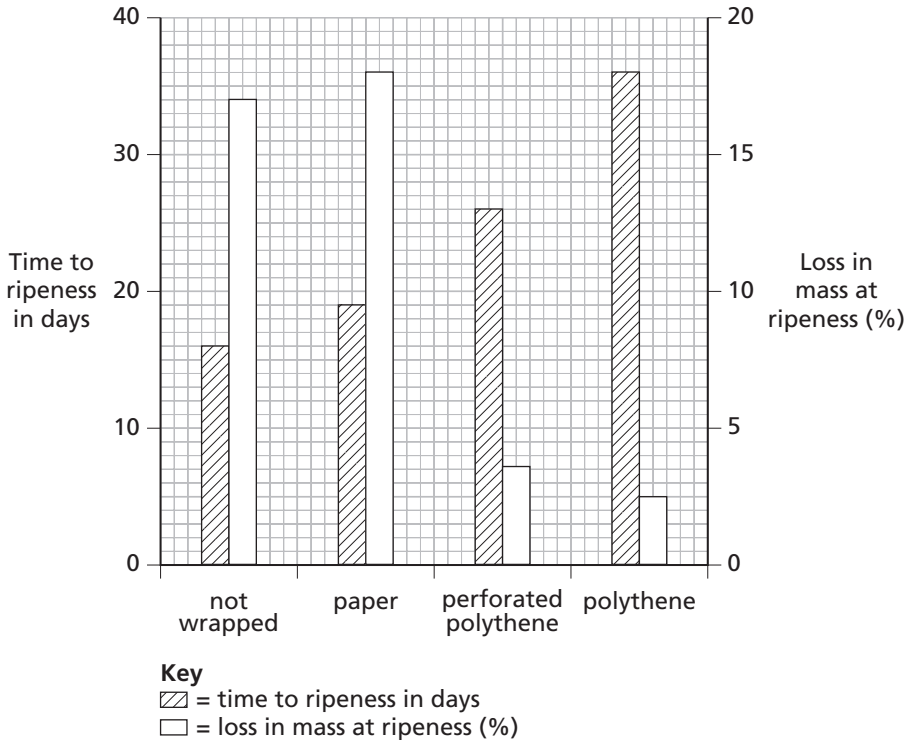


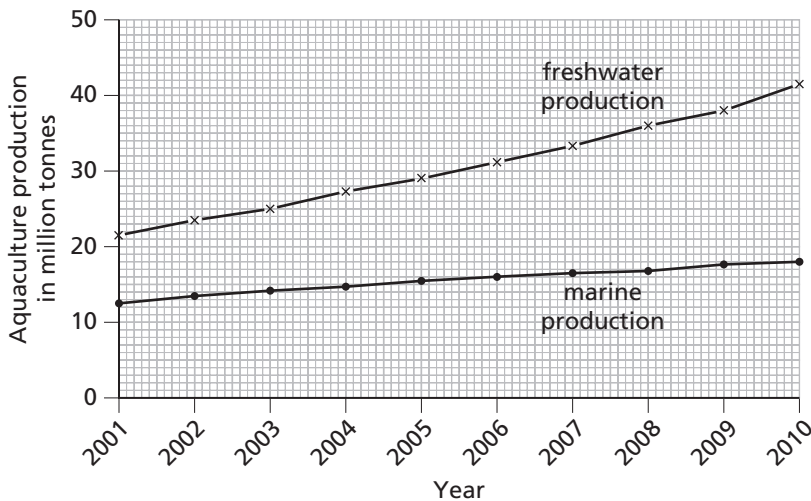
## 7 Use of biological resources

### Using and interpreting data

Question	Mark scheme	Marks
1 a) i)	<ul style="list-style-type: none"> <li>• (dry mass) 359 mg</li> <li>• (nitrogen concentration) 112 (arbitrary units)</li> </ul>	2
ii)	<ul style="list-style-type: none"> <li>• both show increase in dry mass as concentration of nitrogen increases / eq</li> <li>• to max at 112 nitrogen (arbitrary units) / eq</li> <li>• whole plant dry mass remains about the same <i>OR</i> slightly less for higher concentrations of nitrogen / eq</li> <li>• dry mass of roots less at highest concentrations of nitrogen / eq</li> <li>• use of figures to support any statements</li> <li>• eq</li> </ul>	3
b) i)	<ul style="list-style-type: none"> <li>• (dry mass) for whole plant = 359 (mg), (dry mass) for roots = 217 (mg)</li> <li>• so dry mass for leaves = <math>359 - 217 = 142</math> (mg)</li> <li>• % dry mass of leaves = <math>(142 \div 359) \times 100 = 39.5\%</math></li> </ul> <p><i>(correct answer gets 3 marks if no working shown)</i></p>	3
ii)	<ul style="list-style-type: none"> <li>• small plants have high proportion of material in the leaves / eq</li> <li>• (some) larger plants have smaller proportion of material in the leaves / eq</li> <li>• lowest proportion in leaves at nitrogen concentrations 56 (and 112) / eq</li> <li>• at highest nitrogen concentrations, different pattern / ref figures / description / eq</li> <li>• use of figures to support any statements</li> <li>• eq</li> </ul>	2
c)	<ul style="list-style-type: none"> <li>• check amount of N fertiliser being used / eq</li> <li>• higher N concentrations don't necessarily increase the yield of the radish / root / eq</li> <li>• eq</li> </ul>	2
<b>Total</b>		<b>12</b>

Question	Mark scheme	Marks															
2 a) i)	<ul style="list-style-type: none"> <li>• S1 = label 'Time to ripeness in days' + suitable linear scale</li> <li>• S2 = label 'Loss in mass at ripeness (%)' + suitable linear scale</li> <li>• P1 = correct plots + bars for ripeness data</li> <li>• P2 = correct plots + bars for loss in mass data</li> <li>• K = key / bars labelled</li> </ul>  <p><b>Time to ripeness in days</b></p> <p><b>Loss in mass at ripeness (%)</b></p> <p><b>Key</b>        ▨ = time to ripeness in days        □ = loss in mass at ripeness (%)</p> <table border="1"> <caption>Data from Bar Chart</caption> <thead> <tr> <th>Packaging Type</th> <th>Time to ripeness in days (hatched bars)</th> <th>Loss in mass at ripeness (%) (white bars)</th> </tr> </thead> <tbody> <tr> <td>not wrapped</td> <td>16</td> <td>18</td> </tr> <tr> <td>paper</td> <td>19</td> <td>19</td> </tr> <tr> <td>perforated polythene</td> <td>14</td> <td>7</td> </tr> <tr> <td>polythene</td> <td>18</td> <td>5</td> </tr> </tbody> </table>	Packaging Type	Time to ripeness in days (hatched bars)	Loss in mass at ripeness (%) (white bars)	not wrapped	16	18	paper	19	19	perforated polythene	14	7	polythene	18	5	6
Packaging Type	Time to ripeness in days (hatched bars)	Loss in mass at ripeness (%) (white bars)															
not wrapped	16	18															
paper	19	19															
perforated polythene	14	7															
polythene	18	5															
ii)	<ul style="list-style-type: none"> <li>• use of packaging delays ripening / eq</li> <li>• example(s) quoted (e.g. polythene more effective than perforated polythene / polythene twice as effective compared with paper / eq)</li> </ul> <p><i>(allow 2 marks for two examples and credit for quoting figures)</i></p>	2															
b) i)	<ul style="list-style-type: none"> <li>• respiration + loss CO<sub>2</sub></li> <li>• transpiration / evaporation + loss water</li> </ul>	2															
ii)	<ul style="list-style-type: none"> <li>• paper</li> <li>• porous / eq so gases / water / CO<sub>2</sub> pass through / eq <i>(accept converse related to other materials)</i></li> </ul>	2															
c)	<ul style="list-style-type: none"> <li>• microorganisms / bacteria / fungi / eq cause decay / decomposition</li> <li>• disease (e.g. microbes / eq already in fruit)</li> <li>• bruising / mechanical damage / eq</li> <li>• changes in fruit giving unpleasant flavours / eq</li> <li>• eq</li> </ul>	2															
d)	use polythene (bags) / eq	1															
<b>Total</b>		<b>15</b>															

Question	Mark scheme	Marks
<b>3 a) i)</b>	<ul style="list-style-type: none"> <li>• (pH) 4.5</li> </ul>	1
<b>ii)</b>	<ul style="list-style-type: none"> <li>• sample A = 1.8</li> <li>• sample B = 3.4 / 3.5</li> <li>• difference = 1.6 / 1.7 (arbitrary units) (<i>expect units once</i>)</li> </ul>	3
<b>b) i)</b>	<ul style="list-style-type: none"> <li>• fall in pH matches rise in lactic acid / eq</li> <li>• in both graphs / eq</li> <li>• quote figures for days, shape curves / eq</li> </ul>	2
<b>ii)</b>	<ul style="list-style-type: none"> <li>• coagulates / goes solid / thickens / ref protein / eq</li> </ul>	1
<b>c)</b>	<ul style="list-style-type: none"> <li>• preserves 'milk' for longer time / eq</li> <li>• people like the taste / eq</li> <li>• more digestible than milk / eq</li> <li>• eq</li> </ul>	2
<b>d) i)</b>	<ul style="list-style-type: none"> <li>• some bacteria occur naturally on the grass / eq</li> </ul>	1
<b>ii)</b>	<ul style="list-style-type: none"> <li>• longer time in the day for photosynthesis / eq</li> <li>• more sugars present</li> <li>• faster fermentation / eq</li> </ul>	2
<b>Total</b>		<b>12</b>

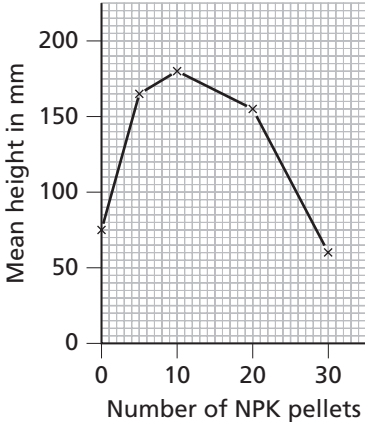
Question	Mark scheme	Marks																																	
4 a)	<ul style="list-style-type: none"> <li>increase (from 2001 to 2010) / ref figures (to support / illustrate increase) / eq</li> </ul>	1																																	
b) i)	<ul style="list-style-type: none"> <li>S = scale linear + half grid in one direction</li> <li>L = lines straight and joining points</li> <li>A1 = axes correct way round</li> <li>A2 = axes labelled ('year' and 'mass produced in millions of tonnes')</li> <li>P = points plotted accurately</li> <li>K = key</li> </ul>  <table border="1"> <caption>Data for Aquaculture Production (2001-2010)</caption> <thead> <tr> <th>Year</th> <th>Freshwater production (million tonnes)</th> <th>Marine production (million tonnes)</th> </tr> </thead> <tbody> <tr><td>2001</td><td>21.7</td><td>12.5</td></tr> <tr><td>2002</td><td>23.5</td><td>13.5</td></tr> <tr><td>2003</td><td>25.0</td><td>14.0</td></tr> <tr><td>2004</td><td>27.0</td><td>14.5</td></tr> <tr><td>2005</td><td>29.0</td><td>15.0</td></tr> <tr><td>2006</td><td>31.0</td><td>15.5</td></tr> <tr><td>2007</td><td>33.0</td><td>16.0</td></tr> <tr><td>2008</td><td>35.5</td><td>16.5</td></tr> <tr><td>2009</td><td>38.0</td><td>17.0</td></tr> <tr><td>2010</td><td>41.7</td><td>17.9</td></tr> </tbody> </table>	Year	Freshwater production (million tonnes)	Marine production (million tonnes)	2001	21.7	12.5	2002	23.5	13.5	2003	25.0	14.0	2004	27.0	14.5	2005	29.0	15.0	2006	31.0	15.5	2007	33.0	16.0	2008	35.5	16.5	2009	38.0	17.0	2010	41.7	17.9	6
Year	Freshwater production (million tonnes)	Marine production (million tonnes)																																	
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2009	38.0	17.0																																	
2010	41.7	17.9																																	
ii)	<ul style="list-style-type: none"> <li><math>(41.7 \div 59.9) \times 100</math></li> <li>69.6 (%)</li> <li>(69.6 = 2 marks without working)</li> </ul>	2																																	
iii)	<p>total (from figures in table) or plotted curves</p> <ul style="list-style-type: none"> <li>increase in (world) population so increased demand for food / eq</li> <li>more people like / can afford to eat fish / eq</li> </ul> <p>freshwater compared with marine</p> <ul style="list-style-type: none"> <li>more increase in freshwater (compared with marine) because can locate freshwater farms near population / other similar idea</li> <li>people prefer freshwater fish / cheaper to set up / ref equipment / eq</li> <li>eq</li> </ul>	2																																	
c) i)	<ul style="list-style-type: none"> <li>conservation wild stocks / eq</li> <li>can produce locally (e.g. reduce transport costs) / eq</li> <li>small-scale production possible / eq</li> <li>can produce fish in areas far from the sea / eq</li> <li>continuous supply / eq</li> <li>hazards of sea fishing (e.g. weather / equipment required) / eq</li> <li>eq</li> </ul>	2																																	
ii)	<ul style="list-style-type: none"> <li>pollution (e.g. from excess feed / excreta)</li> <li>escaped fish mix / compete with local species / eq</li> <li>ref impact of fish farm sites (e.g. aesthetic considerations / demand on local resources such as water supply)</li> <li>eq</li> </ul>	2																																	
<b>Total</b>		<b>15</b>																																	

## Practical activities

Question	Mark scheme	Marks
<b>1 a) i)</b>	<ul style="list-style-type: none"> <li>carbon dioxide</li> <li>from (aerobic) respiration</li> </ul>	2
<b>ii)</b>	<ul style="list-style-type: none"> <li>use ruler / scale / graph paper / eq</li> <li>read level of liquid surface + top level of foam / eq</li> </ul>	2
<b>b) i)</b>	<ul style="list-style-type: none"> <li>axes correct way round (temperature horizontal axis, height vertical axis)</li> <li>(vertical) scale linear + correct label with units (height in mm)</li> <li>(horizontal) scale linear + correct label with units (temperature in °C)</li> </ul>	3
<b>ii)</b>	<ul style="list-style-type: none"> <li>inaccuracies in measuring height of foam (described) (e.g. uncertainty in seeing lower level inside the tube / difficult to hold the scale steady) / eq</li> <li>variability in results (closer for low and high temperatures, quite big differences for mid-range temperatures)</li> <li>anomalous result (e.g. tube 1, 50°C) / eq</li> <li>big jump from 30 to 40°C / big jump from 60 to 70°C</li> <li>eq</li> </ul>	2
<b>iii)</b>	<ul style="list-style-type: none"> <li>descriptions of suggestions for improvement in accuracy in making measurement (e.g. support for ruler to hold it steady / eye on same level as liquid surfaces)</li> <li>use gas syringe / collect gas over water / eq</li> <li>more tubes at each temperature to increase reliability / eq</li> <li>calculate mean of results before plotting</li> <li>use water baths with intermediate temperatures (anywhere across the range shown but particularly at 35°C and 65°C)</li> <li>eq</li> </ul>	2
<b>c)</b>	<ul style="list-style-type: none"> <li>rate of respiration / eq (in yeast) slower at lower temperatures / below 40°C (or a bit lower)</li> <li>rate of respiration / eq (in yeast) faster as temperature increases (e.g. up to 60°C) / eq</li> <li>rate of respiration / eq (in yeast) slower at higher temperatures / above 60°C / enzymes denatured / eq</li> <li>optimum temperature (around) 50°C</li> <li>ref effect of temperature on enzymes</li> </ul>	2
<b>Total</b>		<b>13</b>

Question	Mark scheme	Marks
<b>2 a) i)</b>	<ul style="list-style-type: none"> <li>two columns + headings / alternatively may include additional column for months <i>OR</i> dates / eq</li> <li>suitable headings for columns (yield in kg, in polytunnel, out in field) / time harvested / eq</li> <li>correct figures in each column <math>\times 2 = 2</math> marks</li> </ul>	4
<b>ii)</b>	<ul style="list-style-type: none"> <li>54.3 kg (in polytunnel)</li> <li>31.3 kg (outside in field)</li> </ul>	2
<b>b) i)</b>	<ul style="list-style-type: none"> <li>0.313 kg</li> </ul>	1
<b>ii)</b>	<ul style="list-style-type: none"> <li>higher yield (per metre of row) in polytunnel</li> <li>higher temperature / greenhouse effect / eq</li> <li>more photosynthesis / eq</li> <li>faster growth / eq</li> <li>suitable ref artificial conditions / eq</li> </ul>	2
<b>c)</b>	<ul style="list-style-type: none"> <li>inside start = 10 June, finish = 28 August</li> <li>outside start = 10 July, finish = 14 September</li> <li>(accept two correct start dates <i>OR</i> two correct finish dates for 1 mark)</li> </ul>	2
<b>d) i)</b>	<ul style="list-style-type: none"> <li>higher yield / eq</li> <li>early crops / eq</li> <li>longer growing season / eq</li> <li>can apply effective pest control / eq</li> <li>eq</li> </ul>	2
<b>ii)</b>	<ul style="list-style-type: none"> <li>extended season (for sale of crop) / eq</li> <li>may not need to irrigate outside (essential in polytunnel) / other feature related to growing / eq</li> <li>less cost for equipment / eq</li> <li>eq</li> </ul>	1
<b>Total</b>		<b>14</b>

Question	Mark scheme	Marks
<b>3 a) i)</b>	<ul style="list-style-type: none"> <li>• dip forceps (step 2) + smaller pieces in tube (step 5) + in agar (step 6)</li> </ul>	1
<b>ii)</b>	<ul style="list-style-type: none"> <li>• prevent contamination</li> <li>• by fungi / bacteria / microorganisms / eq</li> <li>• spoilage / damage to growing material / eq</li> </ul>	2
<b>b) i)</b>	<ul style="list-style-type: none"> <li>• explant(s)</li> </ul>	1
<b>ii)</b>	<ul style="list-style-type: none"> <li>• provide energy / for respiration / eq</li> </ul>	1
<b>iii)</b>	<ul style="list-style-type: none"> <li>• (growing plant) can carry out photosynthesis</li> <li>• when green / chlorophyll develops</li> <li>• provides source of energy / sugars / carbohydrate / for respiration / eq</li> <li>• sugar provided in agar at start gets used up / eq</li> </ul>	2
<b>c) i)</b>	<ul style="list-style-type: none"> <li>• prevent loss of species / eq</li> <li>• scientific value / eq</li> <li>• potential value of plants for products / eq</li> <li>• examples / eq</li> </ul>	2
<b>ii)</b>	<ul style="list-style-type: none"> <li>• small amount of material can produce many 'offspring' / eq</li> <li>• can be grown on to mature / adult plants</li> <li>• genetically identical to parent material</li> <li>• short time scale (to produce large numbers) / eq</li> <li>• eq</li> </ul>	2
<b>iii)</b>	<ul style="list-style-type: none"> <li>• no need to dig up / remove plant from natural habitat</li> <li>• only small part of plant need be used / minimal disturbance / eq</li> <li>• no need to re-establish plant in laboratory / eq</li> <li>• simple equipment can be used with limited experience / training</li> <li>• eq</li> </ul>	2
<b>Total</b>		<b>13</b>

Question	Mark scheme	Marks												
4 a) i)	<ul style="list-style-type: none"><li>• 5 treatments (i.e. different numbers of fertiliser pellets)</li><li>• 10 (seeds) × 10 (compartments) = 100</li><li>• total = 500</li></ul> <p>(500 with no working = 2 marks) (accept other stages for working)</p>	2												
ii)	<ul style="list-style-type: none"><li>• (increase) reliability</li></ul>	1												
iii)	<ul style="list-style-type: none"><li>• reduce effect of anomalous results / eq</li><li>• reduce effect of variation between seeds / different heights in seedlings / eq</li><li>• eq</li></ul>	2												
b)	<ul style="list-style-type: none"><li>• S = scale linear + at least half grid in one direction</li><li>• L = lines, straight joining points</li><li>• A1 = axes correct way round</li><li>• A2 = axes labelled correctly, including units</li><li>• P = points plotted accurately</li></ul>  <table border="1"><caption>Data points from the graph</caption><thead><tr><th>Number of NPK pellets</th><th>Mean height in mm</th></tr></thead><tbody><tr><td>0</td><td>75</td></tr><tr><td>5</td><td>165</td></tr><tr><td>10</td><td>180</td></tr><tr><td>20</td><td>155</td></tr><tr><td>30</td><td>60</td></tr></tbody></table>	Number of NPK pellets	Mean height in mm	0	75	5	165	10	180	20	155	30	60	5
Number of NPK pellets	Mean height in mm													
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5	165													
10	180													
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30	60													
c) i)	<ul style="list-style-type: none"><li>• temperature</li><li>• light (e.g. intensity / direction)</li><li>• water levels (in trays)</li><li>• eq</li></ul>	2												
ii)	<ul style="list-style-type: none"><li>• inaccuracies in methods used for measuring height of seedlings / eq</li><li>• difficulties in measuring individual seedlings / eq</li><li>• water used to top up trays may have contained some nutrient / eq</li><li>• pellets may be different sizes / contain different quantities of fertiliser / eq</li><li>• eq</li></ul>	2												
d)	<ul style="list-style-type: none"><li>• some increase in yield expected from adding fertiliser / eq</li><li>• need to check suitable quantity of fertiliser to add (as excess may not increase yield) / eq</li><li>• eq</li></ul>	2												
Total		16												

## Understanding structure, function and processes

Question	Mark scheme	Marks																
1 a)	<table><tr><th>Stage</th><th>Statement (letter or words)</th></tr><tr><td>1</td><td>A (select a variety of strawberry that produces fruits with a lot of juice – call this a 'juicy' strawberry)</td></tr><tr><td>2</td><td>C (when the strawberry plants are beginning to flower [on a juicy strawberry plant], before they open, enclose the flowers in a thin pollen-proof cloth bag)</td></tr><tr><td>3</td><td>B (transfer pollen from the flower on one juicy strawberry plant to the stigma of a flower on another juicy strawberry plant ['pollination by hand'])</td></tr><tr><td>4</td><td>E (collect the strawberry fruits from the strawberry plants that are pollinated by hand and check that they are juicy)</td></tr><tr><td>5</td><td>F (select the juiciest strawberry fruits from the plants that are pollinated by hand)</td></tr><tr><td>6</td><td>D (grow the seeds ['pips'] from the juiciest strawberry fruits and wait for two years for the plants to produce flowers and strawberry fruits again)</td></tr><tr><td>7</td><td>G (repeat the process for several generations [for at least 10 years] and each year select the juiciest strawberries to be the parents for the next generation)</td></tr></table> <p>A, C, B, E, F, D, G (whole sequence correct = 3 marks) (two pairs in correct sequence = 2 marks [e.g. C before B, F before D]) (one pair correct in sequence = 1 mark) (more errors = 0)</p>	Stage	Statement (letter or words)	1	A (select a variety of strawberry that produces fruits with a lot of juice – call this a 'juicy' strawberry)	2	C (when the strawberry plants are beginning to flower [on a juicy strawberry plant], before they open, enclose the flowers in a thin pollen-proof cloth bag)	3	B (transfer pollen from the flower on one juicy strawberry plant to the stigma of a flower on another juicy strawberry plant ['pollination by hand'])	4	E (collect the strawberry fruits from the strawberry plants that are pollinated by hand and check that they are juicy)	5	F (select the juiciest strawberry fruits from the plants that are pollinated by hand)	6	D (grow the seeds ['pips'] from the juiciest strawberry fruits and wait for two years for the plants to produce flowers and strawberry fruits again)	7	G (repeat the process for several generations [for at least 10 years] and each year select the juiciest strawberries to be the parents for the next generation)	3
Stage	Statement (letter or words)																	
1	A (select a variety of strawberry that produces fruits with a lot of juice – call this a 'juicy' strawberry)																	
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7	G (repeat the process for several generations [for at least 10 years] and each year select the juiciest strawberries to be the parents for the next generation)																	
b) i)	• bees / insects / eq	1																
ii)	• keep out insects / bees / eq • to make sure pollen comes from juicy strawberry flower / not from other strawberry plants / eq	2																
c)	• runners / other vegetative / asexual description / eq • plant tissue culture / micropropagation / eq	2																
Total		8																

Question	Mark scheme	Marks
2 a) i)	• correct position (at top on right)	1
ii)	• heat given off (by bacteria / microorganisms)* • by respiration / from metabolic reactions • need to cool / remove heat to keep suitable / optimum temperature for the reaction / eq • need to cool / remove heat to prevent damage to / denaturation of enzymes / eq	2
b) i)	• mix contents • ensure nutrients available for bacteria / eq • aeration / eq • ensure temperature even throughout fermenter / eq	2
ii)	• ref enzymes / narrow pH range / denaturation / eq	1
iii)	• sterile air to prevent contamination / eq • air supply provides oxygen (for respiration)	2
iv)	• sugar / carbohydrate / eq for respiration • mineral ions / named for growth • eq (if suitable) <i>(two named nutrients but no reason = 1 mark)</i>	2
c) i)	• restriction enzyme	1
ii)	• GM human insulin is exactly the same (as insulin produced in human body) / correct / eq • compatibility / eq • no need to kill pigs to extract insulin / eq • ethical issues / eq	2
<b>Total</b>		<b>13</b>

\* can use 'E. coli' for bacteria / microorganisms for any of the mark scheme points



Question	Mark scheme	Marks
3 a) i)	• nucleus / chromosomes	1
ii)	<i>two from (accept letters)</i> • adenine (A) / cytosine (C) / guanine (G) / thymine (T)	1
b) i)	• restriction enzyme	1
ii)	• use vector • <i>Agrobacterium (tumefaciens)</i> • plasmid • recombinant DNA / insert cut out DNA into vector DNA / eq • allow vector to infect tomato cells / eq • tomato cells take up some altered DNA / eq	2
c) i)	• enzyme wrong shape / substrate does not fit active site / eq	1
ii)	• (transgenic means) DNA / genetic material from two species combined • tomato has own DNA altered then inserted again / eq	2
d) i)	• fewer losses in transport / after harvest / from spoilage / eq • better flavour (consumer appeal) / eq • red colour (consumer appeal) • improved profit / eq	2
ii)	• ethical issues / uncertainty about implications (of GM) / mistrust of novel plant / eq	1
<b>Total</b>		<b>11</b>

Question	Mark scheme	Marks																								
4 a)	<table border="1"> <thead> <tr> <th>Stage</th><th>Statement (letter or words)</th><th>Nucleus (haploid, diploid, none)</th></tr> </thead> <tbody> <tr> <td>1</td><td>A (skin cells are taken from the original animal to be cloned)</td><td>diploid</td></tr> <tr> <td>2</td><td>E (the nucleus is removed from an egg cell so that this becomes an enucleated cell)</td><td>no nucleus</td></tr> <tr> <td>3</td><td>G (the skin cell nucleus is inserted into the egg cell)</td><td>diploid</td></tr> <tr> <td>4</td><td>D (the egg cell containing the skin cell nucleus develops into an embryo)</td><td>diploid</td></tr> <tr> <td>5</td><td>C (the embryo grows on an artificial medium)</td><td>diploid</td></tr> <tr> <td>6</td><td>F (the embryo is implanted into a surrogate mother)</td><td>diploid</td></tr> <tr> <td>7</td><td>B (the embryo develops into a fetus and is born)</td><td>diploid</td></tr> </tbody> </table> <p>(whole sequence correct = 3 marks) (two pairs in correct sequence = 2 marks [e.g. E before G, D before C]) (one pair in correct sequence = 1 mark) (more errors = 0) (2 marks for nucleus descriptions – all correct = 2; 1 error = 1; more errors = 0)</p>	Stage	Statement (letter or words)	Nucleus (haploid, diploid, none)	1	A (skin cells are taken from the original animal to be cloned)	diploid	2	E (the nucleus is removed from an egg cell so that this becomes an enucleated cell)	no nucleus	3	G (the skin cell nucleus is inserted into the egg cell)	diploid	4	D (the egg cell containing the skin cell nucleus develops into an embryo)	diploid	5	C (the embryo grows on an artificial medium)	diploid	6	F (the embryo is implanted into a surrogate mother)	diploid	7	B (the embryo develops into a fetus and is born)	diploid	5
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b)	<i>sexual reproduction (converse accepted if clear):</i> • fertilisation takes place • (fertilisation) of two haploid cells / nuclei • embryo develops inside own mother / no surrogate mother required • no laboratory techniques / no growth of embryo on external media / eq • offspring genetically different (unless identical twins) / eq • eq	2																								
c)	• keep identical copies of mammal with desired characteristics / eq • increase numbers of mammal (with desired characteristics) / eq • conservation of rare breeds / endangered species / eq • production of special products (e.g. from GM mammals) / eq • eq (including named examples)	2																								
<b>Total</b>		<b>9</b>																								

## Extended writing

Question	Mark scheme	Marks
1	<ul style="list-style-type: none"> <li>• fish contained in pond / tank / cage in water / eq</li> <li>• water kept oxygenated by paddles / aerators / sprinklers / re-circulated / eq</li> <li>• net / eq covers container / eq to prevent predation / interspecific competition / eq</li> <li>• prevent overcrowding / watch fish density / separate into other tanks / eq</li> <li>• separate fish of different sizes / large ones become aggressive / ref intraspecific competition / eq</li> <li>• regular feeding in small amounts / appropriate food / e.g. high protein especially in younger stages / eq</li> <li>• removal of waste nitrogenous material / excreta / eq / prevent pollution / eq</li> <li>• check for disease and remove unhealthy fish / use antibiotics in food / eq</li> <li>• select good breeding stock / eq</li> <li>• containers / eq with fish of different ages to allow continuity of supply / eq</li> </ul> <p><i>(accept other points relating to water quality [e.g. ref temperature, pH] + quality of fish stock + detail of fish feed [e.g. canthoxanthin for flesh colour])</i></p>	6
<b>Total</b>		<b>6</b>

Question	Mark scheme	Marks
2	<ul style="list-style-type: none"> <li>• protected environment + allows growth in difficult situations (e.g. desert / cold / poor soil / eq) / eq</li> <li>• protected environment + gives longer growing season / out of season crops / eq</li> <li>• protected environment + less damage from wind / exposure / eq</li> <li>• higher temperature / greenhouse effect gives higher rate of photosynthesis / gives faster growth / eq</li> <li>• extra CO<sub>2</sub> (especially glasshouse) allows higher rate of photosynthesis / gives faster growth / eq</li> <li>• extra / artificial lighting (especially glasshouse) allows longer time in light / higher light intensity allows more photosynthesis / faster growth / eq</li> <li>• controlled irrigation / less loss of water by transpiration / eq</li> <li>• controlled application of fertiliser / nutrients / eq</li> <li>• ref pest control / can be good for biological control / controlled chemical spray / eq</li> <li>• protection from animals / birds / eq that might eat / destroy the crop / eq</li> <li>• higher yield likely to give more profit for grower / eq (allow ref to different inputs of growing crops in fields) / eq</li> </ul> <p><i>(accept other points if relevant and suitably presented)</i></p>	6
<b>Total</b>		<b>6</b>

Question	Mark scheme	Marks
3	<p><i>food + drink</i></p> <ul style="list-style-type: none"> <li>• fermentation of milk to yoghurt</li> <li>• <i>Lactobacillus</i> + detail (e.g. pH change, lactic acid, thickens / eq, taste / keeping qualities)</li> <li>• fermentation of sugar to alcohol / beer / wine</li> <li>• yeast / <i>Saccharomyces</i> + detail (e.g. enjoyable taste / CO<sub>2</sub> given off / keeping qualities)</li> </ul> <p><i>growth of microorganisms for products</i></p> <ul style="list-style-type: none"> <li>• using fermenter for commercial / industrial scale + detail</li> <li>• examples, e.g. production of human insulin (from GM bacteria) / production of antibiotics / penicillin / eq</li> </ul> <p><i>ecological role in recycling</i></p> <ul style="list-style-type: none"> <li>• carbon cycle + recycling / release carbon as CO<sub>2</sub> / eq</li> <li>• bacteria / fungi + breakdown / decay / decomposition / decomposers</li> <li>• nitrogen cycle + recycling nitrogen</li> <li>• bacteria + detail (e.g. nitrogen-fixing bacteria, nitrifying bacteria)</li> </ul> <p><i>(accept other points and examples if relevant and suitably presented)</i>  <i>(max. 2 marks per example)</i>  <i>(other examples that are not on spec but may be familiar to students and are acceptable)</i>  <i>(include, for example, cheese, soy sauce / tofu, many other food fermentations, vinegar, production of enzymes, digestion of cellulose in ruminants, production of biogas, production of silage)</i></p>	6
Total		6

Question	Mark scheme	Marks
4	<p><i>artificial selection</i></p> <ul style="list-style-type: none"> <li>• humans / people select individuals with desired characteristics / eq</li> <li>• use these as parents / breeding stock / eq</li> <li>• select again from offspring (with desired characteristics) / eq</li> <li>• to be parents for next generation</li> <li>• continue for successive generations, bringing about change in population / higher proportion of individuals with desired character(s) / eq</li> <li>• suitable example (1)</li> <li>• suitable example (2)</li> </ul> <p><i>natural selection</i></p> <ul style="list-style-type: none"> <li>• individuals in population differ / eq</li> <li>• those better suited to environment more likely to survive / eq</li> <li>• be parents for next generation / eq</li> <li>• continue for successive generations, bringing about change in population / higher proportion of individuals with favourable character(s) / eq</li> <li>• suitable example (1)</li> <li>• suitable example (2)</li> </ul> <p><i>general points (referring to both)</i></p> <ul style="list-style-type: none"> <li>• in artificial selection humans choose character whereas in natural selection environmental factors provide selection pressure / eq</li> </ul> <p><i>(max 4 if reference ONLY to artificial selection OR natural selection)</i></p>	6
Total		6