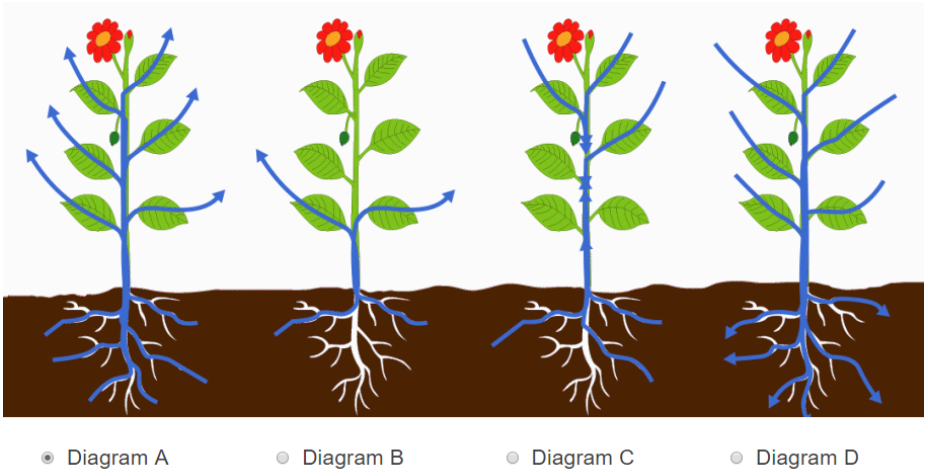
Question		Answers	Notes	Total	Criterion
1	a	correct animation selected: Diagram A  ◉ Diagram A ○ Diagram B ○ Diagram C ○ Diagram D		**1**	A
	b	<u>cell wall</u>		**1**	A
	c	***Any reasonable suggestion for example:*** • the plant will no longer be able to stand upright • the plant will wilt ***or*** go floppy.	*WTTE*	**1**	A

	d	***Either*** the leaves are curled ***or*** the stomata are sunken ***or*** there are hairs surrounding the stomata this allows transpired water to become trapped in enclosed spaces humidity increases so <u>evaporation</u> ***or*** <u>transpiration</u> is reduced in humid / moist conditions ***or*** leaf has a waxy cuticle leaf surface is impermeable to water this reduces area of leaf where water can be lost prevents <u>evaporation</u> ***or*** <u>transpiration</u> through that surface		**4**	A

2	a	***Any two from:*** • light / sunlight • water • heat / high temperature • nutrients • pheromones		**2**	A
	b	positive tropism shown by stem growing upwards so that the leaves are exposed to light negative tropism shown by roots growing downward so that roots can absorb water/nutrients ***or*** a stable root structure is formed		**4**	A
	c	***Any three reasonable suggestions (3 max), for example:*** • (touch causes leaves to close) so leaves cannot be eaten • gives wilted, unappealing appearance • predators are confused as food disappears • (hence) improved chance of survival with more photosynthetic tissue.		**3**	A
	d	the stalk ***or*** plant will bend ***or*** move toward the light only if the <u>tip</u> is exposed to the light	*WTTE* *ORA*	**3**	C
	e	on the shaded side, the mica blocked the substance moving down from the tip (and therefore) the plant did not bend when the mica was on the lit side, the bending was not affected (so) the plant grew toward the light		**4**	C

<table>
<tr><td>3</td><td>a</td><td colspan="2"><table>
<tr><th>Function</th><th>Organelle</th></tr>
<tr><td>The part of the cell containing DNA and responsible for control of growth and function</td><td>Nucleus</td></tr>
<tr><td>Packaging of molecules like proteins, movement of lipids and the creation of lysosomes</td><td>Golgi apparatus</td></tr>
<tr><td>Conversion of energy in food molecules to energy</td><td>Mitochondria</td></tr>
</table></td><td>3</td><td>A</td></tr>
<tr><td></td><td>b</td><td>Accept any reasonable function, for example:
• a specific instruction for a specific trait/protein
• contains the genetic code for a cell activity
• contains the genetic code for a particular characteristic.</td><td>Do not accept “DNA has genetic information” alone.</td><td>1</td><td>A</td></tr>
<tr><td></td><td>c</td><td>A similarity, for example:
• both select for desired trait
• both rely on the principles of heredity
• both aim to alter the genetic code.

A difference, for example:
• genetic engineering can introduce a new trait whereas selective breeding uses an existing trait
• genetic engineering needs one generation to introduce the trait, selective breeding needs more generations
• genetic engineering is much faster than selective breeding to gain the desired trait
• genetic engineering is an artificial process whereas selective breeding is natural.

Any further two points from either list (2 max)</td><td></td><td>4</td><td>D</td></tr>
<tr><td></td><td>d</td><td>Any two reasonable suggestions, for example:
• reduction in the gene pool/variation
• trait desired by humans might have a negative effect on the species
• low variation reduces the ability to survive changes in the environment.</td><td></td><td>2</td><td>A</td></tr>
</table>

4	a	diffusion		**1**	A
	b	Sign C: harmful sign 		**1**	A
	c	***Any two reasonable precautions, for example (2 max):*** • use gloves • use safety glasses.		**2**	B
	d	(does the) concentration of iodine (solution affect the) time taken for iodine to diffuse across a semi-permeable membrane correct use of word concentration	*WTTE accept references to rate*	**3**	B D
	e	***A correct prediction linking the two variables, for example:*** if the concentration of the iodine solution increases then the rate of diffusion will increase.		**1**	B
	f	***Identification of independent, dependent and control variables (2 max):*** one correct all correct ***Description for how to manipulate each variable identified above (4 max)***	 *ECF for correct description of manipulation of an incorrectly identified variable **except** for rate of diffusion of water*	**6**	B
	g	at least three trials average data can be calculated ***or*** anomalous data can be identified ***or*** allows for statistical analysis		**2**	B

	h	a table with at least three trials a table with at least three rows (for concentrations) labels including units		**3**	C
	i	***Any reasonable weakness, for example:*** • determining when the bag was completely changed could be subjective • the concentration of the solutions was not changed in equal increments.	*WTTE*	**1**	C

<table>
<tr><td rowspan="4">5</td><td>a</td><td>whether temperature affects the rate of movement across a membrane</td><td></td><td>1</td><td>B</td></tr>
<tr><td>b</td><td>measurement is made for a fixed time period

change in mass over a fixed time period used to determine rate

g min^{-1} or g s^{-1}</td><td>

Accept g / min or g/s</td><td>3</td><td>B</td></tr>
<tr><td>c</td><td>0.10(1)

correctly stated as 0.10 with correct sig figs</td><td>Accept incorrect precision for first mark</td><td rowspan="2">2</td><td rowspan="2">C</td></tr>
<tr><td colspan="2"><table>
<tr><th>Temperature / °C</th><th>Average initial mass / g</th><th>Average final mass / g</th><th>Increase in mass after 10 minutes / g</th><th>Rate of osmosis / unit formulated in part (b)</th></tr>
<tr><td>5</td><td>10.90</td><td>10.91</td><td>0.01</td><td>Negligible</td></tr>
<tr><td>10</td><td>11.06</td><td>11.76</td><td>0.70</td><td>0.07</td></tr>
<tr><td>15</td><td>11.10</td><td>12.11</td><td>1.01</td><td></td></tr>
<tr><td>20</td><td>11.41</td><td>12.58</td><td>1.17</td><td>0.12</td></tr>
<tr><td>35</td><td>12.33</td><td>13.73</td><td>1.40</td><td>0.14</td></tr>
</table></td></tr>
<tr><td>d</td><td>increments evenly spaced

y axis scale appropriate to give good visual differentiation of data trend

two points plotted

all points plotted correctly</td><td>

ECF from part c

Ignore point (5,0) if plotted</td><td>4</td><td>C</td></tr>
</table>

	e	both graphs show similar trend until 35°C both graphs increase at a similar rate ***or*** rate of increase slows at a similar rate the university graph shows a plateau ***or*** reaches a constant value above 35°C the student graph has no data above 35°C		**4**	C
	f	as temperature increases (kinetic) energy increases particles move more quickly so the rate of movement across the membrane increases term kinetic energy used correctly ***or*** at a temperature above 35°C (the movement of water is) equilibrium is reached (for this system) so the rate of (net) movement becomes constant because particles are moving in both directions at the same rate term equilibrium ***or*** osmotic pressure used	*Accept any other correctly used terminology associated with osmosis e.g. isotonic etc.*	**4**	C
	g	valid because the trends match (below 35°C) ***or*** valid because the data / results were similar ***or*** not valid because there are no measurements above 35°C	*Do **not** accept valid or not valid alone unless a correct reason is given.*	**1**	C

	h	***Any reasonable extension – change to the independent variable, for example:*** • increase the temperature range • investigate a different solute. ***Any reasonable improvement, for example:*** • fill in the missing increments • increase the duration of each trial to check if equilibrium is reached after 10 mins.	*Accept one extension and one improvement given in either box.*	**2**	C

<table>
<tr><td>6</td><td>a</td><td>Necessary equipment: balance or ruler, potato, beaker, thermometer, flask of distilled water, knife, ice, kettle, paper towels, goggles

Three items: potato, thermometer, water

A further three items from the necessary equipment list</td><td></td><td>2</td><td>B</td></tr>
<tr><td></td><td>b</td><td colspan="3"><table>
<tr><th></th><th>1</th><th>2</th><th>3</th><th>4</th></tr>
<tr><td>Variables</td><td>Variables are connected to the problem</td><td>Independent or dependent variable and one control variable identified</td><td>Independent and dependent variable and one control variable identified</td><td>Independent and dependent variable and at least two control variables are identified</td></tr>
<tr><td>Hypothesis</td><td>formulates a hypothesis connected to the variables but not explicitly linked to the variables with no explanation</td><td>formulate a testable hypothesis correctly linked to the variables (no explanation)</td><td>formulate a testable hypothesis correctly linked to the variables and with correct scientific explanation</td><td></td></tr>
<tr><td>Manipulation of variables / method</td><td>attempt at a method but detail is insufficient for another student to follow</td><td>partial method is described but detail is insufficient for another student to follow</td><td>method is described and could easily be followed by another student</td><td>method is described with fine detail and could easily be followed by another student</td></tr>
<tr><td>Data collection</td><td>plans to repeat at least three trials or measures over a range of at least 15 ºC</td><td>plans to repeat at least three trials at and measures over a range of at least 15 ºC</td><td></td><td></td></tr>
<tr><td>Safety</td><td>A relevant comment relating safety</td><td>A relevant comment relating to safety and corrected linked to the specific hazard</td><td></td><td></td></tr>
</table></td><td>15</td><td>B</td></tr>
</table>

7	a	***Carbohydrate: quick energy release*** ***Fat: long term energy storage and insulation*** ***Minerals and vitamins: supports metabolism*** ***Protein: body structures and cell functions*** one pair correctly matched two pairs correctly matched all pairs correctly matched		**3**	A
	b	goat		**1**	C

<table>
<tr>
<td></td>
<td>c</td>
<td>
<table>
<tr><th></th><th>1</th><th>2</th><th>3</th><th>4</th></tr>
<tr><td>Impacts</td><td>States an impact of intensive farming</td><td>States an impact of intensive farming and states the effect</td><td>states more than one impact of intensive farming, states the effects and uses science to explain the effect of one of the impacts</td><td>states more than one impact of intensive farming and their effects and gives detailed scientific explanations</td></tr>
<tr><td>Strengths and limitations of in vitro production</td><td>States a strength or a limitation of in vitro production</td><td>States a strength and a limitation of in vitro production</td><td>states a strength and a limitation of in vitro production supported by scientific reasoning</td><td>states a strength and a limitation of in vitro production supported by detailed scientific reasoning</td></tr>
<tr><td>Environmental</td><td>an environmental consideration for farming or in vitro</td><td>an environmental consideration for farming and in vitro
or
an environmental consideration for farming or in vitro and scientific reasoning</td><td>an environmental consideration for farming and in vitro supported by scientific reasoning</td><td></td></tr>
<tr><td>Ethical</td><td>an ethical issue for farming or in vitro</td><td>an ethical issue for farming and in vitro
or
an ethical consideration for farming or in vitro and scientific reasoning</td><td>an ethical issue for farming and in vitro supported by scientific reasoning</td><td></td></tr>
<tr><td>Appraisal</td><td>A brief concluding appraisal</td><td>A concluding appraisal linking all factors discussed</td><td></td><td></td></tr>
</table>
</td>
<td>16</td>
<td>D</td>
</tr>
</table>

<table>
<tr>
<td>8</td>
<td></td>
<td>
<table>
<tr><th></th><th>1</th><th>2</th><th>3</th><th>4</th></tr>
<tr><td>Advantages and disadvantages</td><td>an advantage or a disadvantage linked to bio-printing</td><td>an advantage or a disadvantage correctly linked to bio-printing</td><td>an advantage and a disadvantage correctly linked to bio-printing</td><td>More than one advantage and disadvantage correctly linked to bioprinting</td></tr>
<tr><td>Evaluative statement</td><td>Evaluative statement</td><td>Evaluative statement is justified</td><td>Evaluative statement is justified with scientific reasoning</td><td></td></tr>
<tr><td>Concluding appraisal</td><td>A brief concluding appraisal</td><td>A concluding appraisal linking all factors discussed</td><td></td><td></td></tr>
</table>
</td>
<td>9</td>
<td>D</td>
</tr>
</table>