

Question Number	Answer	Additional Guidance	Mark
<b>1(a)(i)</b>	<p>1. solution should contain (all) the { mineral / ions } that duckweed needs ;</p> <p>2. at the minimum concentration / eq ;</p> <p>Any two correctly named ion and its corresponding function :</p> <p>e.g. { nitrate (ions) / <math>\text{NO}_3^{2-}</math> } for { amino acids / protein / nucleic acid / ATP / chlorophyll / eq }</p> <p>{ magnesium ions / <math>\text{Mg}^{++}</math> } for chlorophyll</p> <p>{ calcium ions / <math>\text{Ca}^{++}</math> } for { cell wall / pectate / middle lamella / eq }</p> <p>{ phosphate (ions) / <math>\text{PO}_4^{3-}</math> } for { nucleic acid / ADP / ATP / NAD / phospholipid / eq } ; ;</p>	<p><b>1 IGNORE</b> nutrients</p> <p><b>2 ACCEPT</b> in excess</p> <p><b>IGNORE</b> carbon dioxide and wrong formulae</p> <p><b>NOT</b> nitrogen</p> <p><b>NOT</b> magnesium</p> <p><b>NOT</b> calcium</p> <p><b>ACCEPT</b> membrane</p> <p><b>NOT</b> phosphorous</p>	<b>(3)</b>

Question Number	Answer	Additional Guidance	Mark
<b>1(a)(ii)</b>	<p>1. idea of { extrapolation / drawing a line of best fit / eq } (to estimate number of fronds after 10 days) ;</p> <p>2. read value from graph / eq ;</p> <p>3. idea of subtracting { 50 / 10 } from the number of fronds after 10 days ;</p>	<p><b>NB</b> Apply this mark scheme even if they describe weighing the fronds and calculating the mass increase</p> <p><b>2 IGNORE</b> time refs.</p>	<b>(2)</b>

Question Number	Answer	Additional Guidance	Mark
<b>*1(b)</b>	<p><b>(QWC – Spelling of technical terms must be correct and the answer must be organised in a logical sequence)</b></p> <p>1. idea of using { solution of ions / complete medium } ;</p> <p>2. idea of using a { range of / minimum of 5 } temperatures ;</p> <p>3. idea that different temperatures will be achieved using { waterbaths / incubators / eq } ;</p> <p>4. idea of determining growth over a period of time ;</p> <p>5. credit appropriate named example of how growth is to be assessed eg { number / size / mass } of { fronds / plants } , length of roots ;</p> <p>6. credit named control variable e.g. same concentration of (each) inorganic ions ;</p> <p>7. idea of repeats to calculate a { mean / average } ;</p>	<p><b>QWC with an emphasis on logical sequence</b></p> <p>2. <b>ACCEPT</b> 5 quoted temperatures in between <math>1^\circ\text{C}</math> and <math>70^\circ\text{C}</math></p> <p><b>IGNORE</b> room temp if 6 or more values given</p> <p>5. <b>IGNORE</b> height / refs to germination</p> <p><b>7 ACCEPT</b> for reliability</p>	<b>(5)</b>

Question Number	Answer	Mark
<b>2(a)(i)</b>	B – nitrate ;	<b>(1)</b>

Question Number	Answer	Mark
<b>2(a)(ii)</b>	B – chlorophyll ;	<b>(1)</b>

Question Number	Answer	Additional guidance	Mark
<b>2(b)(i)</b>	<ol style="list-style-type: none"> <li>1. idea of greater mass with calcium nitrate ;</li> <li>2. difference is significant / error bars do not overlap / eq ;</li> <li>3. manipulation of data ;</li> </ol>		<b>(2)</b>

Question Number	Answer	Additional guidance	Mark
<b>2(b)(ii)</b>	<ol style="list-style-type: none"> <li>1. idea of choosing Red Delicious because of greater mass of apples ;</li> <li>2. idea of choosing Red Delicious because fertiliser has less effect on mass of apples ;</li> <li>3. idea of data overlap for Red Delicious and Golden Delicious when using calcium nitrate ;</li> <li>4. idea of choosing calcium nitrate because of {greater mass of apples / has equal effect on both trees} ;</li> <li>5. manipulation of data ;</li> </ol>	1. ACCEPT converse argument e.g. not Golden Delicious as lower mass of apples	<b>(2)</b>

Question Number	Answer	Additional guidance	Mark
<b>2(c)</b>	<ol style="list-style-type: none"> <li>1. idea that there is more contact between cells e.g. fewer spaces, cell shape ;</li> <li>2. reference to calcium pectate ;</li> <li>3. middle lamellae holding cells together ;</li> <li>4. idea that more calcium resulting in more { pectate / middle lamellae } ;</li> <li>5. idea of { stronger cell structure / less spaces between cells / thicker cell walls } resulting in firmer fruit ;</li> </ol>	<ol style="list-style-type: none"> <li>1. ACCEPT smaller cells, closer packing</li> <li>5. CCEPT reference to cells being packed closer together</li> </ol>	<b>(4)</b>

Question Number	Answer	Mark
3 (a)(i)	<ol style="list-style-type: none"> <li>1. (increasing or doubling nitrate ion concentration) decreased mitosis / negative correlation / eq ;</li> <li>2. manipulation of the data (e.g. by 6 cells (per 500 cells) / reduces by 24%) ;</li> </ol>	(2)

Question Number	Answer	Mark
3 (a)(ii)	<ol style="list-style-type: none"> <li>1. only two concentrations were used / additional nitrate ion concentrations should be used ;</li> <li>2. no {trend / eq} (as only 2 data sets) ;</li> <li>3. If one of the two sets of data was {anomalous / eq} ;</li> <li>4. reference to one with no nitrate ions present ;</li> </ol>	max (2)

Question Number	Answer	Mark
3 (a)(iii)	<p>Two appropriate safety risks given ; ;</p> <p>One appropriate precaution, linked to one of the risks above ;</p>	(3)

Question Number	Answer	Mark
3 (b)	<ol style="list-style-type: none"> <li>1. 3 + / sensible range of nitrate ion concentrations ;</li> <li>2. reference to repeats (at each concentration) ;</li> <li>3. reference to uniformity of seedlings (e.g. all from same parent plant, same age, same original root length) ;</li> <li>4. idea that solution used should contain other mineral ions / named mineral ions ;</li> <li>5. mention one other variable maintained / kept constant (e.g. temp, all run for same length of time, light intensity, volume of mineral solution) ;</li> <li>6. reference to mechanism of judging root {growth /eq} (to measure optimum nitrate concentration) ;</li> </ol>	<p style="text-align: right;">max (3)</p>

Question Number	Answer	Mark
4 (a) (i)	<ol style="list-style-type: none"> <li>1. both increase / eq ;</li> <li>2. qualification of increase e.g. both increase most rapidly between 0 and 100 mg dm<sup>-3</sup> / converse / gradient decreases with increase in calcium / eq ;</li> <li>3. dry mass {equal / 10.6 g} in both at 150 mg dm<sup>-3</sup> ;</li> <li>4. increase in mass very similar in both after 150 mg dm<sup>-3</sup> / increase higher in pods after 150 mg dm<sup>-3</sup> / eq ;</li> <li>5. change in pod mass greater (than shoot) / eq ;</li> <li>6. correct comparative manipulation of the data e.g. shoot increased by {8.1 g to 8.3 g} whilst pod has increased by 11 g ;</li> </ol>	maximum (3)

Question Number	Answer	Mark
4 (a)(ii)	{more / larger} cells / more {cell walls / calcium pectate / middle lamella} / helps uptake of other ions / eq ;	(1)

Question Number	Answer	Mark
4 (b)(i)	<ol style="list-style-type: none"> <li>1. positive (relationship / correlation) / as calcium ion concentration increases so does total nitrogen uptake by pods [not other way round] / eq ;</li> <li>2. {non-regular /greatest increase in total nitrogen uptake occurs between 0 and 75 mg dm<sup>-3</sup> of calcium / eq ;</li> </ol>	(2)

Question Number	Answer	Mark
4 (b)(ii)	nitrate / ammonium / ammonia ;	(1)

Question Number	Answer	Mark
4* (b)(iii) QWC	<p>(QWC - Spelling of technical terms (<i>shown in italics</i>) must be correct and the answer must be organised in a logical sequence)</p> <ol style="list-style-type: none"> <li>1. {greater / eq} (protein content) ;</li> <li>2. greater nitrogen uptake / eq ;</li> <li>3. nitrogen is {part / used in synthesis} of {amino acids / protein} / eq ;</li> <li>4. (amino acids) used to synthesise protein / eq ;</li> </ol>	<p>maximum (3)</p>