

Question number	Answer	Marks	Guidance
1 (a)	Limited space due to glasshouse size; idea of temperature control, e.g. too hot in the summer; ventilation due to plants being enclosed;	3	
1 (b) (i)	Rate of, photosynthesis and respiration, increase as temperature increases; rate of photosynthesis higher than rate of respiration at lower temperatures; rate of photosynthesis levels out at higher temperatures; due to, limiting factor / named; figures quote; enzyme controlled reactions in photosynthesis and respiration; enzyme activity effected by temperature;	5 max	
1 (b) (ii)	Assimilates / named, required for, growth / development; <i>idea that</i> rate of photosynthesis must be higher than rate of respiration for net production of assimilates; temperatures need to be lower to increase saleability of tomatoes; tomatoes would be, smaller / less sweet, if grown at higher temperatures;	4	
1 (b) (iii)	Maintenance of optimum, temperature / carbon dioxide concentration; expensive to heat or cool / ventilate; <i>idea that</i> cost of maintaining maximum rate of photosynthesis would reduce profits;	3	
2 (a)	A	1	
2 (b) (i)	Different positions on plant / described;	1	
2 b (ii)	A	1	
2 b (iii)	<i>Cells</i> large number of chloroplasts; <i>leaves</i> large surface area to absorb maximum light; large number of stomata for maximum diffusion of carbon dioxide; adaptations to high temperatures; <i>whole plants</i> taller/broader;	5	
3 (a)	124 (%) / 123.7 (%);;	2	
3 (b)	<i>Benefit</i> allows entry of more CO ₂ ; <i>Explanation</i> (CO ₂) for , light-independent reaction / Calvin cycle or light-dependent reaction is taking place quickly / reduced NADP building up / ATP building up or CO ₂ not as limiting (than when there are fewer stomata) or <i>idea that</i> increases access to air spaces for distribution of CO ₂ ; OR benefit reduces transpiration;		Read through complete answer. Award 2 marks if a benefit and explanation are correctly linked. If benefit and explanation are not correctly linked: Award Max 1 for either a benefit or an explanation.

	<p>explanation idea of stomata sheltered from , air currents / heat (when on lower surface) or idea that diffusion shells maintained;</p>		
3 (c)	<p>Equal sample size for sun and shade leaves / increase sample size of shade leaves / greater numbers of sun and shade leaves; measure thickness of cuticle / make cuticle observations quantitative; record range / calculate SD / calculate SE / (named) statistical analysis; record data on leaf, length / width / area / colour / chlorophyll content; record data on , size of stomata / stomatal count on upper surface; define what is a sun or shade leaf / measure light levels to classify type of leaf; repeat / replicate , the (whole) experiment / using other plants of the same species;</p>	2 max	DO NOT CREDIT refs to controlling temperature or light or wind or time
4 (a)	<p>Oxygen 1 oxygen only produced in one (named) stage of photosynthesis; 2 oxygen produced might be used for respiration; carbon dioxide 3 CO₂ only used in one (named) stage of photosynthesis; 4 CO₂ produced during respiration might be used for , photosynthesis / light independent reaction / Calvin cycle; 5 O₂ / CO₂ / both , could be an underestimate or represents net production (O₂) or represents net use (CO₂);</p>	2 max	<p>1 CREDIT for O₂ 'only measures the rate of the light dependent stage / photolysis' 3 CREDIT for CO₂ 'only measures the rate of the Calvin cycle' 5 ACCEPT a description e.g. 'measurement is less than expected because not all the oxygen produced can be measured' (but not if expressed in terms of terms of experimental error – e.g. dissolves in the water) IGNORE refs to reliability / accuracy</p>
4 (b) (i)	Light intensity;	1	
4 (b) (ii)	<p>Carbon dioxide concentration / partial pressure of CO₂ / temperature; AVP;</p>	1	<p>DO NOT CREDIT 'high' or 'low', as these indicate situations rather than factors eg stomatal density stomatal size chlorophyll concentration number of chloroplasts enzyme turnover rate IGNORE (temporary) changes in stomatal , opening / closing IGNORE ref to water availability</p>
4 (b) (iii)	(aerobic / anaerobic) respiration;	1	

4 (b) (iv)	<p>1 at 0 , respiration only / no photosynthesis; <i>between 0 and X</i></p> <p>2 idea that (rate of) respiration is greater than (rate of) photosynthesis; <i>at X</i></p> <p>3 idea that (rate of) respiration equals (rate of) photosynthesis / at compensation point; <i>after X</i></p> <p>4 idea that (rate of) photosynthesis is greater than (rate of) respiration;</p>	3 max	<p>Assume that candidate is answering in the same order as the bullet points, unless otherwise indicated. IGNORE photorespiration throughout</p> <p>CREDIT 'Calvin cycle' for 'photosynthesis' throughout For mps 2, 3 & 4 must include clear ref. to both respiration and photosynthesis 2 DO NOT CREDIT no photosynthesis</p>
4 (c) (i)	Reduced NADP / NADPH / NADPH ₂ / NADPH ⁺ ; ATP; oxygen;	3	
4 (c) (ii)	<p>1 prevents photophosphorylation;</p> <p>2 cyclic and non-cyclic;</p> <p>3 no / less , ATP / reduced NADP , for , light-independent stage / Calvin cycle / GP to TP;</p> <p>4 no (named) substrate made for respiration;</p>	2 max	<p>3 'no ATP for photosynthesis' is not quite enough DO NOT CREDIT (oxidised) NADP</p> <p>4 substrate eg glucose / starch / carbohydrate / sucrose / sugars IGNORE triose phosphate / food / nutrients</p>