



1 (a)	$6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$ ;;	[2]	one mark for the correct chemical formulae one mark for balancing the equation correctly <b>R</b> word equation
(b)	as <u>wavelength</u> increases, rate (of photosynthesis) decreases and increases ;  high rates in, blue and violet and red / 400–475 nm and 675 nm ; low(est) rate in, green and yellow / 550–600 nm ;  <i>either</i> maximum rate = $0.9\text{ cm}^3$ , at 675 nm / red <i>or</i> minimum rate = $0.2\text{ cm}^3$ , at 550 nm / green ;	[max 3]	units must be used once in the answer <b>A</b> volume of gas for rate
(c)	divide the volumes by, five (minutes)/time ;	[1]	
(d) (i)	to keep the <u>light intensity</u> the same ;	[1]	<b>R</b> temperature <b>I</b> 'fair test' <b>A</b> 'control light intensity' / 'light intensity is a control(led) variable'
(ii)	to provide carbon dioxide / so carbon dioxide is not a limiting factor / so the only limiting factor is wavelength ;	[1]	
(e)	for, respiration / energy ; converted to sucrose ; used to make, nectar / fruits ; used to make, cellulose / lignin ; used in cell walls ; used to make, starch / oils / fats ; storage ; used to make, amino acids ; used to make, chlorophyll ;	[max 3]	<b>I</b> protein synthesis / growth / active transport <b>R</b> produces energy  <b>I</b> 'makes food', but <b>A</b> 'stores food' for 1 mark
		[Total: 11]	



Question		Mark	Guidance
<b>2 (a) (i)</b>	retina ;	[1]	
<b>(ii)</b>	optic (nerve);	[1]	<b>I</b> sensory neurone
<b>(iii)</b>	(light is) refracted ;	[1]	<b>A</b> description of refraction
<b>(iv)</b>	sensitive to / detect, light ; in low intensity / night ; pass impulse to, <u>sensory</u> neurone / optic nerve ; AVP ;	[max 2]	sensitive in dim light = 2 marks <b>A</b> provides night vision
<b>(b) (i)</b>	gravity ;	[1]	
<b>(ii)</b>	negative / away from (gravity) ; (gravi)tropism / (geo)tropism ;	[2]	



Question		Mark	Guidance
2 (iii)	<p><i>upwards</i> grow towards (where) light (should be); more, light absorbed / photosynthesis ; more growth ; flowers more likely to attract, insects / pollinators ; more likely to, release / shed / disperse, seeds ;</p> <p><i>downwards</i> better, anchorage / AW ; absorb, water / mineral ions ;</p> <p>AVP ; ref to competition / damage</p>	[max 2]	
(iv)	<p>auxins <u>made</u> in shoot tip ; (auxin) spread / move / diffuse ; <i>idea of</i> unequal distribution of auxin ; auxins collect, in <u>lower</u> side of stem ; auxin stimulates (cell) elongation (where it accumulates); AVP ;</p>	[max 4]	<p>I found in tip</p> <p>I growth e.g. (by) absorption of water (osmosis) / ref to turgor pressure (and) stretching of cell walls / statoliths / detect gravity</p>
		[Total: 14]	

3 (a) (i)	<p>maintain constant temperature / prevent heat from the lamp heating the water / absorbs heat from the lamp / heat shield ;</p> <p>(thermometer) to measure / check / monitor / record, water ;</p> <p>prevent temperature (change), influencing / affecting, the results / rate of photosynthesis ;</p> <p>temperature is a, control(led) / standardised, variable ;</p>	<b>[max 2]</b>	<p>1 mark for 'controlling'</p> <p>1 mark for 'measuring'</p>
(ii)	<p>maintain constant light intensity ;</p> <p>(light meter) to measure / check / monitor / record, the light intensity ;</p>		<p>1 mark for 'controlling'</p> <p>1 mark for 'measuring'</p>



Question	Answers	Marks	Additional Guidance
3	prevent light intensity (change) influencing/affecting the, results / rate of photosynthesis ; make sure the lamp is always, in the same place/at right distance ; light, intensity/level, is dependent on distance ; light intensity is, a controlled/standardised, variable ;	[max 2]	<b>A</b> (ruler) to measure the distance between lamp and plant
<b>(b) (i)</b>	rate / photosynthesis / bubbles: increases as carbon dioxide concentration increases and then, levels off AW ; increases to 0.40 % ; <b>A</b> rate remains constant above 0.40% little / slow, increase up to 0.1 % ; <b>ora</b> one data quote with CO <sub>2</sub> concentration and rate with units ;	[max 3]	units must be used at least once anywhere in the answer to award marking points that require them <b>A</b> bpm for bubbles per minute
<b>(ii)</b>	carbon dioxide / CO <sub>2</sub> , concentration / % / level / availability ;	[1]	<b>R</b> 'amount of carbon dioxide'
<b>(iii)</b>	ref to <u>limiting factor</u> in suitable context ; carbon dioxide (concentration), is no longer limiting / AW ; light, intensity / level, could be limiting / AW ; reference to light providing <u>energy</u> for photosynthesis ; temperature could be limiting / AW ; reference to temperature influencing the activity of enzymes ;	[ma 4]	



Question	Answers	Marks	Additional Guidance
3	chloroplast/chlorophyll/number of leaves/size of plant, could be limiting factor ;		
(c)	measure <u>volume</u> (of oxygen/gas) ; use, inverted test-tube/measuring cylinder/syringe (barrel) ; reference to, graduations/markings ; <b>A</b> 'take readings from...'/ 'record results...' filled with water ; gas collects at the top and pushes out the water/ downward displacement of water; gas syringe ; attached by (delivery) tube to, flask/AW ; oxygen sensor ; data logger for any other suitable electronic method ; reference to equilibration/ described ; reference to time period ; <b>A</b> rate = volume divided by time	[max 3]	
(d) (i)	use/combustion/burning, of fossil fuels ; reason for increased demand for energy ; carbon dioxide from, volcanic activity/volcanoes ;	[max 2]	<b>A</b> named fossil fuel(s) <b>A</b> named example, e.g. increased use of cars/heating/air-conditioning



Question	Expected Answers	Marks	Additional Guidance
3	deforestation ; burning of, forests/trees ;		
(ii)	carbon dioxide is a <u>greenhouse gas</u> ; (enhanced) <u>greenhouse effect</u> (in context of carbon dioxide) ; heat/infra-red/long wavelength radiation, radiated/emitted, from / absorbed/trapped/AW, by, carbon dioxide/greenhouse gases ; travels/AW, back to the surface ; heat cannot, leave (from the atmosphere)/pass into outer space ;	[max 4]	<b>R</b> 'ozone causes greenhouse effect'  <b>A</b> reflected as an alternative to radiated  <b>ignore</b> UV light/visible light/(solar) radiation
		[Total: 21]	