

Rate of photosynthesis (required practical)

Q1. (2018)

A)

03.3	measure the volume of gas released	allow use a measuring cylinder / capillary tube / (gas) syringe	1	AO3 4.4.1.2
	increase length of time	allow sensible length of time allow video the investigation so you could re-count the bubbles later allow repeat the measurement at each distance several times and calculate a mean ignore references to using other distances	1	

B)

03.4	temperature affects rate of photosynthesis or temperature affects rate of bubble production	allow correct description of effect of temperature on rate	1	AO3 4.4.1.2
	(because) reaction / photosynthesis is controlled by enzymes	allow high temperatures denature enzymes enzymes being denatured must be linked to high temperature	1	

C)

03.5	evidence of squaring for two distances that double: 25 and 100 or 100 and 400		1	AO2 4.4.1.2
	calculate $1/d^2$ for two distances that double: 0.04 and 0.01 or 1/25 and 1/100 or 0.01 and 0.0025 or 1/100 and 1/400	allow 2 marks for these calculations without working ignore calculations for a third distance as long as two where the distance doubles are correct	1	AO2 4.4.1.2
	(therefore as distance doubles) light intensity is quartered		1	AO3 4.4.1.2

D)

03.6	2 (bubbles would be produced)		1	AO3 4.4.1.2
	(as) very little light / energy for photosynthesis to occur	do not accept no light allow 2 marks for a quarter of the bubbles are produced as light distance doubles so 2 bubbles would be expected	1	AO2 4.4.1.2

E)

03.7	(independent variable) use different concentrations of sodium hydrogencarbonate solution	allow three concentration values ignore different concentrations of carbon dioxide ignore different amounts of sodium hydrogen carbonate solution	1	AO3 4.4.1.2
	(control variables) any two from: • distance from light source • temperature of solution • same plant • time for plant to equilibrate	max 2 marks for control variables allow light intensity ignore light unqualified ignore same lamp allow type / size of plant allow time for plant to adjust to different solution ignore time unqualified	2	

Q2. (2021)

A)

01.2	distance of the pondweed from the lamp		1	AO1 4.4.1.2 RPA5
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B)

01.3	bubbles (of gas) would be produced faster	allow more / bigger bubbles of gas would be produced (in a given time)	1	AO3 4.4.1.2 RPA5
	(because) enzymes work faster	allow (because) photosynthesis is controlled by enzymes allow (because) photosynthesis would be faster	1	AO2 4.2.2.1 4.4.1.2

C)

01.4	any one from: • use an LED (lamp) • place a tank / beaker of water between the lamp and tube / pondweed • put the tube in a beaker of water • put the tube in a (thermostatically controlled) water bath • place a piece of glass between the lamp and tube / pondweed	allow use a light that does not emit (a lot of) infrared / thermal radiation allow place a heat shield between the lamp and tube / pondweed	1	AO3 4.4.1.2 RPA5
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D)

01.5	<p>any two from:</p> <ul style="list-style-type: none"> measure the volume of gas produced allow the pondweed time to equilibrate repeat and calculate a mean or repeat and remove anomalies control the concentration of carbon dioxide (in the water) use the same bulb / lamp 	<p>allow amount for volume allow use a cylinder / gas syringe to collect the gas</p> <p>allow a description of this</p> <p>ignore repeat unqualified</p> <p>allow put the pondweed in sodium hydrogen carbonate (solution) or sodium bicarbonate (solution)</p> <p>allow use the same type / size / age / piece of pondweed</p> <p>allow record the number of bubbles of gas produced in a longer period of time</p>	2	AO3 4.4.1.2 RPA5
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E)

01.6	3 (bubbles of gas produced per minute)	<p>allow 3.2 (bubbles of gas produced per minute)</p> <p>do not accept 3.0 (bubbles of gas produced per minute)</p>	1	AO2 4.4.1.2 RPA5
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F)

01.7	as light intensity decreases the rate of photosynthesis decreases	<p>allow as distance from lamp increases rate of photosynthesis decreases</p> <p>allow as distance from lamp increases number of bubbles produced decreases</p>	1	AO3 4.4.1.2 RPA5
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G)

01.8	all points plotted correctly	<p>allow tolerance of $\pm \frac{1}{2}$ a small square</p> <p>allow 1 mark for four points plotted correctly</p>	2	AO2 4.4.1.2 RPA5
	line of best fit through their points	<p>do not accept line extended to 0, 0</p> <p>ignore extrapolations of line</p>	1	

H)

01.9	8	<p>allow correct value from their line $\pm \frac{1}{2}$ a small square</p> <p>allow value in range 6 to 9 if a curved line of best fit is not drawn</p>	1	AO3 4.4.1.2 RPA5
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Q3. (2022)

04.3	allow the pondweed to equilibrate in the light	allow leave the pondweed in the light (for a few minutes) before taking measurements allow use the same concentration of sodium hydrogen carbonate solution ignore control carbon dioxide concentration unless method described ignore use same intensity / distance of light ignore control temperature ignore use same pondweed	1	AO3
	use a gas syringe or use a (measuring) cylinder to measure / collect the oxygen / gas produced	do not accept carbon dioxide ignore references to counting bubbles	1	AO1
	measure time oxygen / gas is collected for using a timer / stopwatch / stopclock		1	AO1
	repeat the measurements and calculate a mean	allow repeat the measurements and discard anomalies	1	AO1
				4.4.1.1 4.4.1.2 RPA5

Q4. (2022)

A)

04.4		ignore answers relating to the scale on the y-axis		AO2 4.4.1.2 RPA5
	independent variable in student's investigation is categoric / discrete	allow colour of light is a categoric / discrete variable ignore discontinuous	1	
	independent variable in scientist's investigation is continuous	allow wavelength is a continuous variable	1	

B)

04.5	492 to 577 (nm)	allow answers in ranges 475 to 525 and 575 to 650 (nm)	1	AO3 4.4.1.1 4.4.1.2 RPA5
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Q5. (2024)

A)

04.2	(as temperature increases) the rate of photosynthesis increases then (the rate of photosynthesis) decreases	ignore references to volume unqualified	1	AO3 4.4.1.2
	fastest rate between 30 °C and 35 °C	allow a fastest rate at a temperature above 30 °C and below 35 °C allow reaches an <u>optimum</u> temperature between 30 °C and 35 °C	1	
	up to 30 °C the rate doubles every 5 °C increase	allow up to 30 °C the rate increases at an increasing rate allow up to 30 °C the rate increases exponentially	1	

B)

04.3	enzymes (in the plant / chloroplast) become destroyed	allow enzymes become denatured do not accept enzymes are killed do not accept cells / plants are denatured	1	AO2 AO3
	(because) <u>active site</u> changes shape		1	4.2.2.1 4.4.1.2
	OR the <u>active site</u> changes shape (1)			
	(so) the substrate no longer fits / binds (1)			
	OR enzymes (in the plant / chloroplast) become destroyed (1)	allow enzymes become denatured do not accept enzymes are killed do not accept cells / plants are denatured		
	(so) the substrate no longer fits / binds (1)			
		ignore the plant is killed / dead		

C)

04.4	repeat the investigation, measuring the volume of gas to 0.5 cm ³		1	AO3 4.4.1.2
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Q6. (2024)

04.5	<p>any two from:</p> <ul style="list-style-type: none"> • may have too many tomatoes to eat / sell • other factors could limit photosynthesis • the optimum temperature might be above / below 25 °C • greenhouses are poorly insulated • pollution from the heater • increase the rate of transpiration • increased spread of plant disease(s) 	<p>allow the idea of a glut or all ripen at the same time allow other named limiting factor could limit photosynthesis allow factors could limit tomato production</p> <p>allow increase carbon dioxide emissions allow increase global warming allow increase the water loss from the plant</p> <p>if no other mark awarded allow it is a fire hazard for 1 mark</p>	2	AO3 4.4.1.2
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