Photosynthesis, Respiration and Transpiration (Specified Practicals): Eduqas A Level Biology Exam Questions

22 questions · 49 marks · about 59 minutes. Answer in the spaces, then check the mark schemes at the end.

Question 1 · A level Component 1 · June 2019 · Q4(c)(i) · 3 marks

(c) NAD is a hydrogen acceptor used in many stages of respiration. Methylene blue can be used as an artificial hydrogen acceptor. It decolourises when reduced and can be used to give an indication of the rate of respiration.

An experiment was set up using isolated liver mitochondria extracted in ice-cold, isotonic buffer. The same volume and concentration of pyruvate, mitochondrial suspension and methylene blue was added to each experiment. The temperature was changed for each experiment and the experiment repeated three times. Thermostatic water baths were used throughout.

(i) Explain why the mitochondria were initially suspended in **ice cold**, **isotonic buffer**. [3]

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Question 2 · A level Component 1 · June 2019 · Q4(c)(iii) · 3 marks

The results of the experiment are shown in the table below.

	Time taken for methylene blue to decolourise / seconds				
Temperature / °C	Trial 1	Trial 2	Trial 3	Mean	Standard deviation
10	320	290	385	332	±48.6
20	280	275	282	279	±3.6
30	165	172	159	165	±6.5
40	102	105	98	102	±3.5
50	156	162	148	155	±7.0
60	330	355	342	342	±12.5

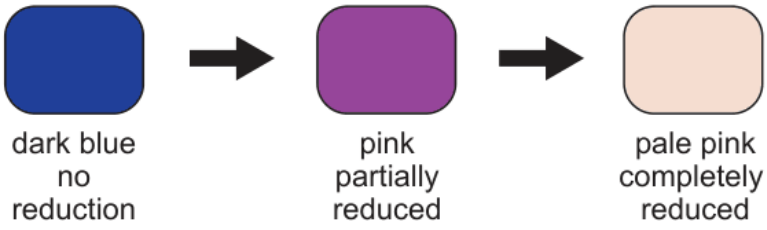
(iii) State **one** conclusion you can draw from this experiment and comment on the reliability of the results in the table shown. [3]

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Question 3 · A level Component 1 · June 2025 · Q1(b)(i) · 1 mark

(b) Resazurin dye changes colour when it is reduced and will change colour in the presence of respiring cells. If resazurin is present it will be reduced by hydrogen and changes colour from dark blue to pink to pale pink as shown in **Image 1.1**.

Image 1.1



Students used resazurin to investigate the action of dehydrogenase in yeast. They set up a thermostatically controlled water bath at 35 °C. Two test tubes were prepared as follows and left in the water bath for five minutes:

Test tube **A**: 3 cm^3 of boiled 2.5% yeast suspension + 3 cm^3 of 5% glucose solution
Test tube **B**: 3 cm^3 of 2.5% yeast suspension + 3 cm^3 of 5% glucose solution

After five minutes, 3 cm^3 of 0.01% resazurin was added to test tubes **A** and **B**. The resazurin solution was at the same temperature as the yeast and glucose mixture.

(i) Explain why the resazurin was brought to the same temperature as the yeast and glucose mixtures before mixing. [1]

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Question 4 · A level Component 1 · June 2025 · Q1(b)(ii) · 2 marks

(ii) Explain the purpose of test tube **A**. [2]

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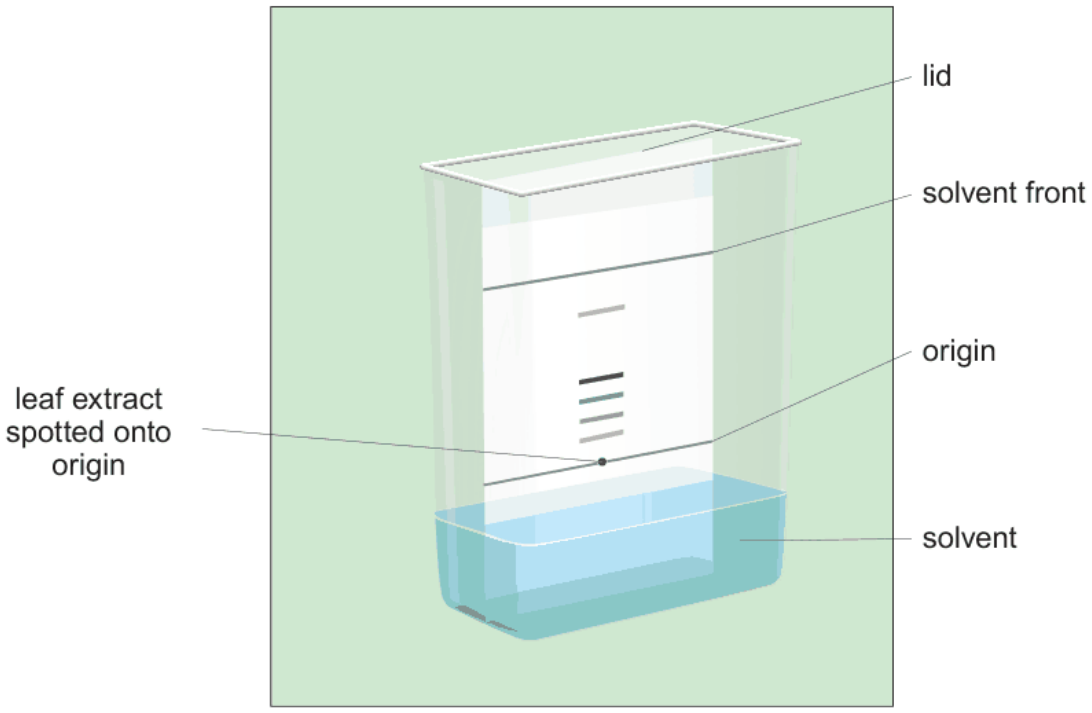
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(b) The pigments in a leaf can be separated by either paper or thin layer chromatography in the apparatus shown in **image 1.1**.

Image 1.1



The flow diagram gives an outline of the method used.

Extract pigments from leaf using a solvent.

↓

Draw a pencil line at the origin.

↓

Spot leaf extract onto the origin.

↓

Place in the chromatography chamber.

↓

Leave in solvent.

↓

Mark position of solvent front and position of each pigment front.

(i) Explain why the origin line is drawn in pencil **and** why the level of the solvent used is below the origin line. [2]

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Question 6 · A level Component 1 · Autumn 2021 · Q1(b)(ii) · 1 mark

(ii) Describe the method by which the pigment is concentrated on the origin line. [1]

.....

.....

Question 7 · A level Component 1 · Autumn 2021 · Q1(b)(iv) · 1 mark

(iv) State **one** variable which would need to be controlled if this method was used to compare the pigments in leaves of two different species of plant. [1]

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Question 8 · A level Component 1 · June 2024 · Q4(b)(ii) · 1 mark

(ii) Explain why a pencil is used to draw the origin line on the chromatography paper. [1]

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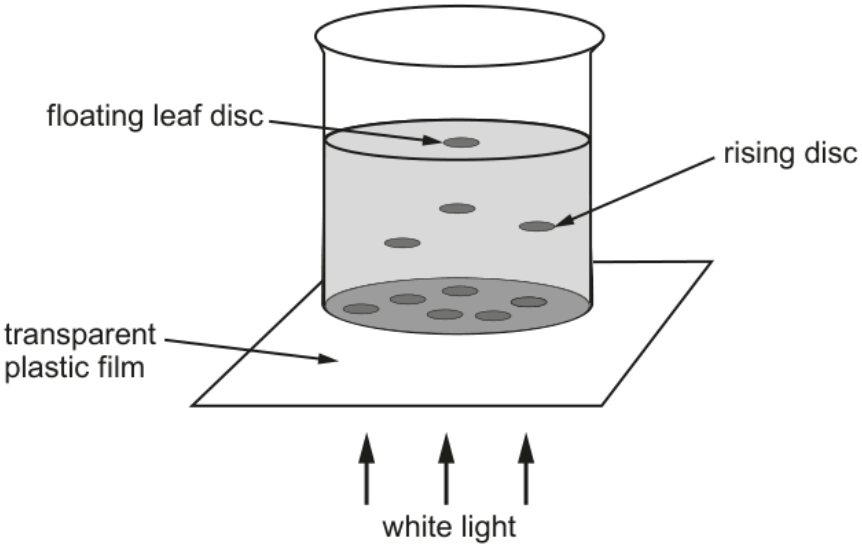
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Question 9 · information from earlier in the question

(c) An experiment was carried out to investigate the effect of leaf colour on the rate of photosynthesis. Leaves placed in water naturally float, but if small discs of leaves are punched out of the leaves and the air in the discs is replaced by hydrogen carbonate solution (a CO_2 source), they will sink.

The time taken for 15 light green leaf discs to float to the top of the solution when illuminated from below can be determined and gives an estimate of the rate of photosynthesis. This was repeated for dark green leaf discs.



The results of such an experiment are shown below.

Order of leaf discs rising	Time taken for each leaf disc to rise / seconds	
	Dark green colour discs	Light green colour discs
1st	102	296
2nd	157	324
3rd	186	358
4th	201	360
5th	240	420
6th	260	422
7th	287	665
8th	317	666
9th	396	805
10th	404	1000
11th	474	1108
12th	535	1173
13th	622	1674
14th	808	1821
15th	898	2388
Mean time	.....	898.7

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Question 9 · A level Component 1 · June 2017 · Q4(d)(i) · 4 marks

(d) (i) Describe how would you use the technique described in *(c)* to investigate the effect of light wavelength on photosynthesis. [4]

Question 10 · A level Component 1 · June 2017 · Q4(d)(ii) · 2 marks

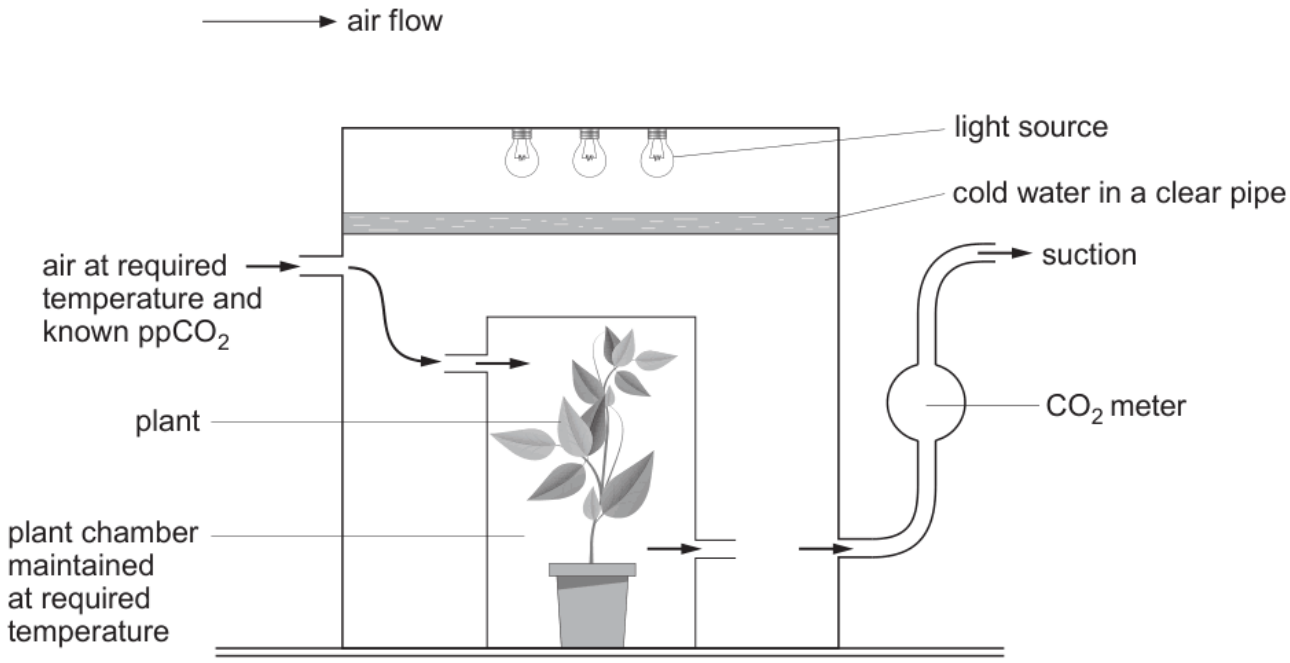
(ii) Predict the results that you would expect from this experiment. [2]

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Question 11 · A level Component 1 · Autumn 2021 · Q3(a)(i) · 1 mark

3. The rate of photosynthesis at different temperatures was determined by measuring the rate of carbon dioxide exchange using the apparatus shown in **image 3.1**.

Image 3.1



The mass of carbon dioxide absorbed by ten tomato plants in 1 hour was measured at 15, 20, 30 and 40 °C. The same group of plants were grown at the same light intensity at all temperatures.

(a) (i) Suggest why cold water was placed between the light source and plant chamber. [1]

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Question 12 · A level Component 1 · Autumn 2021 · Q3(a)(iii) · 2 marks

(iii) Suggest a suitable control for this experiment. [2]

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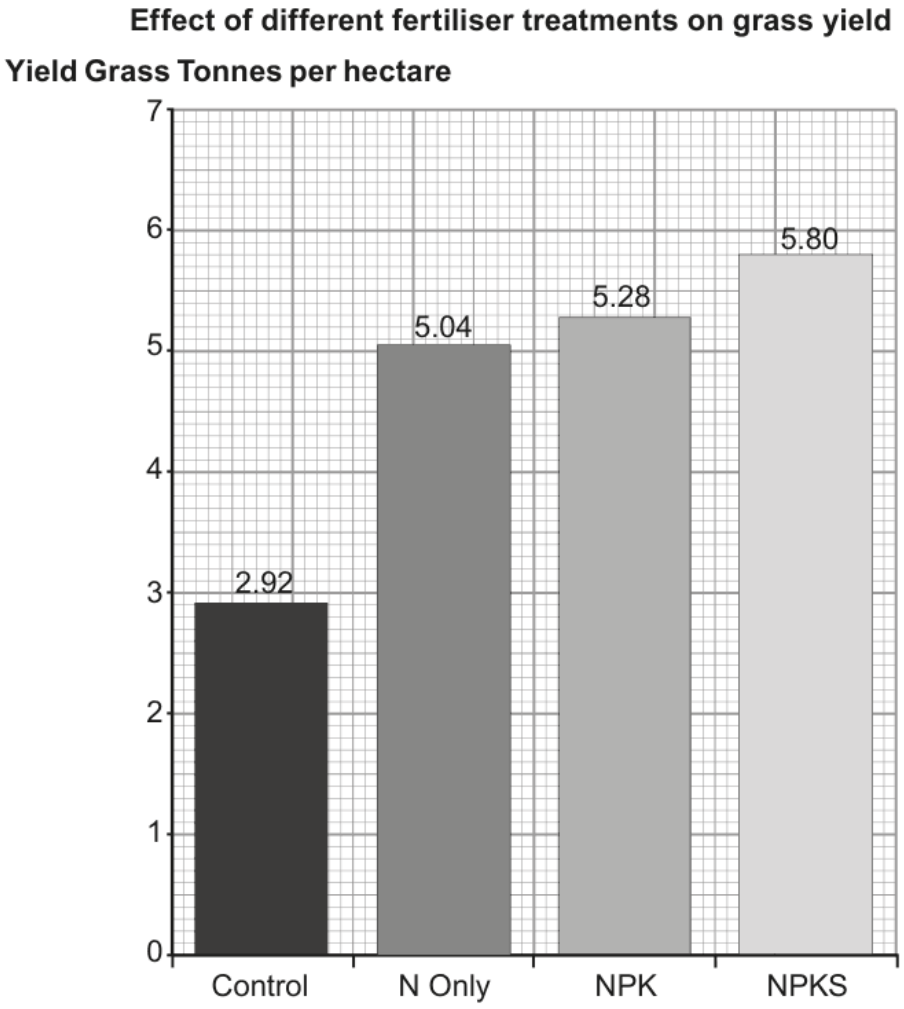
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Question 13 · information from earlier in the question

Field trials were carried out by a fertiliser company to determine the effect of the four macronutrients on grass growth.



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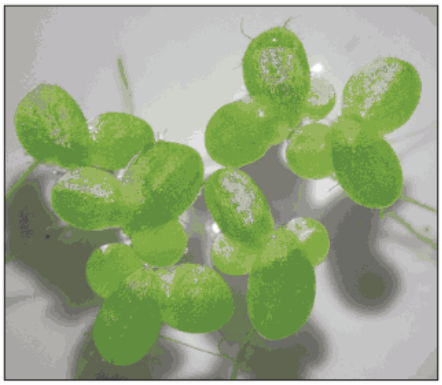
Question 13 · A level Component 1 · June 2017 · Q2(c) · 4 marks

(c) Give experimental details of how you could set up an experiment in the laboratory to determine increase in mass of the grasses over a 4 week period with the three fertilisers shown on the graph. [4]

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(b) An experiment was carried out to investigate the effects of some micronutrient deficiencies on duckweed (*Lemna minor*). This is a simple, aquatic plant that floats on the surface of ponds. It grows rapidly and individual plants can be counted easily. **Image 3.1** shows some *L. minor* plants.

Image 3.1



Five different nutrient media were tested. One contained complete nutrient medium containing all the minerals required for healthy growth. The others contained the same nutrient medium but with a source of one micronutrient omitted. The method used to set up the culture vessels is described below.

- wrap the sides of a 250 cm^3 beaker with aluminium foil to prevent entry of light
- place 150 cm^3 of nutrient medium in the beaker
- place two *L. minor* plants on the surface of the nutrient medium
- cover the top of the beaker with clear plastic film
- place the beaker in a room kept at a constant 20 °C under continuous light
- after 14 days
    1. record the colour of the leaves on a scale of 0–5 where 0 is complete chlorosis and 5 is normal dark green
    2. record the size of the leaves as T = tiny, S = small, M = medium and L = large
    3. harvest the plants and dry to constant mass
- repeat the whole experiment to gain five sets of data and calculate mean results for each nutrient medium tested

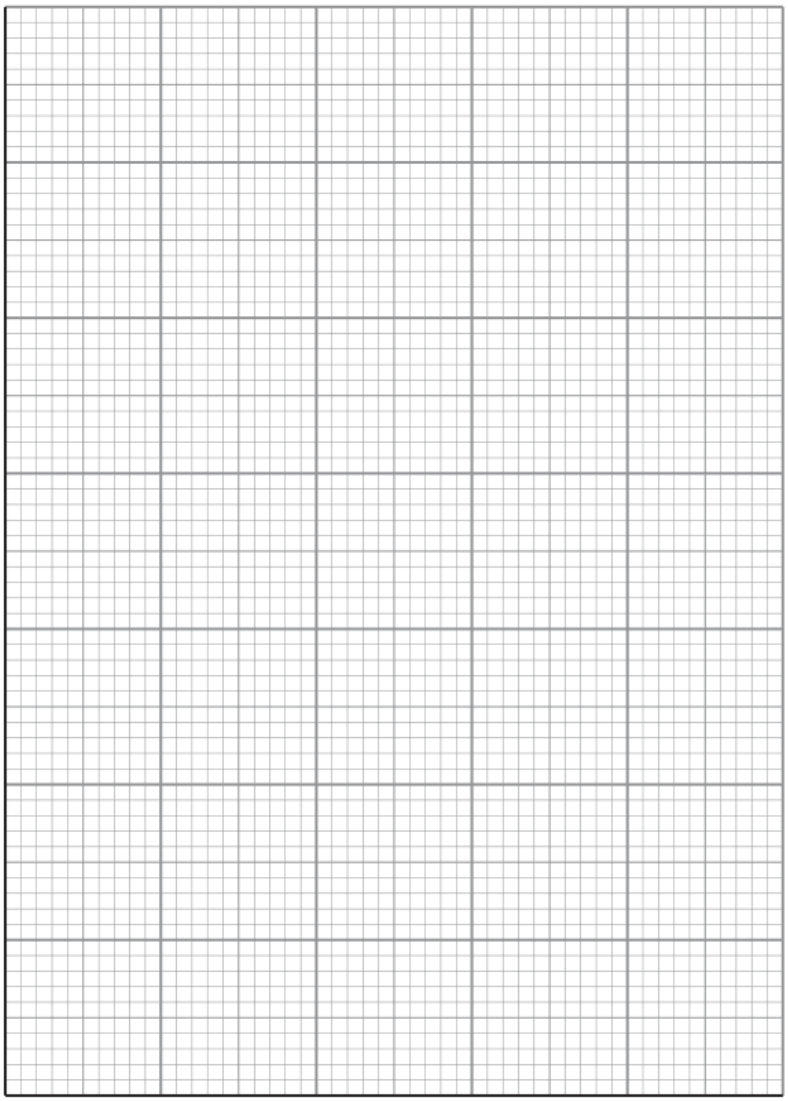
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The results of the experiment are shown in **Table 3.2**.

Table 3.2

Nutrient medium – micronutrient omitted	Mean results		
	dry mass / mg	leaf colour score	leaf size
none	13.2	5	L
copper	10.6	4	M
iron	2.5	1	S
manganese	3.1	2	T
zinc	12.1	4	M

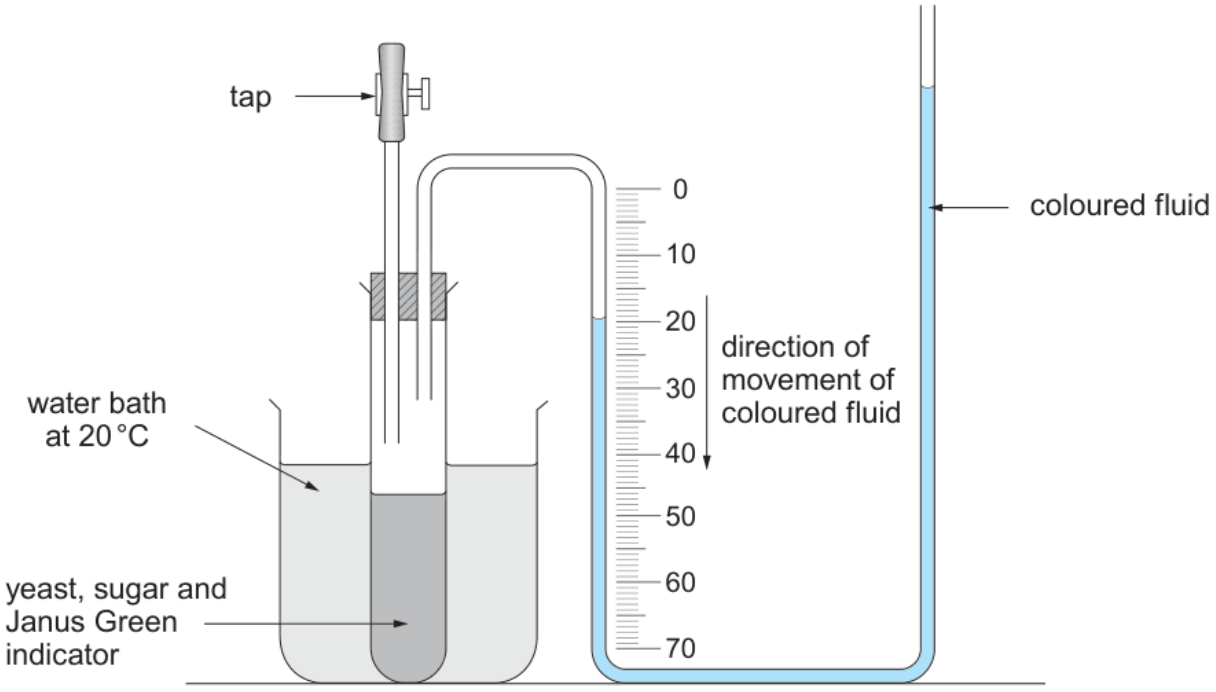
(iv) Use **Table 3.2** to plot a **bar chart** of the mean dry mass of *L. minor* harvested for each nutrient medium on the grid below. [3]



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6. **Image 6.1** shows the apparatus which can be used to measure the production or absorption of gases during respiration. The apparatus relies on changes in pressure to move the coloured fluid along the tube.

Image 6.1



A student used this apparatus to compare the rate of **anaerobic** respiration in yeast using different sugars as the respiratory substrate.

Janus Green indicator is blue if oxygen is present and pink if no oxygen is present.

- Janus Green indicator is added to the yeast and sugar in a test tube as shown above.
- The apparatus is left with the tap open for 5 minutes.
- After this time the tap is closed.
- Once the solution turns pink, the time for the meniscus to move 10 mm is recorded.
- The time for the meniscus to travel 10 mm is repeated a further four times.
- All controlled variables are the same for each sugar and for each repeat.

(a) Explain the following:

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Question 15 · A level Component 1 · Autumn 2020 · Q6(c) · 3 marks

(c) Suggest a suitable control experiment **and** explain why a control is necessary. [3]

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Question 16 · A level Component 1 · Autumn 2020 · Q6(d)(i) · 3 marks

(d) (i) The results when glucose was used as the substrate are shown in the table below. Use the table and formula to calculate the standard deviation for the glucose results. [3]

Time for meniscus to travel 10 mm /seconds	Deviation from mean $x-\bar{x}$	Deviation from mean squared $(x-\bar{x})^2$
254		
246		
255		
253		
252		
Mean = 252		$\sum(x-\bar{x})^2$ =

The formula for standard deviation is:

$$\sqrt{\frac{\sum(x-\bar{x})^2}{n-1}}$$

where

x = individual result $\bar{x}$ = mean result

n = number of trials $\sum$ = sum of

Standard deviation = ...

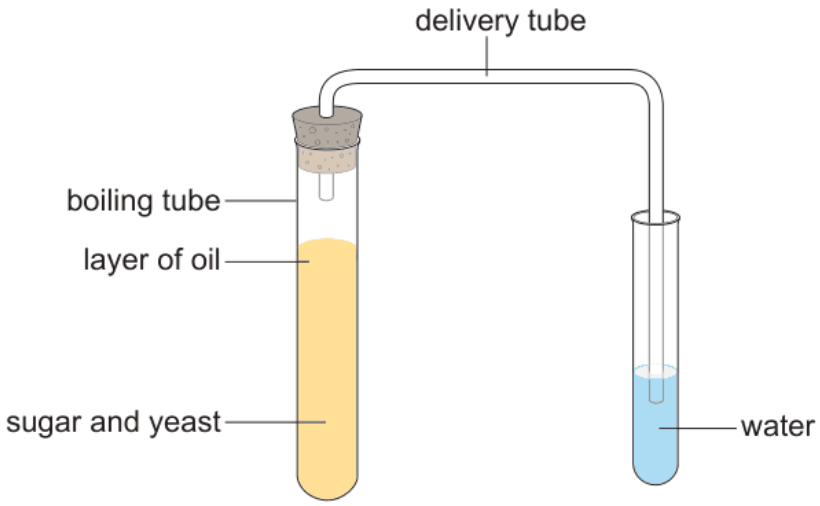
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(b) During the production of sparkling wine, additional sugar and yeast are added during a second fermentation.
An experiment was carried out to determine the best sugar to use when producing sparkling wine.

For each sugar, the following method was followed:

1. Add 10 cm^3 of 1 $g\,cm^{-3}$ yeast suspension to a boiling tube.
2. Add 10 cm^3 of a 2 $g\,cm^{-3}$ solution of the sugar being tested to a test tube.
3. Place both test tubes in a water bath at 30°C and leave for 5 minutes.
4. Pour the sugar solution into the yeast suspension and mix well.
5. Cover the surface with a thin layer of oil and place the bung with the delivery tube into the boiling tube as shown in **Image 3.2**.

Image 3.2



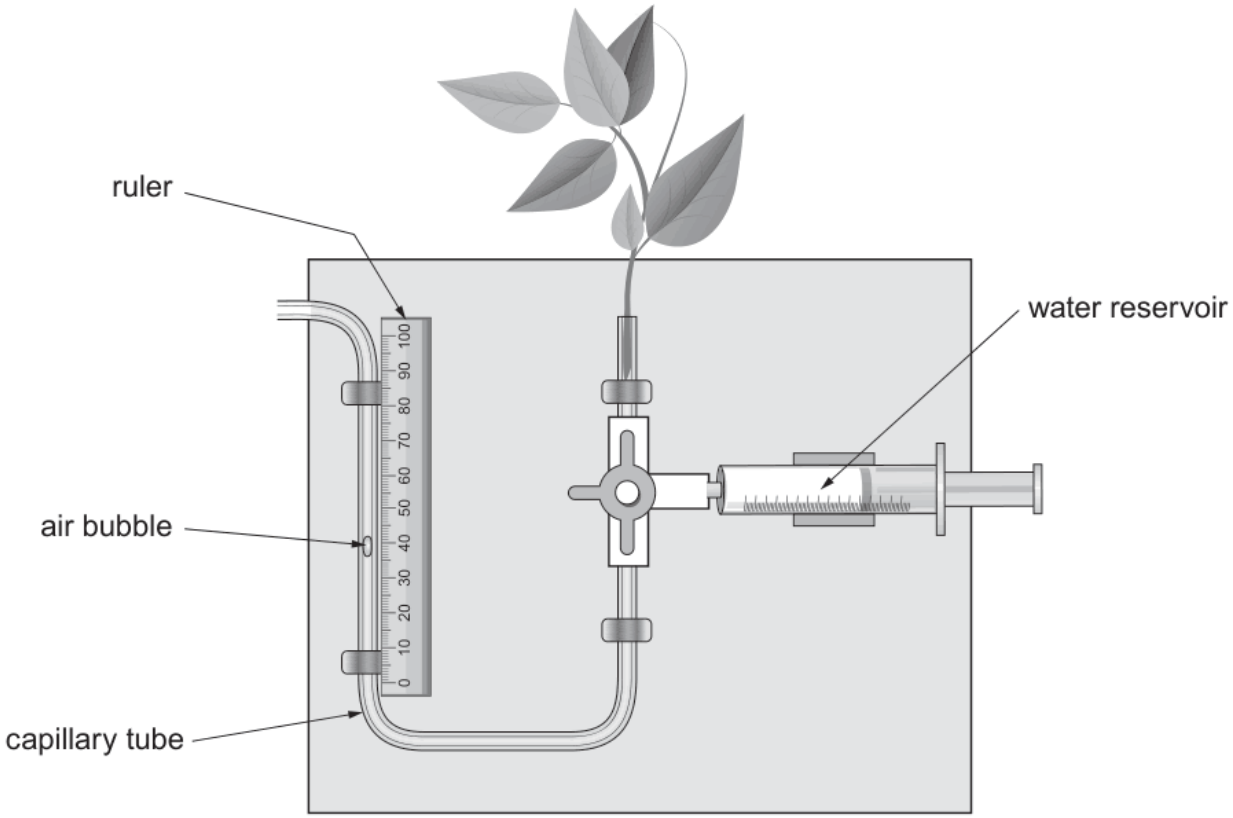
6. When gas bubbles emerge regularly from the delivery tube, count the number released in one minute.
7. Repeat step 6 for two more periods of 1 minute.

(i) Both test tubes were left in the water bath for 5 minutes in step 3.
Explain why this was necessary. [1]

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3. The rate of water uptake by a plant shoot can be measured in the laboratory using a potometer. Students set up a potometer as shown in figure 3.1.

Figure 3.1



The students investigated the effect of light intensity on the rate of water uptake by shining a light onto the shoot. They changed the light intensity by placing a lamp at different distances from the shoot.

(a) (i) The diameter of the capillary tube was measured as 1 mm. State **three** *other* measurements they would need to take in order to calculate the rate of water uptake in $mm^3\ cm^{-2}\ minute^{-1}$ at each light intensity. [2]

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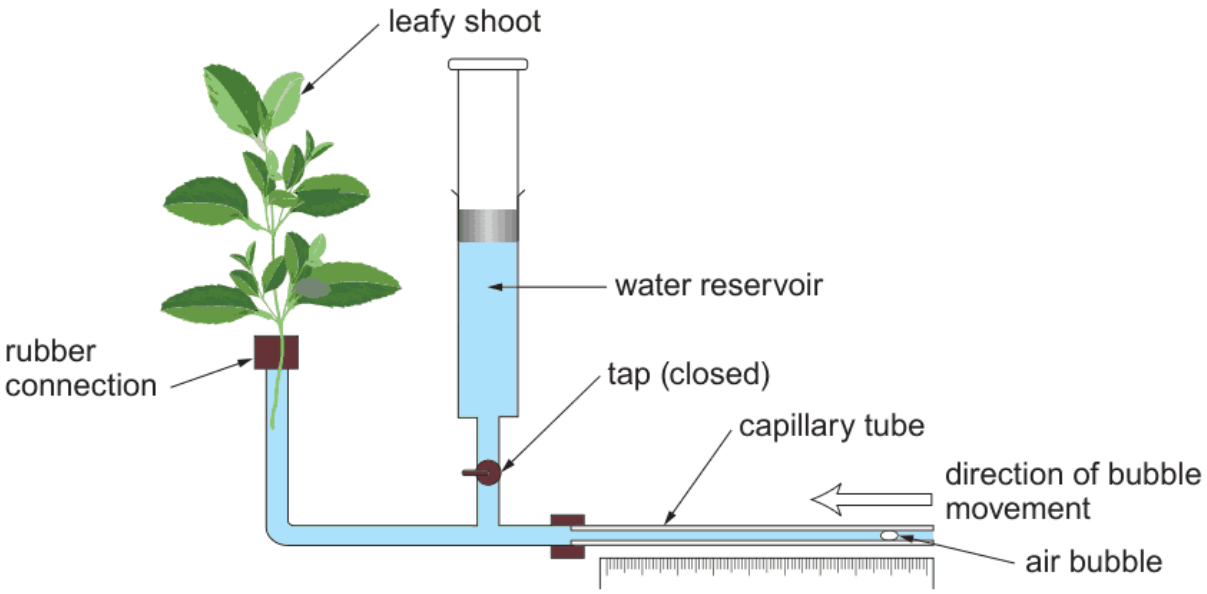
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(b) A potometer was set up, as shown in **image 2.1**, to investigate transpiration in plants. The shoot was exposed to a range of different air speeds using a hairdryer.

Image 2.1



(i) Using the fast air speed, the air bubble in the capillary tubing moved 47 mm in 12 minutes. The capillary tubing diameter was 1 mm. Calculate the volume of water lost through transpiration from the shoot **per hour** using the formula $\pi r^2 h$. [3]

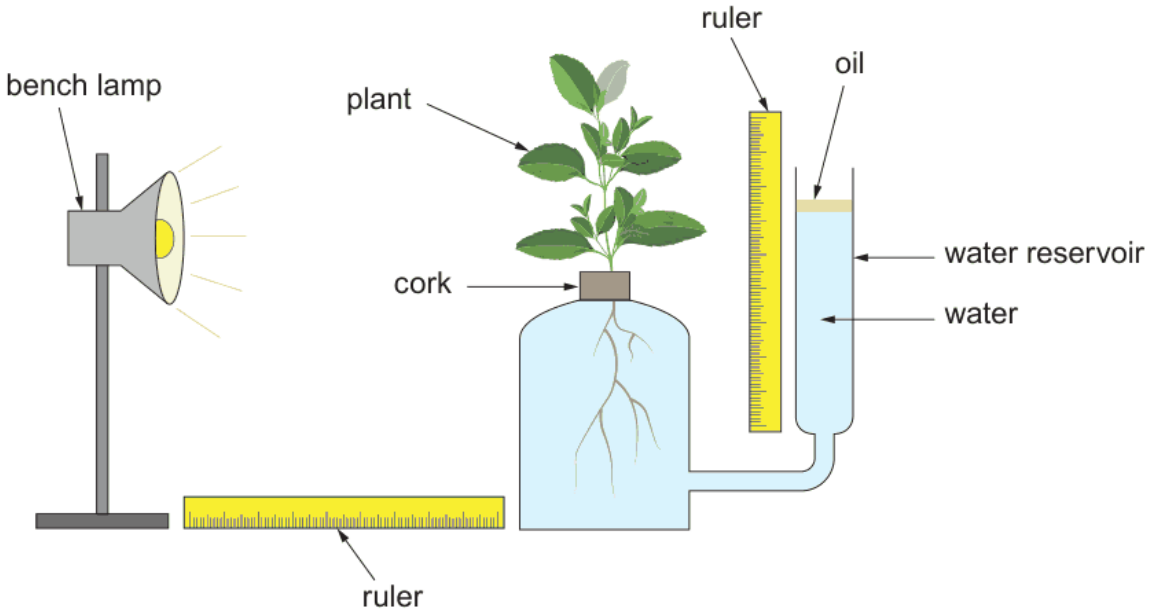
π = 3.14
h = distance moved

Volume of water lost = ... $mm^3\ hr^{-1}$

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5. (a) A potometer can be used to measure the uptake of water by a plant. **Image 5.1** shows one type of potometer.

Image 5.1



(i) The potometer was used to investigate the effect of changing light intensity on the uptake of water by the roots.

State the following for this investigation: [2]

I. the independent variable;

.....

II. the dependent variable.

.....

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Question 21 · information from earlier in the question

(b) **Table 5.2** shows the results from the experiment shown in **Image 5.1**.

Table 5.2

	Distance the water had moved in one hour / mm			
Distance of lamp from plant / cm	Trial 1	Trial 2	Trial 3	Mean
10	6	5	8	6.33
20	4	4	6	.....
30	3	3	3	3.00
40	2	2	2	2.00
50	1	0	0	0.33

Question 21 · AS Component 2 · June 2022 · Q5(b)(ii) · 3 marks

(ii) Calculate the volume of water taken up by the roots per minute when the lamp was 30 cm from the plant, using the formula $\pi r^2 h$. [3]

The diameter of the water reservoir was 8 mm.

π = 3.14

h = distance moved by water in the reservoir

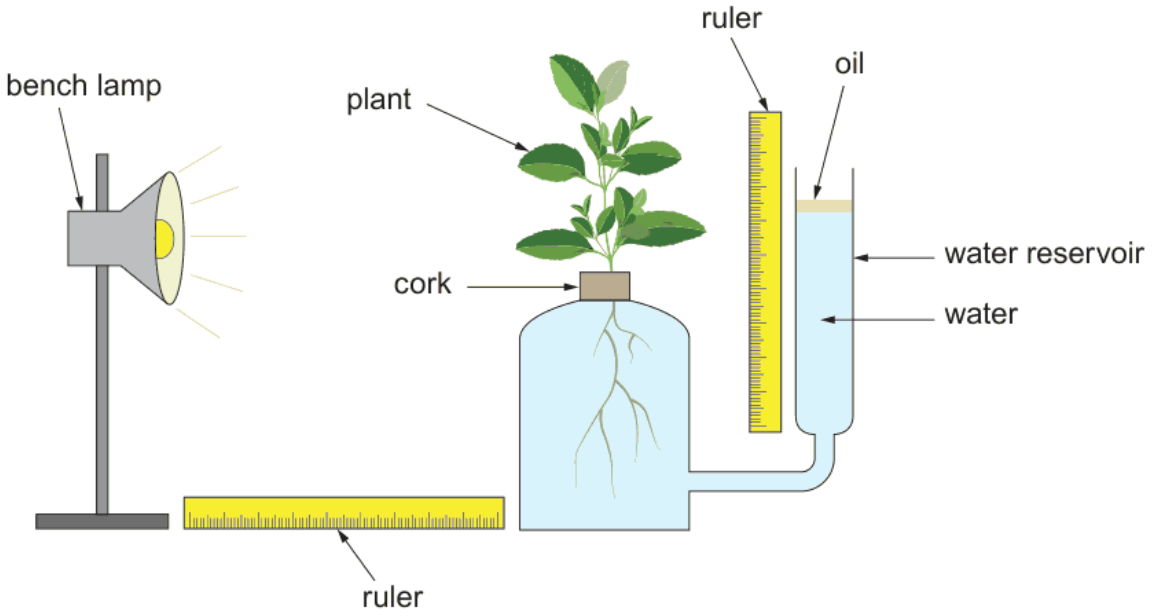
Volume = ... $mm^3\ min^{-1}$

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Question 22 · information from earlier in the question

5. (a) A potometer can be used to measure the uptake of water by a plant. **Image 5.1** shows one type of potometer.

Image 5.1



Question 22 · AS Component 2 · June 2022 · Q5(b)(iii) · 2 marks

(iii) Suggest how the method could be modified to investigate the effect of wind speed on water uptake by the roots. [2]

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Mark schemes

Question 1 · A level Component 1 · June 2019 · Q4(c)(i) · 3 marks

	(c) (i)		Ice cold	{Stops/slows} {enzyme activity/ disruption of membrane} (1)			
			Isotonic	Maintains same Ψ inside and outside (mitochondrion) / stops {osmosis/ water movement / (osmotic) lysis} (1)			
			Buffer	Maintains optimum pH/ stopping pH change (1)			

	3		3		3

Question 2 · A level Component 1 · June 2019 · Q4(c)(iii) · 3 marks

(iii)	40°C is the optimum temperature (1) 10°C very unreliable/ least reliable (1) Any correct use of data with respect to the reliability of any of 20 - 60°C (1)	3	3

Question 3 · A level Component 1 · June 2025 · Q1(b)(i) · 1 mark

(b)	(i)	(changes in temperature) do not affect {enzyme activity / KE of molecules / rate of reaction} / owtte (1)	1	1	1

Question 4 · A level Component 1 · June 2025 · Q1(b)(ii) · 2 marks

(ii)	Acts as control (experiment) (1) Shows that {change in colour / results} is due to {dehydrogenases / enzymes / respiration} (in the yeast) (1)	2		2	2

Question 5 · A level Component 1 · Autumn 2021 · Q1(b)(i) · 2 marks

(b)	(i)	Pencil does not dissolve in solvent/ ORA (1) {Pigments in ink/ sample} would dissolve in solvent (1)	2		2	2

Question 6 · A level Component 1 · Autumn 2021 · Q1(b)(ii) · 1 mark

(ii)	Spot extract, {evaporate /dry}, repeat.	1	1	1

Question 7 · A level Component 1 · Autumn 2021 · Q1(b)(iv) · 1 mark

(iv)	Same {solvent / chromatography paper / TLC medium}	1	1	1

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Question 8 · A level Component 1 · June 2024 · Q4(b)(ii) · 1 mark

(ii)	Pencil {does not dissolve / is insoluble} (in the solvents used) / ink would {dissolve / is soluble}	1	1	1

Question 9 · A level Component 1 · June 2017 · Q4(d)(i) · 4 marks

(d)	(i)	A. Change light wavelength/ or description e.g. using filters/ bulbs (1) B. Record the time taken for discs to rise (1) C. Keep hydrogen carbonate concentration constant/ temperature constant/ light intensity/ height of solution (1) D. same colour leaf/ {area/diameter/ size} discs/ species of plant (1)	4	4	6

Question 10 · A level Component 1 · June 2017 · Q4(d)(ii) · 2 marks

(ii)	{Less time/ faster} to rise at the {blue/ violet/ short/ approx. 350nm} **and** {red / longer/ approx. 650nm} wavelengths (1) {Slower to /More time to/ does not } rise in the {yellow/green/ approx. 500nm} wavelengths (1)	2	2	

Question 11 · A level Component 1 · Autumn 2021 · Q3(a)(i) · 1 mark

3	(a)	(i)	Prevent increase in temperature in plant chamber	1	1	1

Question 12 · A level Component 1 · Autumn 2021 · Q3(a)(iii) · 2 marks

(iii)		Repeat with same apparatus and conditions (1) No plant (1)	2	2		2

Question 13 · A level Component 1 · June 2017 · Q2(c) · 4 marks

(c)			Any four (x1) from A. Set up separate tubes with {(culture) solution/ soil} containing {additional N, NPK and NPKS/ each fertiliser} (1) B. record the dry mass of the seedlings {weekly/ at the end/ named time period}(1) C. Select equal size grass seedlings/ {same number/ type} of seeds (1) D. Named other controlled {variable/ condition} e.g. light/ temperature/ pH (1) E. Set up control tubes with no added {macronutrients/ fertiliser} (1) F. Solutions should be topped up/ watered {when necessary/ regularly} (1)	4	4		4

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Question 14 · A level Component 1 · June 2025 · Q3(b)(iv) · 3 marks

	(iv)		Correct labels and scale: X axis = micronutrient omitted **and** bar labels (1) Y = mean dry mass + mg (unit) + suitable linear scale **with number at origin** (1) Bars drawn to correct height (1) If plot an (x,y) graph then penalise last mp only	3		3	3	3

Question 15 · A level Component 1 · Autumn 2020 · Q6(c) · 3 marks

(c)	Repeated with boiled and cooled yeast. (1) Keep all other conditions the same. (1) Control required to show that effects are being caused by yeast and no other factor. (1)	3	3	3

Question 16 · A level Component 1 · Autumn 2020 · Q6(d)(i) · 3 marks

(d)	(i)	SD = 3.54 (3) Award 2 marks for $\sqrt{\frac{50}{4}}$ Award 1 mark for $\sum(x - \bar{x})^2 = 50$	3	3	3	3

Question 17 · A level Component 1 · June 2024 · Q3(b)(i) · 1 mark

(b)	(i)	**Any one (x1) from** Allow {enzymes / yeast} and substrate to {reach the same temperature / equilibrate} (1) Allow {both / the} tubes to {reach the same temperature / equilibrate} (1) Reject acclimatise / adjust / reach equilibrium	1	1	1

Question 18 · A level Component 3 · June 2019 · Q3(a)(i) · 2 marks

3	*(a)*	(i)	**All three ✓ = 2; 2 ✓ = 1 1 ✓ = 0** • distance (travelled by bubble)/ position of bubble at start and end/ movement of air bubble in {mm/cm}; • {surface/ leaf} area (of leaves); • Time/ how long it took the air bubble to move;	2	2	2

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Question 19 · AS Component 2 · Autumn 2020 · Q2(b)(i) · 3 marks

(b)	(i)	Accept any answer between184 – 185.57 mm^3/hr = 3 marks $\frac{60}{12}$ x 36.9 or $\frac{60}{12}$ x 36.895 = 2 marks 3.14 x $(0.5)^2$ x 47 = 36.9/36.895 = 1 mark	3	3	3	3		

Question 20 · AS Component 2 · June 2022 · Q5(a)(i) · 2 marks

5	(a)	(i)	I	The distance the light is from the plant (1)	1	1	1
			II	The distance the {water level dropped/ fell/meniscus moved/water moved/height of water} (1)	1	1	1

Question 21 · AS Component 2 · June 2022 · Q5(b)(ii) · 3 marks

(ii)	2.51 mm^3 min^{-1} = 3 marks accept 2.5 150.72/60 = 2 marks or 150.79644737/ 60 (used π from calculator Award 1 mark for 3.14 x 4^2x3 150.72 / 150.79644737 (used π from calculator) 1.51 if used 300 or 30 = 51.2 or 25.1 ecf 1 mark	3	3	3			

Question 22 · AS Component 2 · June 2022 · Q5(b)(iii) · 2 marks

	(iii)	Control light intensity (owtte) (1) Range of 5 wind speeds (1)	2	2	2		

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