Graph Skills (MS 3): AQA A Level Biology Exam Questions by Topic

17 questions · 33 marks · about 43 minutes. Answer in the spaces, then check the mark schemes at the end.

Question 1 · A level Paper 3 · June 2022 · Q01.4 · 1 mark

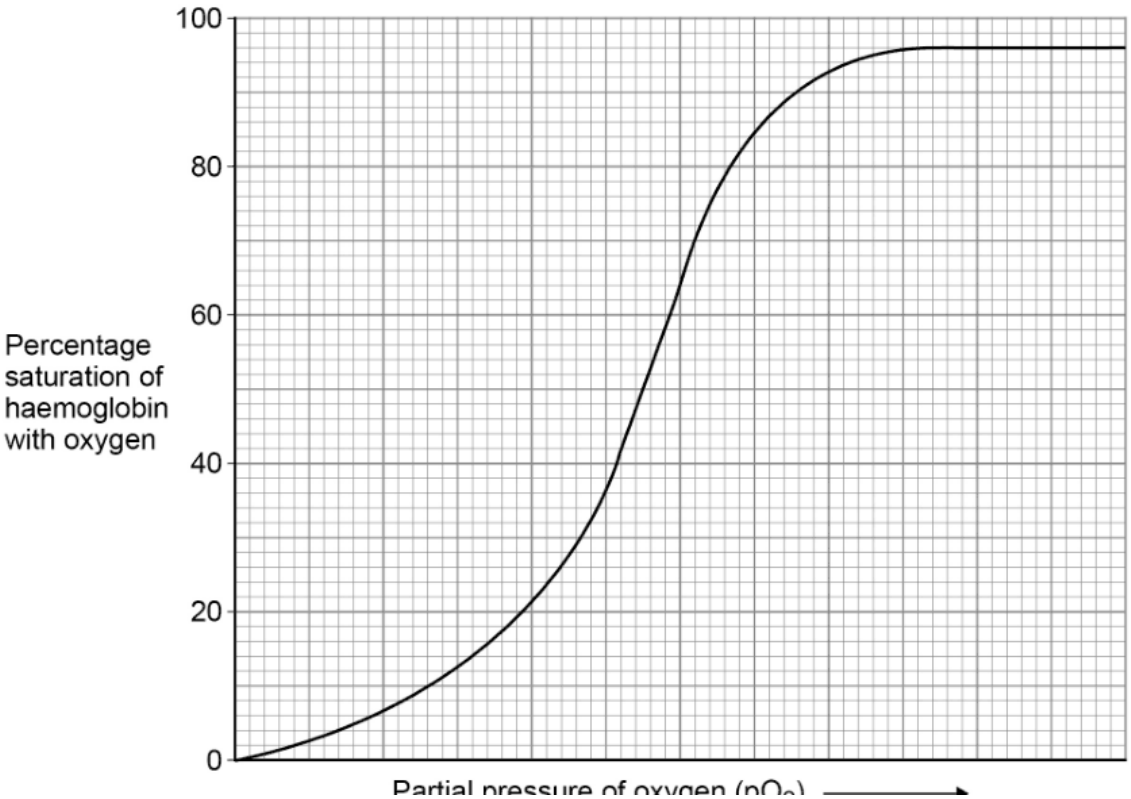
When a substance called BPG binds to haemoglobin, it reduces the affinity of haemoglobin for oxygen.

0 1 . 4 **Figure 3** shows an oxyhaemoglobin dissociation curve for haemoglobin in normal conditions.

Sketch a curve on **Figure 3** to show the oxyhaemoglobin dissociation curve for haemoglobin when BPG binds to it.

[1 mark]

Figure 3

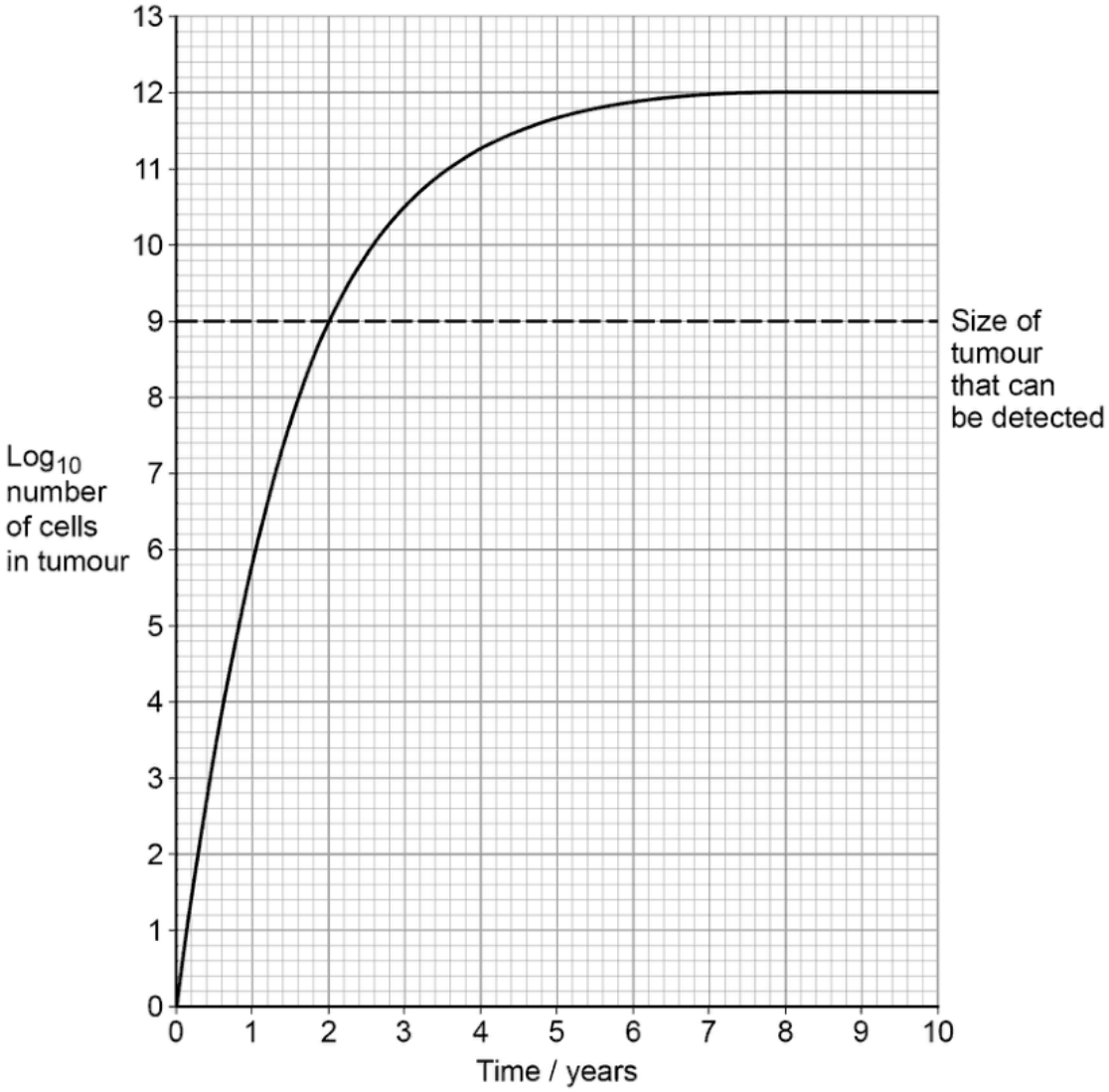


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0 6 Uncontrolled cell division can cause tumours to form.

Figure 7 shows the growth pattern followed by a type of tumour.

Figure 7



0 6 . 1 Use **Figure 7** to calculate the percentage of maximum growth this type of tumour reaches before it can be detected.

You will need to use the 10^x button on your calculator.

[1 mark]

Answer = _____ %

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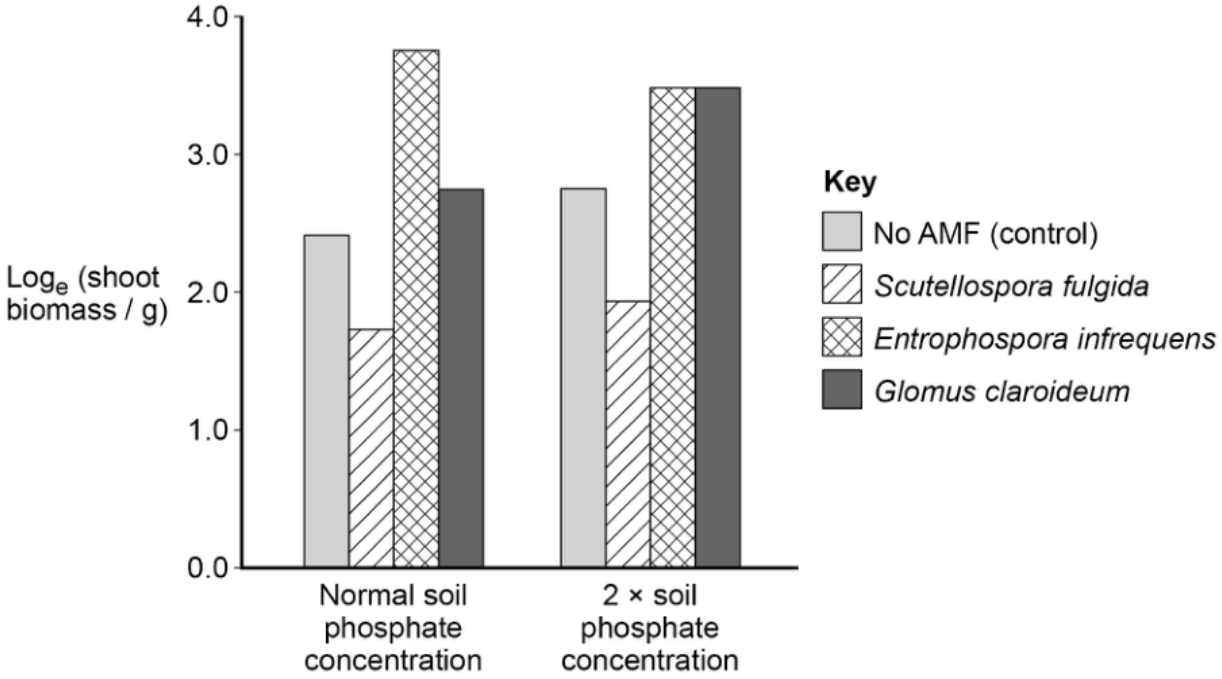
Question 3 · information from earlier in the question

0 5 . 3 Scientists investigated the effects of different AMF species on the productivity of the plant community of a prairie grassland ecosystem when growing in/on soil containing different phosphate concentrations.

The scientists set up identical plots of prairie grassland soil containing seeds of the plant species found in the ecosystem. The scientists added different AMF species and different concentrations of phosphate to particular plots. Control plots without AMF species were also set up. After 20 weeks the scientists determined the shoot biomass for each plot.

The results the scientists obtained are shown in **Figure 5**.

Figure 5



Explain why an increase in shoot biomass can be taken as a measurement of **net** primary productivity.

[2 marks]

Question 3 · A level Paper 2 · June 2017 · Q05.5 · 2 marks

0 5 . 5 Using the e^x button on your calculator, determine the rate of shoot biomass production in grams per day for the control plot in soil with normal phosphate concentration.

[2 marks]

Answer = _____ g day^{-1}

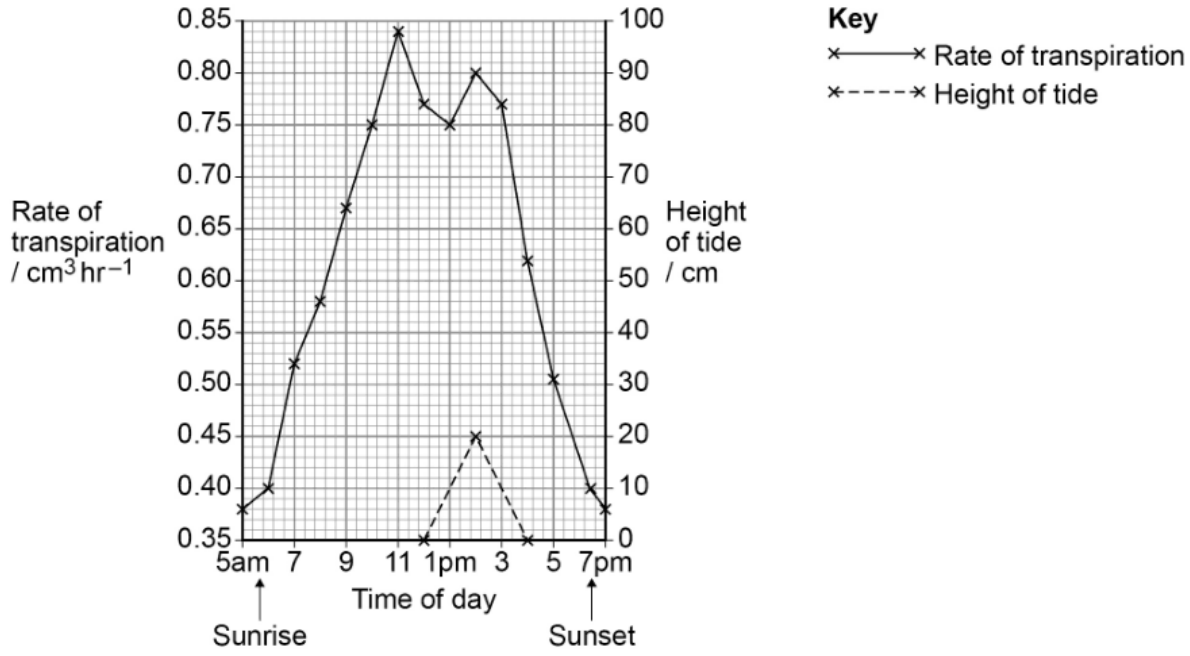
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Question 4 · information from earlier in the question

0 6 Mangrove trees grow near the sea. Sea water surrounds the lower parts of the trees at high tide.

Scientists investigated the rate of transpiration in a mangrove tree.
Figure 9 shows the scientists' results.

Figure 9



Question 4 · A level Paper 1 · June 2022 · Q06.2 · 2 marks

0 6 . 2 Use **Figure 9** to calculate the percentage increase in the rate of transpiration from 1 pm to 2 pm.

[2 marks]

Percentage increase in rate of transpiration _____ %

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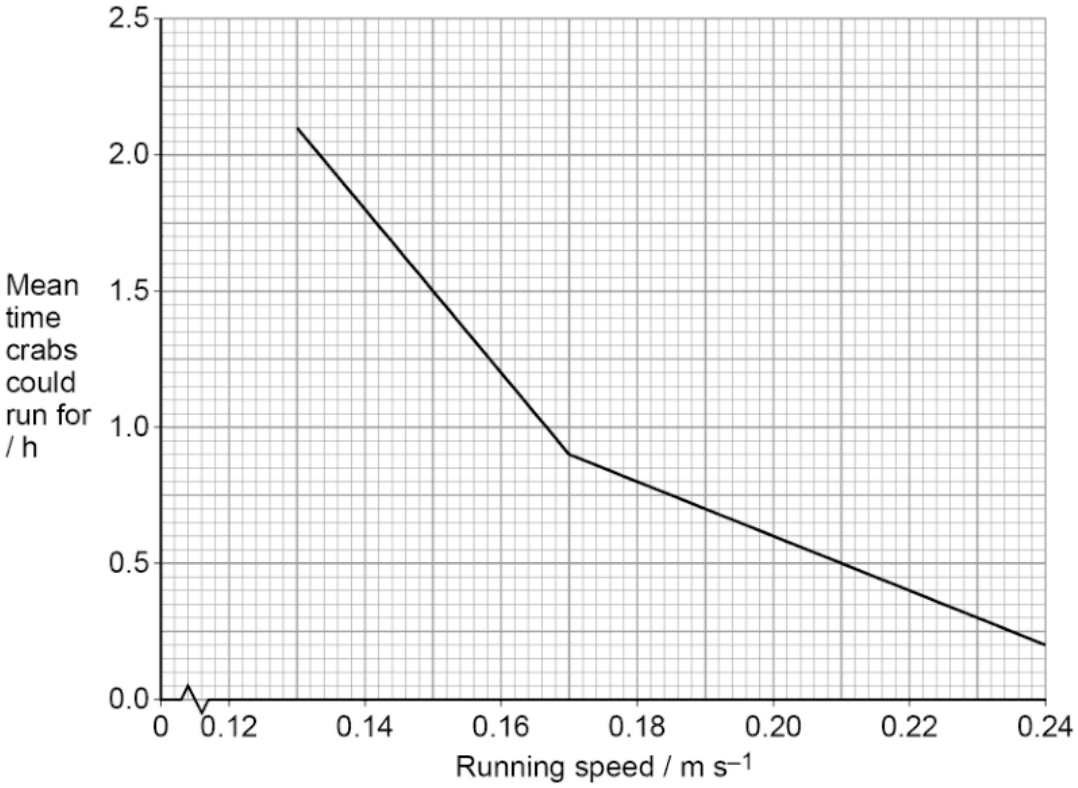
0 6 . 3 Ghost crabs live on sandy beaches.

Ghost crabs can run for a long time before they get tired and have to stop.

A scientist calculated the mean time ghost crabs could run for at different speeds before they stopped.

Figure 5 summarises the scientist's results.

Figure 5



A ghost crab running at 0.14 m s^{-1} covered a distance of 504 m in 1 hour.

Use **Figure 5** to calculate the extra distance this crab could cover if it continued running at 0.14 m s^{-1} before it stopped running.

Show your working.

[2 marks]

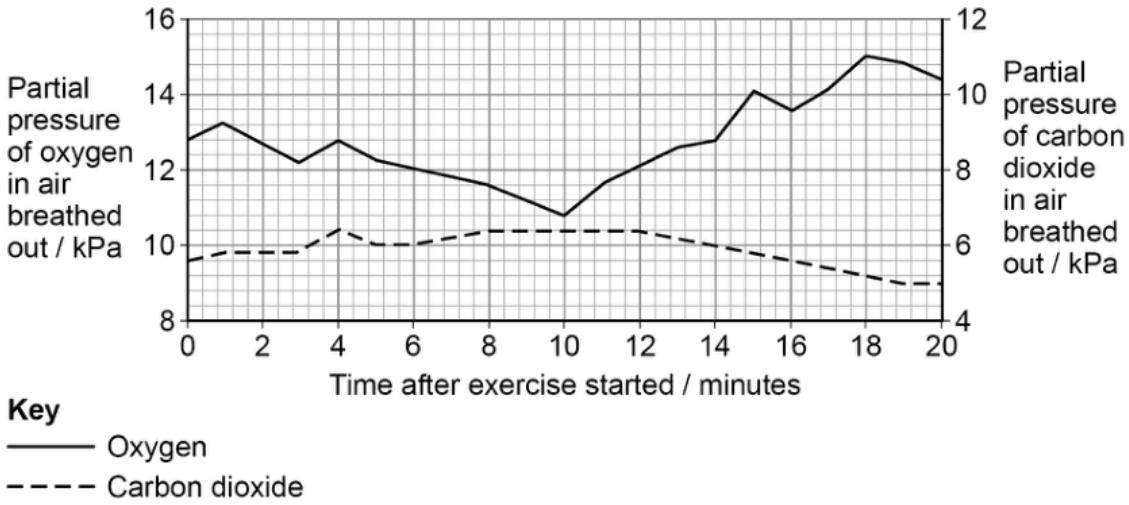
Extra distance _____ m

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A cyclist completed a fitness test on an exercise bike. The intensity of the exercise was increased every 10 seconds. The test finished when he was unable to cycle any further. The partial pressure of oxygen (pO_2) and of carbon dioxide (pCO_2) in air breathed out was measured.

Figure 3 shows the results of the cyclist's fitness test.

Figure 3



Ventilatory threshold (VT) is a measure of the point when anaerobic respiration increases because aerobic respiration alone can no longer maintain muscle contraction.

0 6 . 2 VT can be identified as the **first** point when there is an increase in pO_2 breathed out, without an equivalent increase in pCO_2 breathed out.

Use **Figure 3** to determine the **time** after the exercise started when the cyclist reached VT.

Calculate the **ratio** of pO_2 to pCO_2 in breathed-out air at this time.

Show your working.

[2 marks]

Time when the cyclist reached VT = _____ min

Ratio of pO_2 to pCO_2 at VT = _____:1

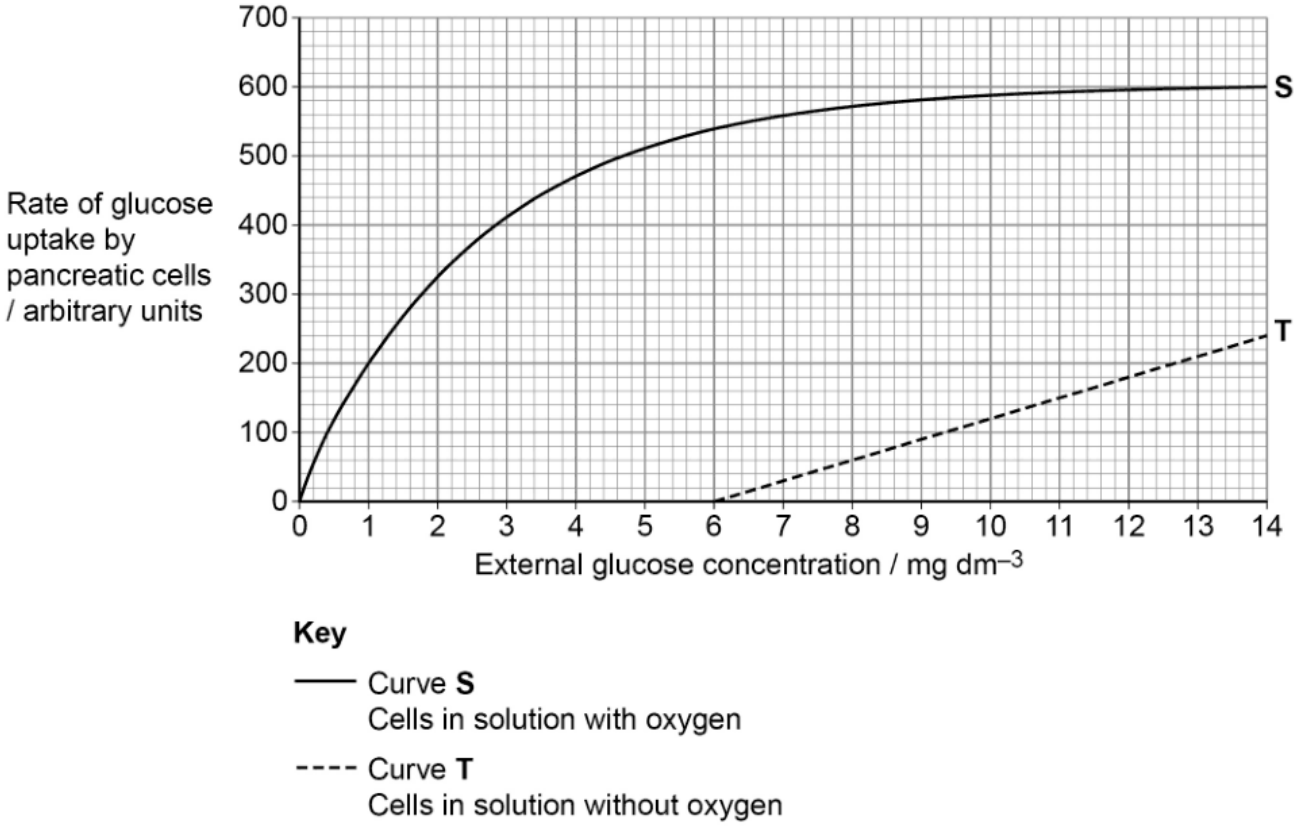
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Question 7 · information from earlier in the question

0 2 . 3 A scientist placed pancreatic cells in solutions containing different concentrations of glucose. The scientist measured the rate of uptake of glucose by these cells.

Figure 4 shows the scientist's results.

Figure 4



Using **Figure 4**, what can you conclude about the processes involved in the uptake of glucose molecules by pancreatic cells?

[3 marks]

Question 7 · AS Paper 2 · June 2025 · Q02.4 · 1 mark

0 2 . 4 Use **Figure 4** to calculate the ratio

rate of glucose uptake with oxygen : rate of glucose uptake with no oxygen

at an external glucose concentration of 14 mg dm^{-3}

[1 mark]

Ratio = _____

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0 8 A scientist investigated birth mass in a population of babies. She determined the birth mass (b) of babies and grouped this information into different ranges of birth mass.

Her results are shown in **Table 4**.

Table 4

Birth mass b / kg	Range of mass / kg	Frequency density
$0.0 < b \leqslant 2.0$	2.0	5 000
$2.0 < b \leqslant 2.5$	0.5	20 000
$2.5 < b \leqslant 3.0$	0.5	90 000
$3.0 < b \leqslant 3.5$	0.5	260 000
$3.5 < b \leqslant 4.5$	1.0	200 000
$4.5 < b \leqslant 5.5$	1.0	20 000

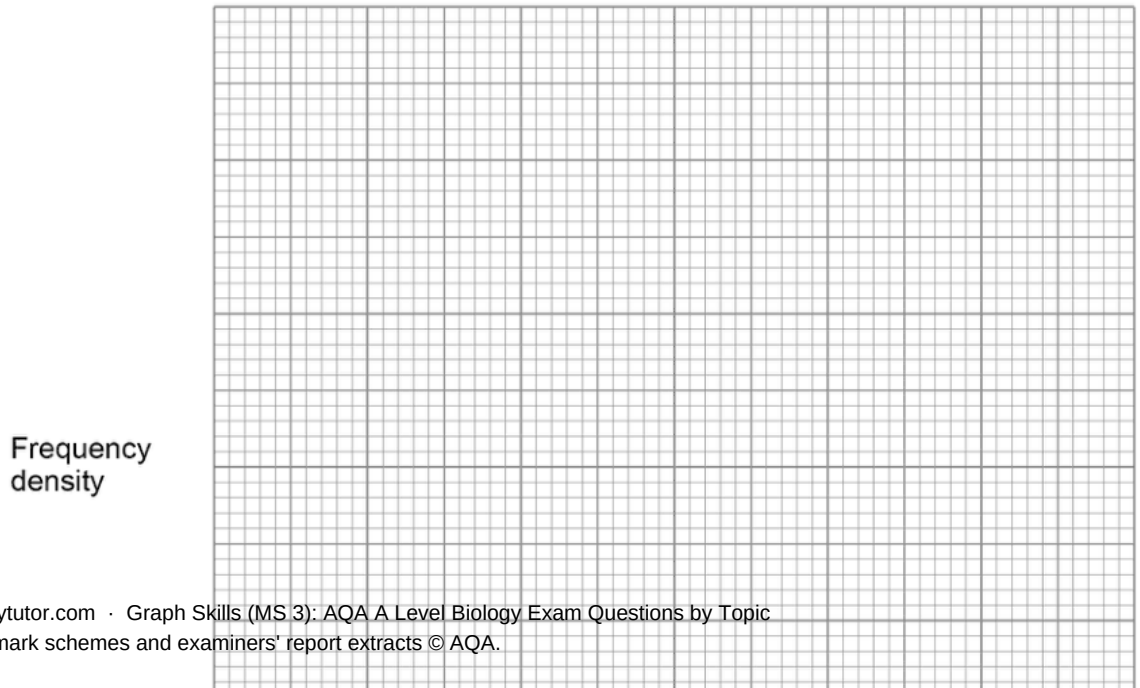
Frequency density is calculated using this equation

$$\text{Frequency density} = \frac{\text{number of babies}}{\text{range of mass}}$$

0 8 . 1 Draw, on **Figure 8**, a **suitable** chart to show the distribution of birth mass for this population of babies.

[4 marks]

Figure 8



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Question 9 · information from earlier in the question

An autoimmune disease causes the immune system to attack healthy body tissues. Scientists investigated the immune responses of healthy mice and mice with autoimmune disease.

The chemical OXA causes an immune response in mice and can make their skin swell. Mice had olive oil applied to their left ear and OXA in olive oil applied to their right ear.

The immune response was recorded in two ways:

- the cellular response by measuring the mean increase in ear thickness 24 hours after exposure to OXA
- the humoral response by measuring the mean concentration of anti-OXA antibody in blood 14 days after exposure to OXA.

Table 2 shows the results of this investigation. The values in the brackets show ± 2 standard deviations. A value of ± 2 standard deviations from the mean includes over 95% of the data.

Table 2

Type of mice	Sex of mice	Mean increase in ear thickness / cm × 10^{-3}	Mean concentration of anti-OXA antibody / arbitrary units
Healthy	Male	17.9 (±4.1)	16 (±3)
	Female	18.5 (±2.9)	14 (±4)
Autoimmune disease	Male	25.9 (±4.5)	14 (±2)
	Female	16.7 (±3.0)	26 (±7)

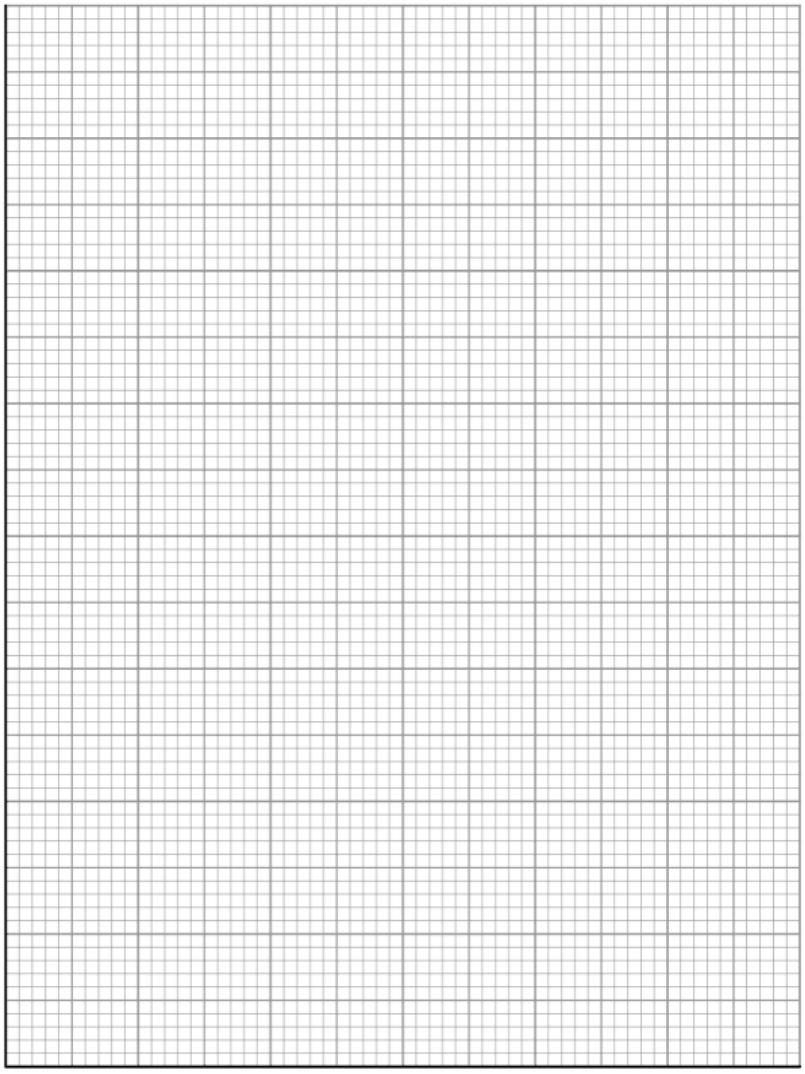
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Question 9 · A level Paper 3 · June 2023 · Q06.3 · 3 marks

0 6 . 3 Plot a suitable graph for mean increase in ear thickness for each group of mice in **Table 2**.

Include the data for ± 2 standard deviations on your graph.

[3 marks]

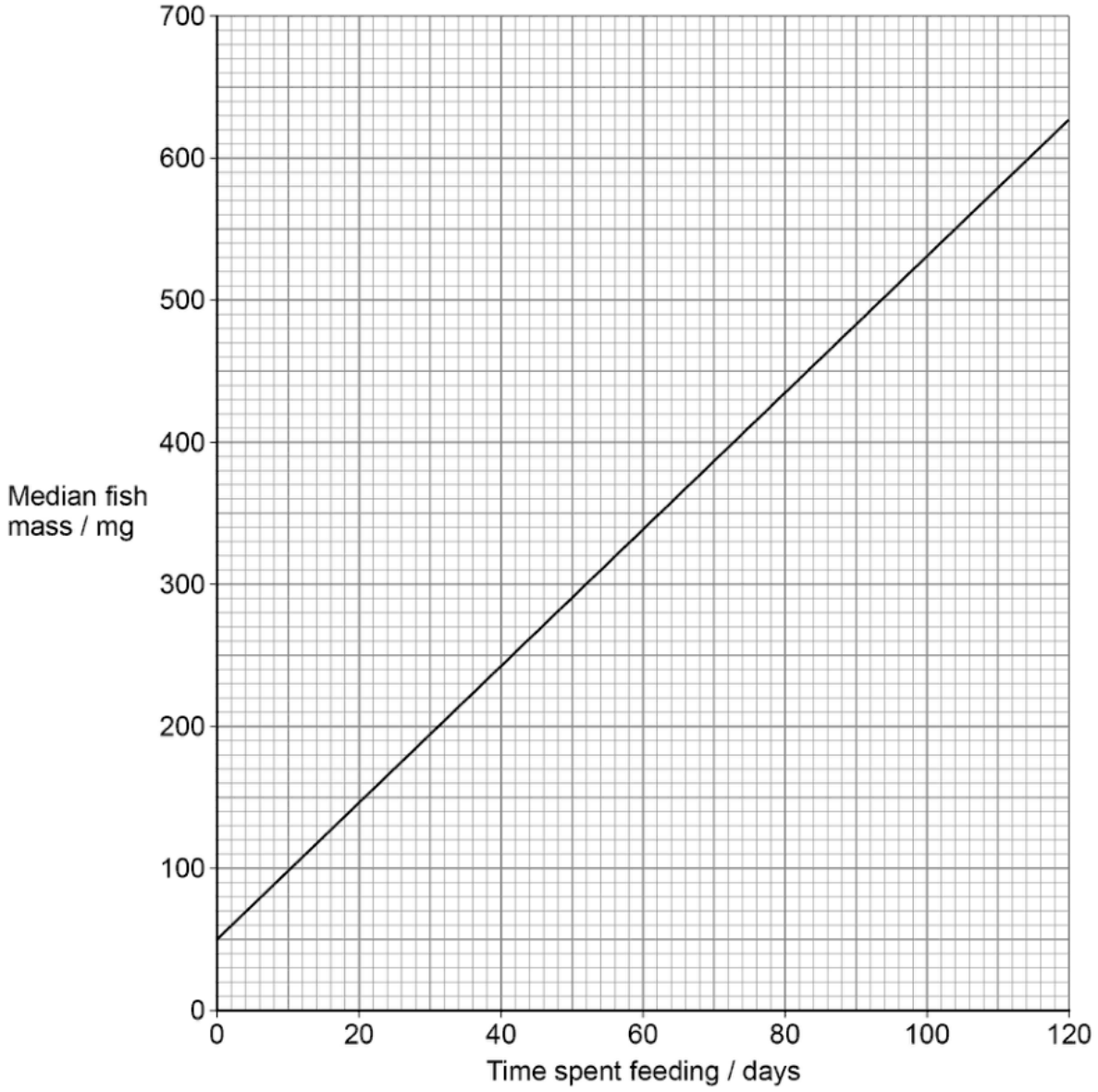


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0 6 Trout is a type of fish, often produced commercially in trout farms.

A scientist investigated the growth of farmed trout. She determined the median mass of a large population of trout at intervals. She started measuring on the day the newly hatched fish began feeding. Her results are shown in **Figure 4**.

Figure 4



The best fit line shown in **Figure 4** is represented using this equation.

$$\text{median fish mass} = (m \times \text{days feeding}) + 50$$

where m is the gradient of the best fit line.

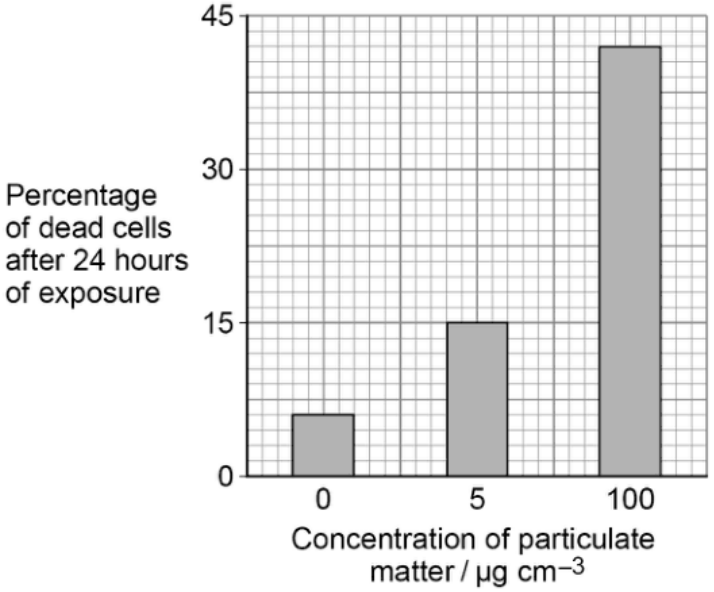
0 6 . 1 Use **Figure 4** and the equation to calculate the median mass of fish after 195 days' feeding.

Show your working.

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Scientists grew alveolar epithelium cells and exposed the epithelium cells to different concentrations of particulate matter. They calculated the percentage of these alveolar epithelium cells that died after 24 hours of exposure to particulate matter. Their results are shown in **Figure 6**.

Figure 6



0 6 . 2 Do the data in **Figure 6** show a linear relationship between concentration of particulate matter and percentage of dead cells?

Use suitable calculations to justify your answer.

[2 marks]

Space for your calculations:

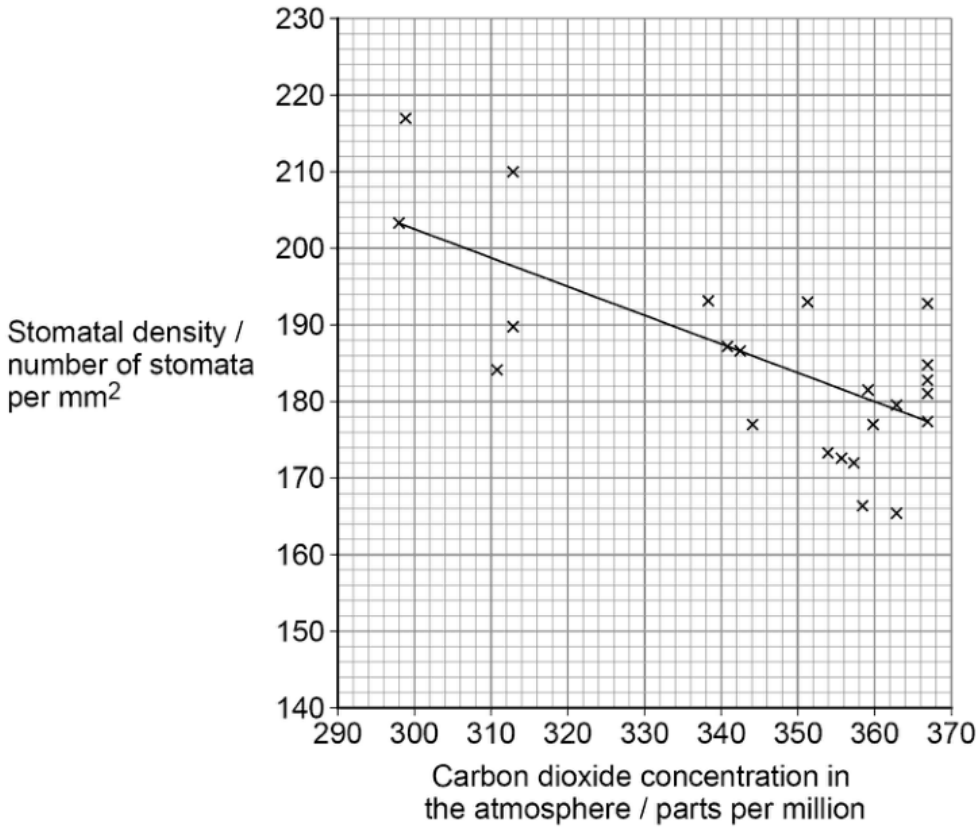
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Question 12 · information from earlier in the question

The scientists used leaves from individual trees that had grown in different areas of the world in different years. Each tree had grown in an area and year with known carbon dioxide concentration.

Their results are shown in **Figure 10**.

Figure 10



Key

Each plotted point represents mean stomatal density from 10 leaves from one tree

Line shows line of best fit, which shows a statistically significant change

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Question 12 · A level Paper 1 · November 2020 · Q09.3 · 2 marks

0 9 . 3 From 1910 to 2000, the carbon dioxide concentration in the atmosphere increased from 300 parts per million to 365 parts per million.

Use **Figure 10** to calculate the mean rate of change in stomatal density from 1910 to 2000.

Give your answer as number of stomata per mm^2 per 10-year period.

Show your working.

[2 marks]

Number of stomata per mm^2 per 10-year period _____

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Question 13 · information from earlier in the question

0 6 Ammonia in soil is oxidised to nitrites and nitrates by species of nitrifying bacteria.

Scientists investigated whether two soils with a different pH contained different communities of nitrifying bacteria. These communities consist of all the nitrifying bacteria of different species in each soil. They took samples of soil from two sites, **A** and **B**.

They measured the pH of the samples and found that

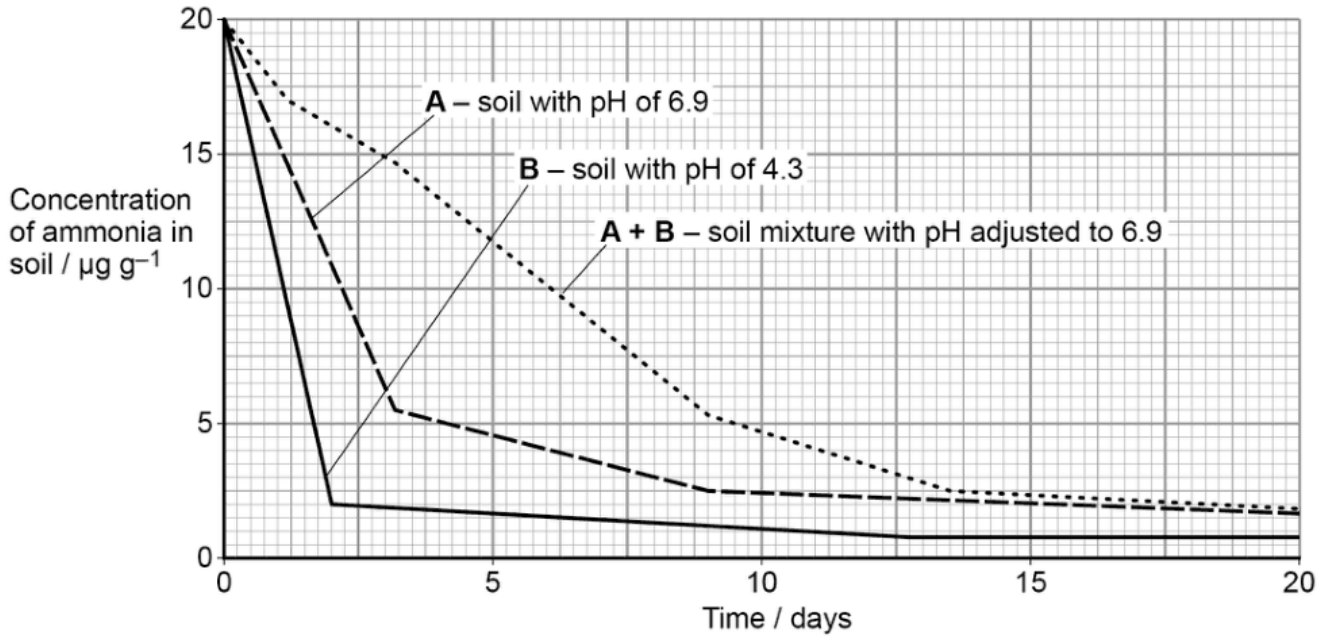
- the soil from site **A** had a pH of 6.9
- the soil from site **B** had a pH of 4.3

The scientists measured the concentration of ammonia in soil samples over 20 days. Each sample contained the same concentration of ammonia at the start and had the same mass. They recorded the concentration of ammonia in

- soil **A** with a pH of 6.9
- soil **B** with a pH of 4.3
- a mixture of equal masses of soils **A** and **B** with its pH adjusted to 6.9

Their results are shown in **Figure 6**.

Figure 6



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Question 13 · A level Paper 3 · June 2018 · Q06.2 · 2 marks

0 6 . 2 Calculate the difference in the rate of breakdown of ammonia per day between day 0 and day 2 in soil **A** and soil **B**.

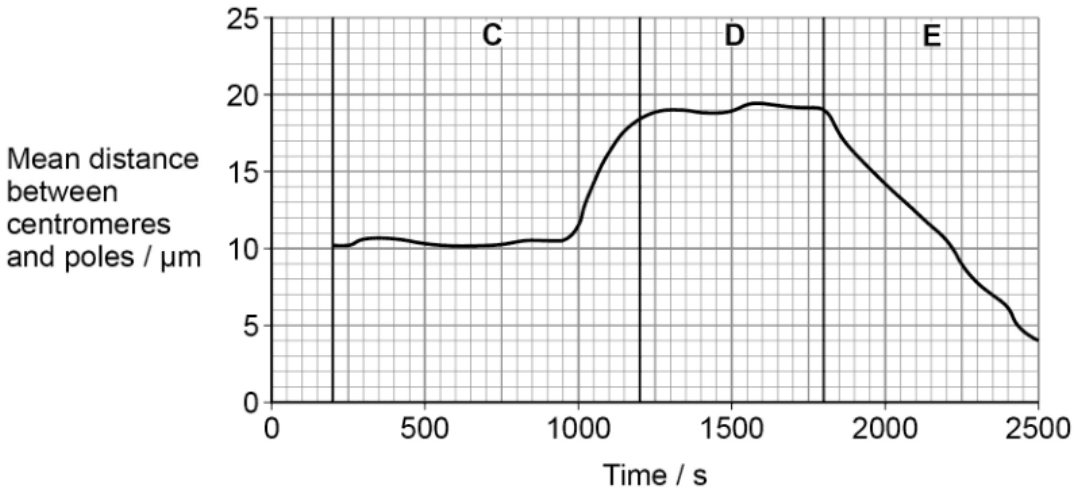
Show your working and the units for your answer. **[2 marks]**

Difference in rate = _____

Question 14 · A level Paper 1 · November 2021 · Q06.1 · 2 marks

0 6 . 1 **Figure 7** shows the mean distance between centromeres and the poles (ends) of the spindle during mitosis.

Figure 7



Calculate the rate of movement of the centromeres during phase **E**.

Give your answer in µm minute^{-1} **and** to 3 decimal places.

[2 marks]

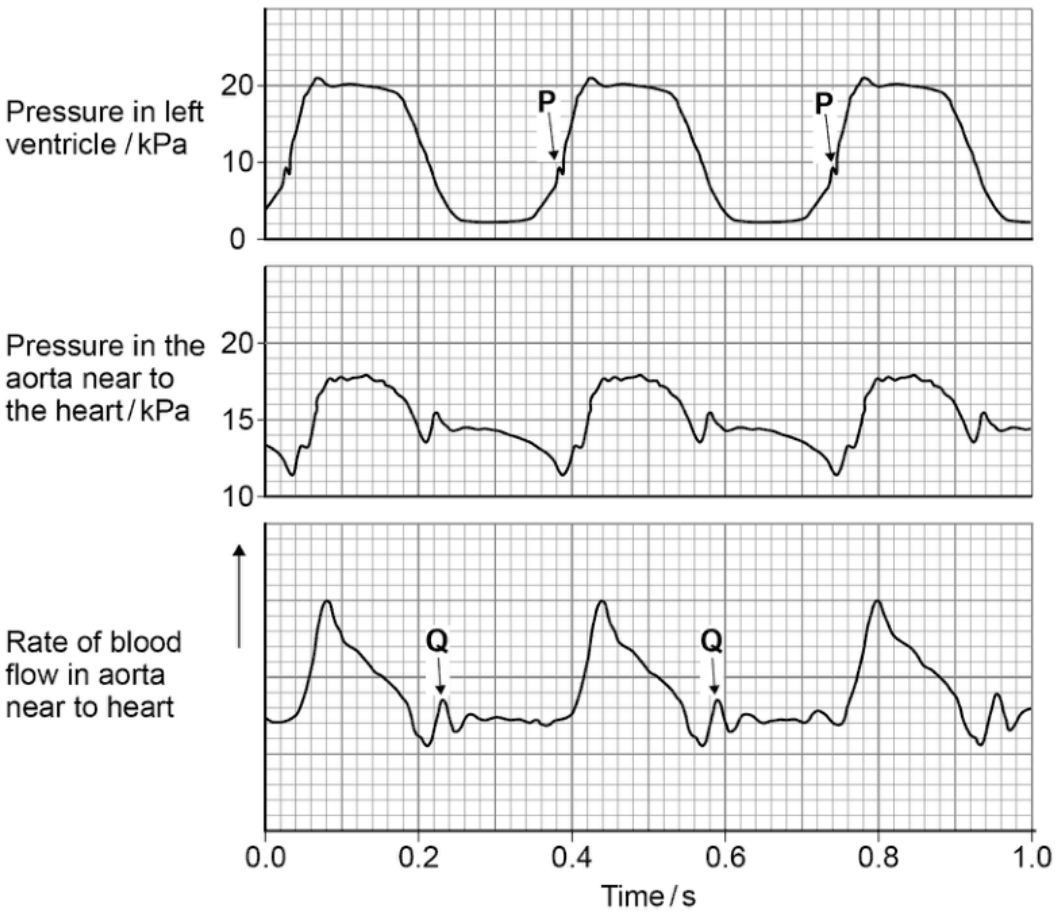
_____ µm minute^{-1}

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Question 15 · information from earlier in the question

0 3 **Figure 3** shows pressure and blood flow during the cardiac cycle in a dog.

Figure 3



Question 15 · A level Paper 1 · November 2020 · Q03.4 · 1 mark

0 3 . 4 Use information from **Figure 3** to calculate the heart rate of this dog.

[1 mark]

Heart rate _____ beats minute^{-1}

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Question 16 · information from earlier in the question

0 6 A scientist investigated the effect of the lung disease emphysema on lung function.

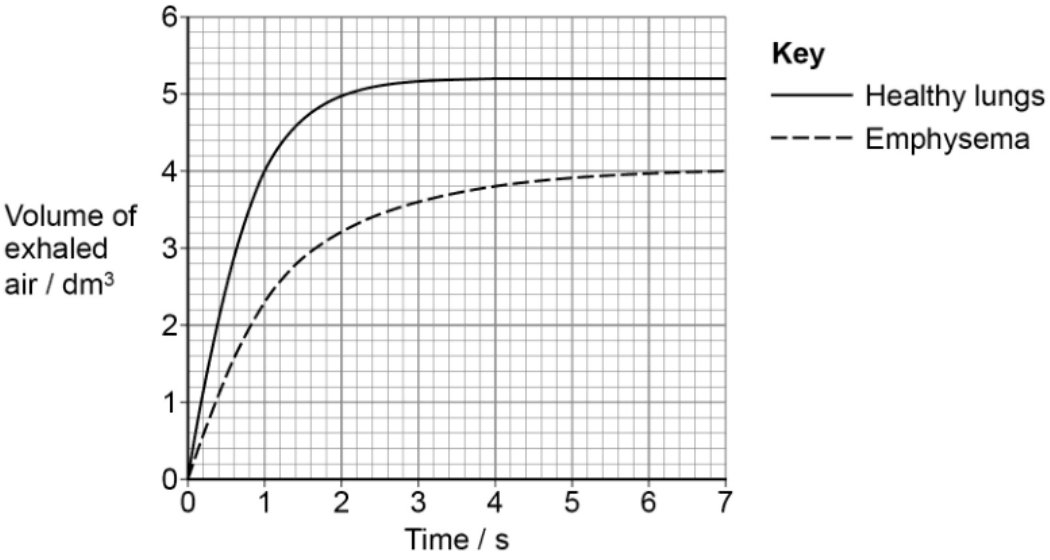
They investigated lung function in:
- a person with emphysema
- a person with healthy lungs.

The scientist told each person:
- to breathe in fully
- then breathe out fully and as quickly as possible.

The scientist measured the volume of air exhaled in one breath.

Figure 7 shows the scientist's results.

Figure 7



Question 16 · AS Paper 1 · June 2025 · Q06.2 · 2 marks

0 6 . 2 Use **Figure 7** to determine the speed of exhalation, in $dm^3\ s^{-1}$, for the person with healthy lungs **at** time = 2 s

Show your working.

[2 marks]

Speed of exhalation _____ $dm^3\ s^{-1}$

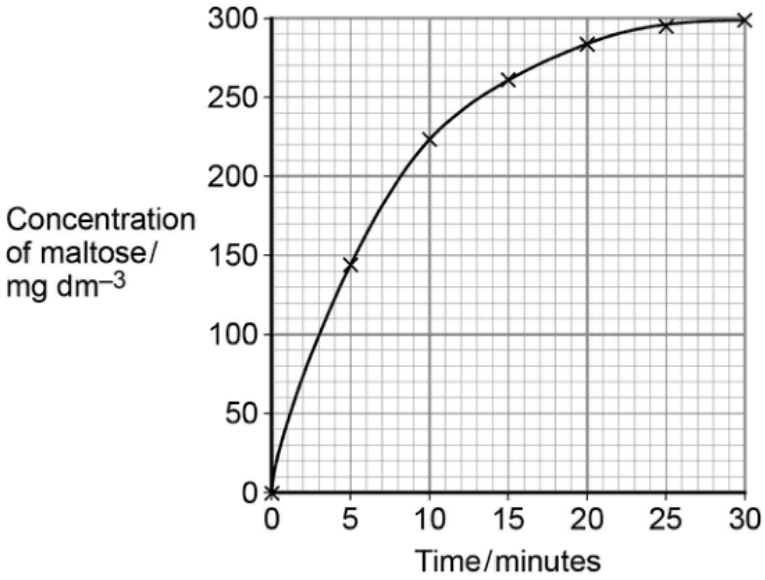
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Question 17 · AS Paper 1 · June 2016 · Q06.2 · 2 marks

0 6 . 2 A scientist investigated the hydrolysis of starch.
He added amylase to a suspension of starch and measured the concentration of maltose in the reaction mixture at regular intervals.

His results are shown in **Figure 4**.

Figure 4



Determine the rate of the reaction **at** 10 minutes.
Show how you obtained your answer.

[2 marks]

Rate of reaction _____ mg dm^{-3} min^{-1}

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Mark schemes

Question 1 · A level Paper 3 · June 2022 · Q01.4 · 1 mark

01.4	Accept curve drawn to the right, following the same pattern **and** starting at Y = 0 and finishing at the same percentage saturation as original curve;	1 (AO3)

Question 2 · A level Paper 3 · June 2019 · Q06.1 · 1 mark

06.1	0.1 ;	1

Question 3 · A level Paper 2 · June 2017 · Q05.5 · 2 marks

05.5	1. Answer in range 0.07 to 0.09 = **2 marks**;;	2
	2. Answer in range 9.97 to 12.2 OR Shows division by 140 or 20 x 7 = 1 mark;	

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Question 4 · A level Paper 1 · June 2022 · Q06.2 · 2 marks

06.2	Correct answer for 2 marks, 6.6̇, 6.67 – 7 (%);; Accept for 1 mark, 0.05 (correct difference in transpiration rate) **OR** 6.6 (correct calculation, but incorrect rounding) **OR** 6.25/6.3 (correct calculation using incorrect denominator) **OR** 666/667 correct number sequence but decimal place in wrong place eg 66.7/0.0667 **OR** 0.75 as denominator	2 (2 x AO2)

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Question 5 · A level Paper 1 · June 2025 · Q06.3 · 2 marks

06.3	Correct answer of 403/403.2 (m) = **2 marks**;; 1.8(h)/108(mins) (correct reading from the Figure) = **1mark** **OR** 0.8(h)/48(mins)/2880(s) (correct time until tired) = **1 mark** **OR** 907/907.2(m) (correct total distance covered) = **1 mark** **OR** Incorrect reading from graph x 0.14 – 504 = **1 mark;**	2 (2 x AO2)

Question 6 · A level Paper 3 · November 2020 · Q06.2 · 2 marks

06.2	1. (Time) 10 minutes; 2. (Ratio) 1.6875(:1); Allow 1 mark for correct ratio calculated from wrong time	2	For the ratio accept any correct rounding

Question 7 · AS Paper 2 · June 2025 · Q02.4 · 1 mark

02.4	2.5 : 1;	1 (1 x AO2)

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Question 8 · AS Paper 1 · November 2020 · Q08.1 · 4 marks

08.1	**Histogram** 1. Linear scale for y axis; 2. Linear scale for x axis; 3. Correct bar widths **and** touching; 4. All bar heights plotted accurately; **OR** **Bar chart** accept for 3 marks, 5. Linear scale for y axis; 6. Labelled bars of equal width **and** not touching; 7. All bar heights plotted accurately; **OR** **Graph** accept for 2 marks, 8. Linear scale for y axis; 9. All co-ordinates plotted accurately for frequency density;	4	Reject answers where data for frequency density and birth mass not used

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Question 9 · A level Paper 3 · June 2023 · Q06.3 · 3 marks

06.3	1. Labelled axes correct way round, linear scale and units; 2. Mean points plotted correctly; 3. SD bars correctly plotted above and below the peak of each bar;	3 (3 x AO2)

1. Reject if line graph drawn
1. Reject if Y-axis does not cover at least half of the grid
1. Reject if bars not of equal width
1. Accept a dual bar chart drawn
1. Reject if bars are touching (except dual bars)
1. Accept interruption drawn on the y axis
2. and 3. Allow all plots to the nearest half cm

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Question 10 · AS Paper 2 · November 2020 · Q06.1 · 2 marks

06.1	Correct answer of 960 to 1025 (mg) for 2 marks;; Accept for 1 mark, m = 4.18 to 5.00	2

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06.2	See appendix 1 for a flow chart (No) **EITHER** 1. 9 (percent per 5 µg cm^{-3}); 2. 1.42/1.8 (percent per 5 µg cm^{-3}); **OR** 3. 1.8 (percent per 1 µg cm^{-3}); 4. 0.28/0.36 (percent per 1 µg cm^{-3}); **OR** 5. 9% **and** 36/27% increase here; 6. (To be linear) 100 (µg cm^{-3}) would be 180/171% (increase) OR (To be linear) 5 (µg cm^{-3}) would be 1.8% (increase) OR % increase is x4 (0-5 µg cm^{-3} compared with 0-100 µg cm^{-3}) but 5-100 is more than x4 OR % increase is x3 (0-5 µg cm^{-3} compared with 5-100 µg cm^{-3}) but 5-100 is more than x3; **OR** 7. (Using y = mx + c) at 5 (µg cm^{-3}) m = 1.8; 8. (Using y = mx + c) at 100 (µg cm^{-3}) m = 0.36; 9. At 100 (µg cm^{-3}) y would be 186%; 10. At 5 (µg cm^{-3}) y would be 7.8%;; If no correct answers accept for one mark Evidence of incorrect graph reading but division by 19 OR Evidence of incorrect graph reading but division by 95	2	Accept any number of significant figures as long as rounding correct, full answer for mp2 is 1.42105263, for mp4 is 0.28421053. Accept 1 and 2 OR 3 and 4 OR 5 and 6 OR 7 and 8 OR 7 and 9 OR 8 and 10

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Question 12 · A level Paper 1 · November 2020 · Q09.3 · 2 marks

09.3	Final answer in range $2.\dot{6}$ to $2.\dot{7}$;; 1 mark for Stomatal density decrease of 24 to 25 OR Final answer of between $0.2\dot{6}$ to $0.2\dot{7}$ OR Correct calculation with incorrectly rounding taking answer out of correct range	2	Accept any number of sf as long as rounding correct. Ignore minus signs.

Question 13 · A level Paper 3 · June 2018 · Q06.2 · 2 marks

06.2	Answer between 4.5 and 4.6 µg g^{-1} day^{-1};; Award 1 mark for correct number but wrong / no units	2	Ignore plus or minus signs Accept 'per gram' **AND** / **OR** 'per day'

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Question 14 · A level Paper 1 · November 2021 · Q06.1 · 2 marks

06.1	Correct answer for 2 marks, 1.286;; Accept for 1 mark, 1.28571429 (correct answer not to 3 decimal places) **OR** 1.285 (incorrect rounding to 3 decimal places) **OR** Evidence of 0.02142857 **OR** Evidence of 19 **and** 4 **and** 700 **OR** Evidence of 15 **and** 1800 **and** 2500 OR Evidence of 15 **and** 700	2

Question 15 · A level Paper 1 · November 2020 · Q03.4 · 1 mark

03.4	167 (beats minute^{-1}) OR 164 (beats minute^{-1}) OR 171 (beats minute^{-1});	1	Full answers 166.6 recurring, 164.383562, 171.428571 Accept any number of decimal places as long as rounding correct.

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Question 16 · AS Paper 1 · June 2025 · Q06.2 · 2 marks

06.2	Correct answer within range of 0.3 to 0.5 (dm^3 s^{-1}) **= 2 marks**;; Incorrect answer but shows correct tangent (at 2 seconds) = **1 mark** **OR** 2.5 (for incorrect method with correct reading at 2 seconds (5) and division by correct time (2)) = **1 mark**;	2 (1 x AO1, 1 x AO2)	Ignore tangent on emphysema line

Question 17 · AS Paper 1 · June 2016 · Q06.2 · 2 marks

06.2	1. Tangent to curve drawn; 2. Value in range of 8 to 11;	2	1.Tangent drawn at about 10 minutes 2.1 mark only for correct answer

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