Geometry: AQA A Level Biology Exam Questions by Topic

14 questions · 31 marks · about 40 minutes. Answer in the spaces, then check the mark schemes at the end.

Question 1 · A level Paper 2 · November 2020 · Q01.3 · 2 marks

0 1 . 3 The retina of the human eye has an area of approximately 1.094×10^3 mm^2

The circular fovea in a human eye has a diameter of 3×10^3 µm

Calculate the area of the fovea as a percentage of the area of the retina.

The area of a circle is πr^2. Use $\pi = 3.14$ in your calculation.

Show your working.

[2 marks]

Answer _____ %

Question 2 · A level Paper 2 · June 2017 · Q03.3 · 2 marks

0 3 . 3 The scientists determined the mean diameter of muscle fibres in trained mice using an optical microscope to examine sections of muscle tissue. The circular area (πr^2) of one field of view was 1.25 mm^2. The diameter of this area was equal to the diameter of 15 muscle fibres.

Using this information, calculate the mean diameter in µm (micrometres) of muscle fibres in this section of tissue.

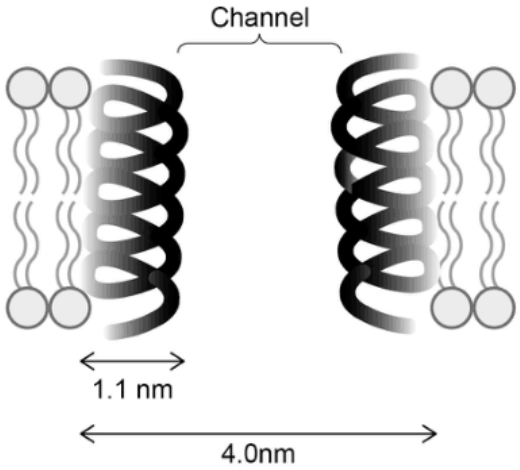
[2 marks]

Answer = _____ µm

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Figure 5 shows further information about a channel formed in the cell-surface membrane by the APs.

Figure 5



0 3 . 4 Use **Figure 5** to calculate the cross-sectional area of the channel through which ions can pass.
Assume the cross-sectional area is circular.
Use $\pi = 3.14$ in your calculation. Give your answer in nm^2 **and** to 1 decimal place.
[2 marks]

Answer _____ nm^2

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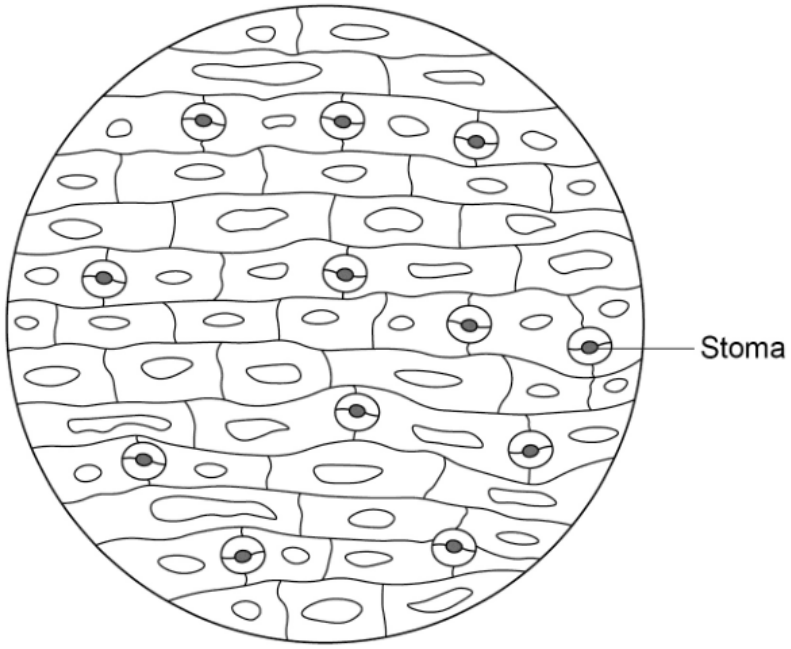
0 4 A student investigated the distribution of stomata on a leaf.

The student:

- observed one area of the lower surface of a leaf using an optical microscope
- counted all the stomata.

Figure 7 shows the area of the leaf the student observed.

Figure 7



The diameter of the field of view was 0.36 mm

0 4 . 1 Use **Figure 7** and the information provided to calculate the stomatal density of the lower leaf surface.

The area of a circle can be calculated using the formula πr^2

For π use 3.14

Give your answer to 2 significant figures.

[3 marks]

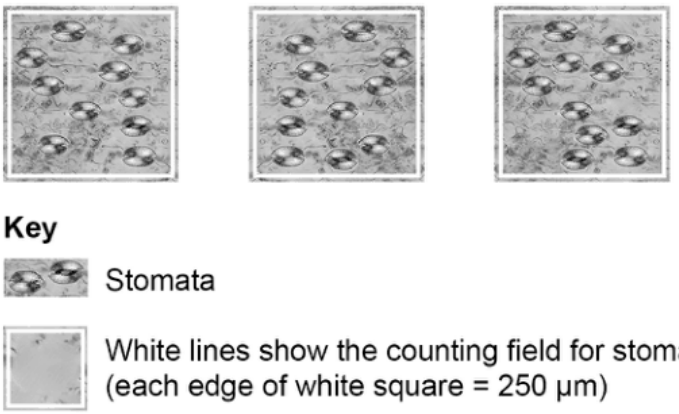
Answer _____ stomata mm^{-2}

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0 9 Scientists investigated stomatal density on leaves of one species of tree.

Figure 9 shows three examples of the square fields of view the scientists used to calculate a mean stomatal density.

Figure 9



0 9 . 1 Calculate the mean stomatal density in the three fields of view in **Figure 9**.

Give your answer as number of stomata per mm^2

Show your working.

[2 marks]

Stomatal density _____ per mm^2

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Question 6 · AS Paper 2 · November 2021 · Q08.2 · 3 marks

0 8 . 2 The scientist joined DNA molecules together to make tiny cages. The cages are exactly 20 nm long, 20 nm wide and 17 nm deep.

He trapped **one** GOx molecule and **one** HRP molecule together in each cage. The GOx molecule and HRP molecule fill 9% of the cage volume.

The volume of a GOx molecule is eight times larger than an HRP molecule.

Use this information to calculate the volume of a GOx molecule. Give the appropriate unit with your answer.

Show your working.

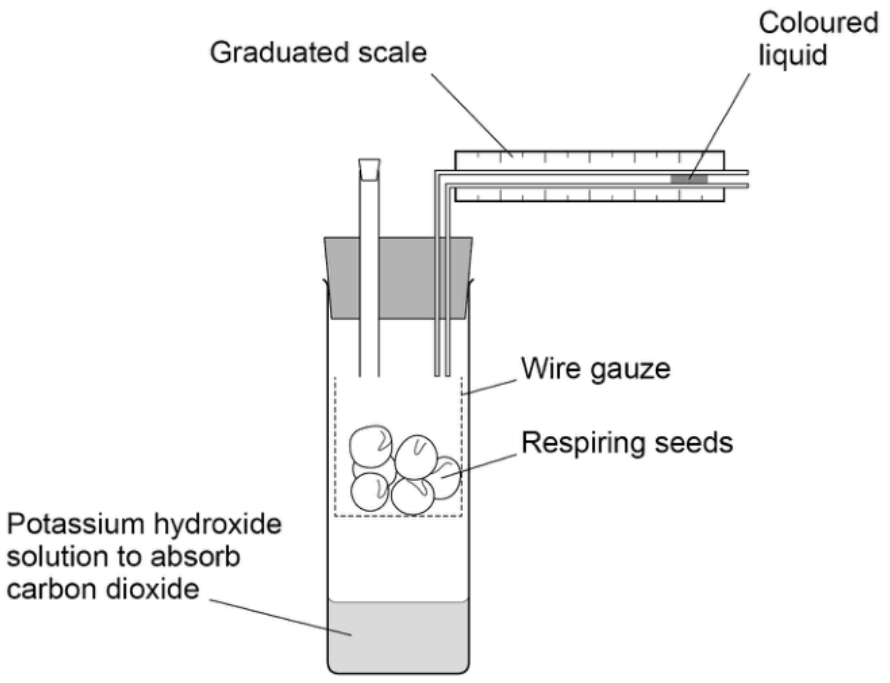
[3 marks]

Answer _____

Question 7 · information from earlier in the question

A student used the apparatus shown in **Figure 1** to measure the rate of aerobic respiration of seeds for 48 hours.

Figure 1



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Question 7 · A level Paper 2 · June 2022 · Q04.3 · 2 marks

0 4 . 3 Apart from time, give **two** measurements the student would have to make to determine the rate of aerobic respiration of these seeds in $cm^3\ hour^{-1}$

[2 marks]

1 _____

_____

2 _____

_____

Question 8 · AS Paper 2 · June 2024 · Q01.3 · 1 mark

0 1 . 3 An air bubble was introduced into the glass tubing in **Figure 1**. The air bubble moved a distance (d) of 1.5 cm in 120 minutes. The radius of the lumen (hole) of the glass tubing was 0.6 cm

Use this information and the formula $\pi r^2 d$ to calculate the rate of water movement in the glass tubing in $cm^3\ hour^{-1}$.

Use $\pi = 3.14$ in your calculation.

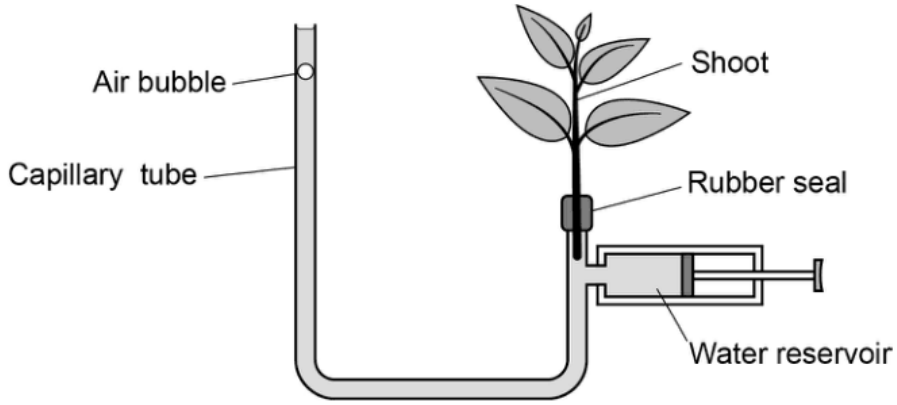
[1 mark]

Answer _____ $cm^3\ hour^{-1}$

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0 6 A student used a potometer to measure the movement of water through the shoot of a plant. The potometer is shown in **Figure 5**. As water is lost from the shoot, it is replaced by water from the capillary tube.

Figure 5



0 6 . 1 In one experiment, the air bubble moved 7.5 mm in 15 minutes. The diameter of the capillary tube was 1.0 mm.

Calculate the rate of water uptake by the shoot in this experiment.

Give your answer in mm^3 per hour. Show your working.
(The area of a circle is found using the formula, area = πr^2)

[2 marks]

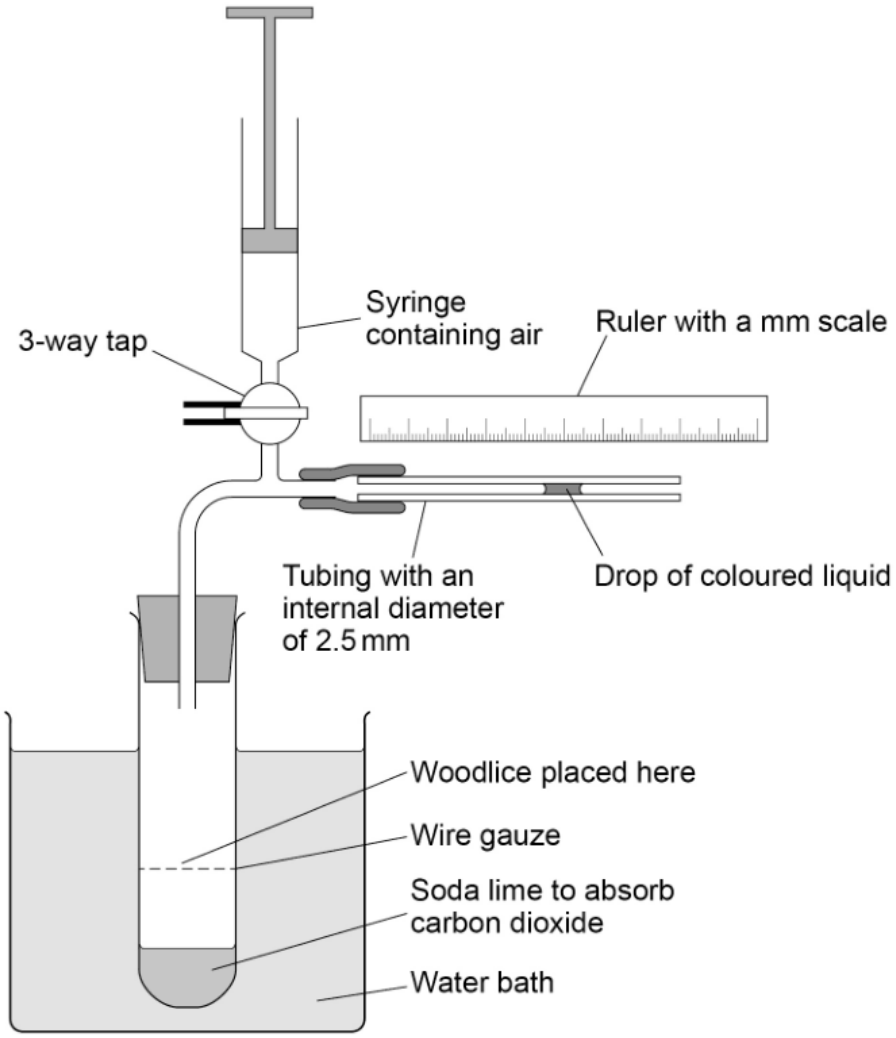
_____ mm^3 $hour^{-1}$

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0 2 A student investigated the effect of temperature on the rate of aerobic respiration in woodlice.

Figure 1 shows the apparatus they used.

Figure 1



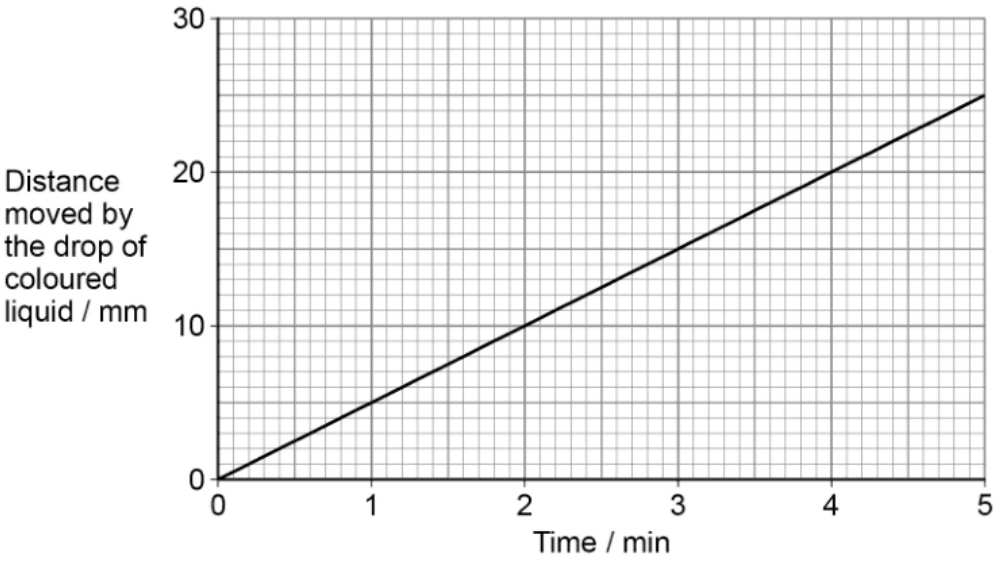
The student altered the temperature of the water bath and measured how far the drop of coloured liquid moved every minute for 5 minutes.

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0 2 . 4 **Figure 2** shows the student's results at 25 °C

The mass of the woodlice in the tube was 3.78 g

Figure 2



Use **Figure 1** (on page 4) and **Figure 2** to calculate the mean rate of oxygen uptake by the woodlice in $mm^3\ s^{-1}\ g^{-1}$

The formula for the volume of the capillary tubing is $\pi r^2 l$.

Use $\pi = 3.14$ in your calculation.

Show your working **and** give your answer to 2 decimal places.

[3 marks]

Answer _____ $mm^3\ s^{-1}\ g^{-1}$

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Question 11 · AS Paper 2 · June 2022 · Q03.2 · 2 marks

0 3 . 2 An ileum cell **without** microvilli has 7.85 μm^2 of cell surface in contact with digested substances.

A scientist found an ileum cell with 1000 microvilli. The microvilli cover the entire cell surface in contact with digested substances.

Microvilli are 0.1 μm in diameter and 1 μm in length.
The surface area of a microvillus is calculated using this equation

$$2\pi rl + \pi r^2$$

where π is 3.14,
r is the radius,
l is the length.

Calculate the ratio of the area of the ileum cell surface **with** microvilli to the area of ileum cell surface **without** microvilli.

Show your working.

[2 marks]

Ratio _____ :1

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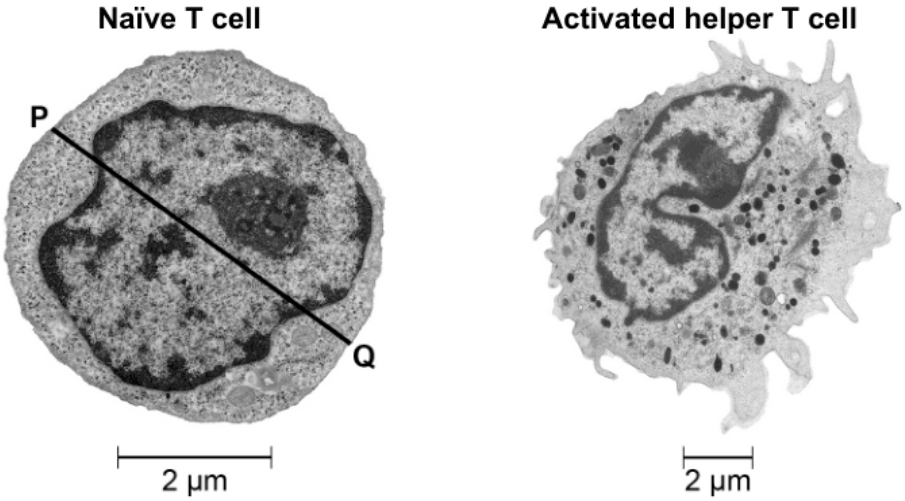
0 4 Scientists investigated the activation of T lymphocytes.

The scientists studied two types of cell:

- naïve T cells, which are T cells that have not yet been in contact with a foreign antigen
- activated helper T cells, which are T cells that have been activated by a foreign antigen.

Figure 5 shows electron microscope images of the two types of cell.

Figure 5



The activated helper T cell has a volume of 463 µm^3

0 4 . 1 Calculate the volume of the naïve T cell shown in **Figure 5**.
Then calculate how many times larger the activated helper T cell volume is compared with the naïve T cell volume.
Assume the cell is spherical.
Use line **PQ** to measure the diameter of the naïve T cell.

Volume of a sphere = $\frac{4}{3}\pi r^3$ where π is 3.14

Show your working.

[3 marks]

Volume of naïve T cell _____ µm^3

Number of times larger the activated helper T cell volume is compared with the naïve T cell volume _____

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Question 13 · A level Paper 3 · June 2018 · Q03.3 · 2 marks

0 3 . 3 A scientist measured the diameter of a polar body and the diameter of the nucleus inside it. The diameter of the polar body was 10.4 μm and the diameter of the nucleus was 7.0 μm. The density of mitochondria in the cytoplasm of the polar body (outside of the nucleus) was 0.08 mitochondria per μm^3.

Calculate the number of mitochondria in the polar body. You should assume polar bodies and nuclei are spherical.

The formula for the volume of a sphere is $\frac{4}{3}\pi r^3$ where $\pi = 3.14$

Show your working.

[2 marks]

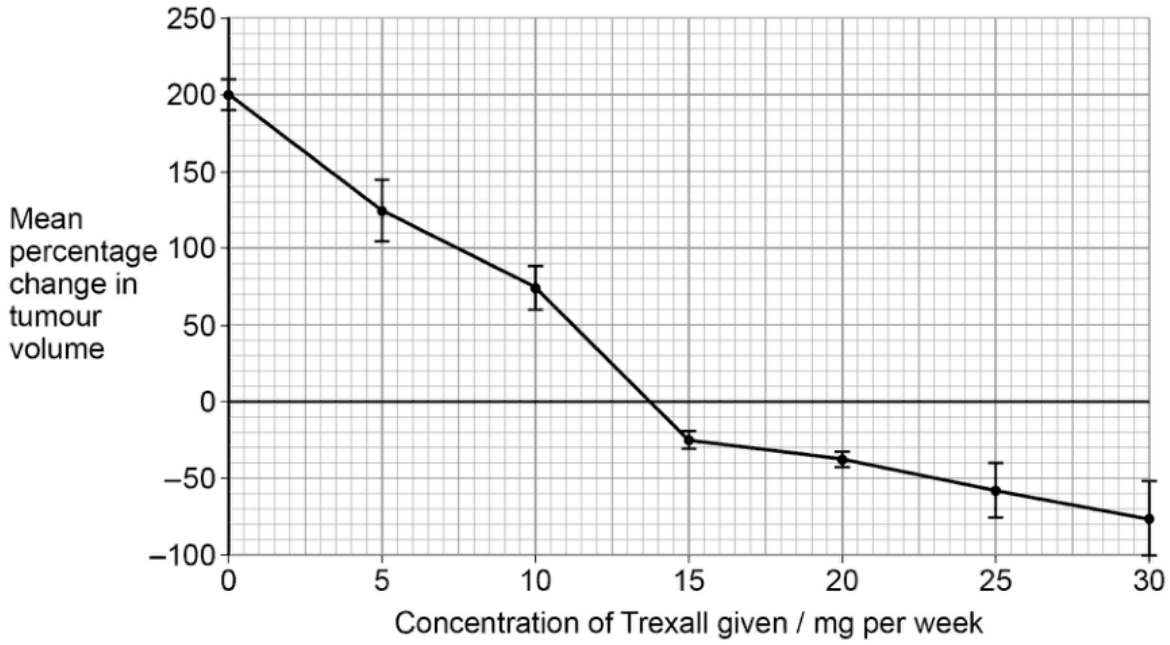
Number of mitochondria = _____

Question 14 · information from earlier in the question

Doctors investigated how the concentration of Trexall given to patients affected the growth of lung tumours. The doctors measured the volume of tumours at the beginning of the study and after 8 months.

Figure 10 shows the results of this investigation. The bars represent ± 2 standard deviations. A value of ± 2 standard deviations from the mean includes over 95% of the data.

Figure 10



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Question 14 · A level Paper 3 · June 2019 · Q06.5 · 2 marks

0 6 . 5 A lung cancer patient received 15 mg of Trexall per week. After treatment, the diameter of his lung tumour was 35.8 mm

Assuming the tumour was spherical, use the mean percentage change in tumour volume shown in **Figure 10** to calculate the volume of the patient's tumour **before treatment** with Trexall.

The formula for the volume of a sphere is $\frac{4}{3}\pi r^3$ where $\pi = 3.14$

[2 marks]

Answer = _____ mm^3

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Mark schemes

Question 1 · A level Paper 2 · November 2020 · Q01.3 · 2 marks

01.3	1. Correct answer of 0.6 (%) = **2 marks**;; 2. Incorrect answer but shows number sequence 7065 / 7068 / 7069 / (ignore position of decimal point) = **1 mark** **OR** Final answer number sequence has 64 / 65 (ignore preceding zeros, numbers that follow and position of decimal point) **= 1 mark** **OR** Final answer is 2.58 / 2.6 (%) = **1 mark** **OR** Final answer of 0.43 (%) = **1 mark**;	2	1. Ignore any numbers after 0.6, 2.58, 2.6 and after 0.43.

Question 2 · A level Paper 2 · June 2017 · Q03.3 · 2 marks

03.3	1. Correct answer in range 84 to 84.2 = 2 marks;; 2. For one mark accept incorrect answer but shows r (radius) = 0.63 (mm) OR d (diameter) = 1.26 (mm);	2	2. Ignore: numbers after 0.63 and 1.26.

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Question 3 · A level Paper 1 · June 2022 · Q03.4 · 2 marks

03.4	Correct answer for 2 marks, 2.5;; Accept for 1 mark, 2.5434 (Correct answer but 2 or more decimal places) **OR** 10.2 (correct area calculation using diameter, to 1 decimal place) **OR** 6.6 (correct calculation using radius (4 – 1.1) ÷ 2, to 1 decimal place) **OR** 26.4 (correct calculation using diameter, 4 – 1.1, to 1 decimal place)	2 (2 x AO2)

Question 4 · AS Paper 2 · June 2025 · Q04.1 · 3 marks

04.1	Correct answer of 120 = **3 marks**;;; Answers in range 117 to 119 = **2 marks**;; 0.1017 - 0.1018 or 0.102 (correct calculation of πr^2) = **1 mark** **OR** 12 divided/multiplied by their incorrectly calculated area = **1 mark**;	3 (3 x AO2)

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Question 5 · A level Paper 1 · November 2020 · Q09.1 · 2 marks

09.1	171 (per mm^2);; 1 mark for Mean of 10.7/11 stomata per square OR Square = 0.0625 mm^2 OR 169.8/174.6/176 stomata OR Digits 170$\dot{6}$/171 with decimal point in the wrong place OR Correct calculation with incorrect rounding	2	Answer – 170.$\dot{6}$, accept any number of decimal places as long as rounding correct. Mean stomata per square = 10.$\dot{6}$, accept any number of decimal places with correct rounding for one mark.

Question 6 · AS Paper 2 · November 2021 · Q08.2 · 3 marks

08.2	Correct answer for 3 marks = 544 **and** nm^3;;; Accept for 2 marks: 612 (cage volume occupied by enzymes) **OR** 68 (volume of HRP) **OR** 544 (correct answers with no unit) Accept for 1 mark: 6800 (cage volume)	3	

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Question 7 · A level Paper 2 · June 2022 · Q04.3 · 2 marks

04.3	1. Distance (drop/liquid moves); 2. Diameter/radius/bore of tubing/lumen;	2 (2 x AO2)	Ignore time. 1.Accept description of distance, e.g. 'start and end position'. 2. Accept (cross-sectional) area of tubing/lumen.

Question 8 · AS Paper 2 · June 2024 · Q01.3 · 1 mark

01.3	0.8/0.85/0.848/0.8478 (using 3.14); OR 0.8482 (using π on calculator)	1 (1 x AO2)

Question 9 · A level Paper 3 · June 2017 · Q06.1 · 2 marks

06.1	Correct answer 23.55 – 24 two marks;; For one mark 5.9 OR 94.2;	2

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02.4

Correct answer of 0.11 = **3 marks**;;;

0.10816247795/0.1082600897/0.1082173395 = **2 marks** (answer not to 2 dp)

Evidence of $\frac{3.14 \times 1.25^2 \times 25}{(5 \times 60) \times 3.78}$ and incorrect answer to 2 dp = **2 marks** (for input error into calculator)

0.41 = **2 marks** (mean rate in $mm^3\ s^{-1}$ for 3.78 g of woodlice)

32.45/32.48/32.47 = **2 marks** (mean rate in $mm^3\ g^{-1}$ in 5 minutes)

0.43 = **2 marks** (used diameter instead of radius in calculation)

Evidence of $\frac{3.14 \times 1.25^2 \times 25}{(5 \times 60) \times 3.78}$ and incorrect answer to **not** to 2 dp = **1 mark** (for input error into calculator)

122.65625/122.767857142/122.718463 = **1 mark** (volume of oxygen taken up in 5 minutes)

0.40885416/0.40922619047/0.4090615434 = **1 mark** (mean rate in $mm^3\ s^{-1}$ for 3.78 g of woodlice and not to 2 dp)

32.44874339/32.47826909/32.46520186 = **1 mark** (mean rate in $mm^3\ g^{-1}$ in 5 minutes and not to 2 dp)

0.4326499118/0.43286935813/0.43304358780 = **1 mark** (used diameter instead of radius in calculation and not to 2 dp)

0.08 = **1 mark** (distance travelled by the drop per second)

0.02 = **1 mark** (just used 25 mm distance travelled by the drop and not worked out volume)

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Question 11 · AS Paper 2 · June 2022 · Q03.2 · 2 marks

03.2	Correct answer for 2 marks, 40–41(:1);; Accept for 1 mark, 0.32–0.33 (correct surface area of a microvillus) **OR** 321–322 (correct cell surface area) **OR** Ratio not simplified e.g. 321:8;	2 (2 x AO2)	

Question 12 · AS Paper 1 · June 2023 · Q04.1 · 3 marks

04.1	(Volume) Correct answer of 57.9 (μm^3) = **2 marks**;; **OR** If volume incorrect, evidence of 2.35-2.45 (as radius) = **1 mark** (Times larger) 8 (times larger) (or ECF) = **1 mark**;	3 (3 x AO2)	58 = **2 marks** 57.91 = **2 marks** Accept 54.3/54 = **2 marks** Accept 61.6/62 = **2 marks** Allow 7.5 – 8.52 ECF Allow any alternative for 8 which shows 463 ÷ their volume

Question 13 · A level Paper 3 · June 2018 · Q03.3 · 2 marks

03.3	32.73 / 32.7 / 32 / 33;; Award 1 max for **either** 409 (409.2) for difference in volume (but incorrect number of mitochondria); **OR** Answer of 262 (261.9) (using diameter, rather than radius);	2

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Question 14 · A level Paper 3 · June 2019 · Q06.5 · 2 marks

06.5	Answer in the range 32 015.93682 to 32 045 = 2 marks **OR** 3.20×10^4 = 2 marks;; Allow 1 mark for correct calculation of volume after treatment in range of 24 011.95261 to 24 034 /2.40×10^4 Allow 1 mark if student uses diameter throughout instead of radius, in range of 256 127 to 256 361/2.56×10^5	2 max	Accept any suitable rounding

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