Algebra: AQA A Level Biology Exam Questions by Topic

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

Question 1 · information from earlier in the question

One species of fungus digests cellulose using two types of enzyme, endocellulases and exocellulases.

Endocellulases act in the middle of the cellulose molecule and exocellulases act at the ends of the cellulose molecule.

A scientist prepared the following mixtures:

- 15 g cellulose with 0.2 mol dm^{-3} endocellulase
- 15 g cellulose with 0.2 mol dm^{-3} exocellulase
- 15 g cellulose with 0.2 mol dm^{-3} endocellulase and 0.2 mol dm^{-3} exocellulase.

The mixtures had identical total volumes. She determined the mass of cellulose remaining after 48 hours.

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

Table 4

Time / hours	Mass of cellulose remaining / g		
	Endocellulase	Exocellulase	Endocellulase + exocellulase
48	11.9	14.8	9.2

Question 1 · AS Paper 2 · June 2018 · Q07.5 · 1 mark

0 7 . 5 The scientist could have expressed her results as the percentage loss in mass of cellulose.

In the space, write the equation for calculating the percentage loss in mass.

[1 mark]

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Question 2 · A level Paper 3 · June 2019 · Q01.3 · 1 mark

0 1 . 3 The equation shows the relationship between urine concentration in arbitrary units (y) and mean length of the loop of Henle in mm (x).

$$y = 0.72x + 4$$

Calculate the mean length of the loop of Henle in an organism that produces urine with a concentration of 16.56 arbitrary units.

[1 mark]

Answer = _____ mm

Question 3 · information from earlier in the question

The scientists used the mark-release-recapture method to determine the number of lemurs in one area of forest. They captured, marked and released a first sample of 30 lemurs. A week later, they captured a second sample of 25 lemurs from the same area of forest. The scientists calculated that there were 250 lemurs in that area of forest.

Question 3 · A level Paper 2 · June 2022 · Q05.4 · 1 mark

0 5 . 4 Using the information provided, calculate how many lemurs in the second sample were marked.

[1 mark]

Answer _____

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Question 4 · AS Paper 2 · November 2020 · Q03.4 · 2 marks

0 3 . 4 A scientist measured the heart rate and the volume of blood pumped in a single heart beat (stroke volume) of an athlete before exercise and calculated the cardiac output.

Cardiac output is calculated using this equation.

cardiac output = heart rate × stroke volume

Her results are shown in **Table 1**.

Table 1

Heart rate / beats minute^{-1}	Stroke volume / cm^3	Cardiac output / cm^3 minute^{-1}
62	80	4960

After exercise, the athlete's stroke volume increased by 30% and the cardiac output was 13 832 cm^3 minute^{-1}

Calculate the athlete's heart rate after exercise.

Give the answer to 2 significant figures. Show your working.

[2 marks]

Heart rate _____ beats minute^{-1}

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Question 5 · AS Paper 2 · June 2018 · Q03.2 · 2 marks

0 3 . 2 A scientist calculated the surface area of a large number of frog eggs. He found that the mean surface area was 9.73 mm^2. Frog eggs are spherical.

The surface area of a sphere is calculated using this equation

$$\text{Surface area} = 4\pi r^2$$

where r is the radius of a sphere

$$\pi = 3.14$$

Use this equation to calculate the mean diameter of a frog egg.

Show your working.

[2 marks]

Diameter = _____ mm

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Question 6 · A level Paper 1 · June 2024 · Q03.4 · 2 marks

The scientist used a ruler to measure the diameter of some of the alveoli.

Table 2 shows the scientist's results.

Table 2

Alveolus diameter / mm								
Alveolus diameter / mm	4	2	5	1	2	3	5	2

0 3 . 4 The magnification of the image in **Figure 2** is × 40

Use this information and **Table 2** to calculate the mean diameter, in μm, of the alveoli.

Show your working.

[2 marks]

Answer _____ μm

Question 7 · information from earlier in the question

Scientists investigated the effect of the number of fungal species in soil on the diversity of plant species.

Table 1 shows their raw data for soil containing 14 fungal species.

Table 1

Plant species	**Total shoot biomass / g m^{-2}**
Poa compressa	2
Achillea millefolium	4
Aster cordifolius	5
Aster novae-angliae	7
Chrysanthemum leucanthemum	15
Daucus carota	36
Fragaria virginiana	51

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Question 7 · A level Paper 1 · June 2022 · Q01.4 · 2 marks

0 1 . 4 The scientists used this equation to calculate the plant species index of diversity.

$$d = 1 - \sum \left(\frac{n}{N}\right)^2$$

where n = shoot biomass of each plant species
and N = total shoot biomass of all plant species

Use this equation to calculate the index of diversity for the data in **Table 1**.

[2 marks]

Index of diversity _____

Question 8 · A level Paper 2 · June 2025 · Q06.4 · 2 marks

0 6 . 4 One study has suggested that the atropine dosage for severely obese male patients should be 0.01 mg kg^{-1} of lean body weight (LBW).

LBW is determined by using this equation.

$$\text{LBW} = \frac{9.27 \times 10^3 \times \text{TBW}}{(6.68 \times 10^3) + (216 \times \text{BMI})}$$

where TBW = total body weight
BMI = body mass index

Calculate the suggested dosage of atropine, in mg, for a severely obese male patient whose:

- TBW = 115.2 kg
- BMI = 41

Give your answer to 3 significant figures.

Show your working.

[2 marks]

Answer _____ mg

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Question 9 · AS Paper 2 · June 2023 · Q07.4 · 2 marks

0 7 . 4 During anaphase, the spindle exerts 3×10^{-11} N of force on each chromatid. This force generates 6×10^{-19} W of power.

Calculate the speed of movement, in nm s^{-1}, of one chromatid during anaphase using the following equation:

$$P = F \times V$$

Where P = power in W
F = force in N
V = speed in m s^{-1}

Show your working.

[2 marks]

Answer _____ nm s^{-1}

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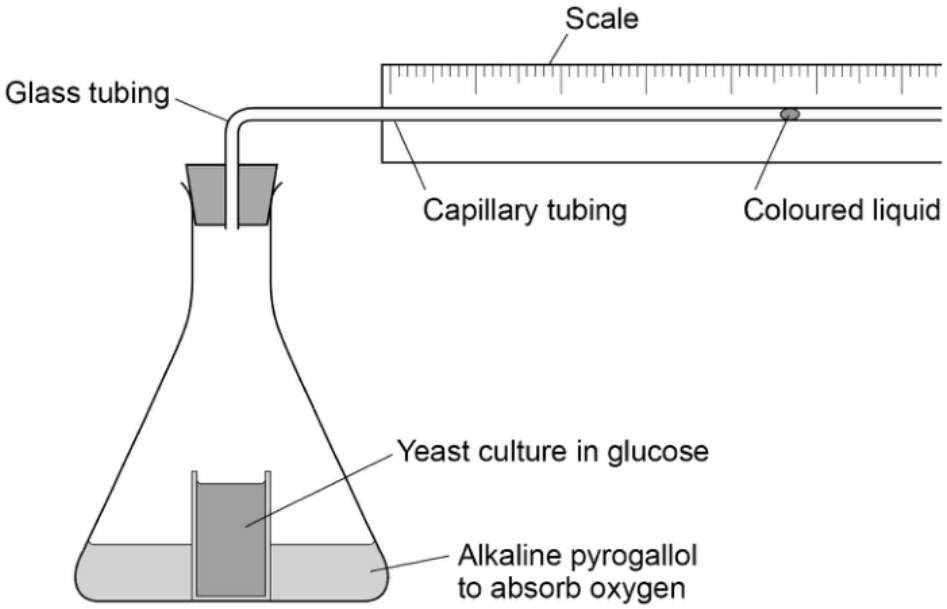
Question 10 · information from earlier in the question

0 3 Yeast cells can respire aerobically or anaerobically. A student used the apparatus shown in **Figure 3** to measure the rate of respiration in yeast.

She:

- positioned the flask in a water bath so that the yeast culture reached a constant temperature
- then left the apparatus for one hour before starting her investigation.

Figure 3



Question 10 · A level Paper 2 · June 2018 · Q03.3 · 2 marks

0 3 . 3 The student found that the coloured liquid moved 1.5 cm in 24 hours. The diameter of the lumen (hole) of the capillary tubing was 1 mm.

The volume of a capillary tubing is given by $\pi r^2 l$, where π is 3.14 and l = length.

Calculate the volume of gas produced in $cm^3\ hour^{-1}$.
Show your working.

[2 marks]

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

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Question 11 · A level Paper 1 · June 2023 · Q05.2 · 2 marks

0 5 . 2 On each agar plate, the student cut a well (a hole) in the agar.

The well had a diameter of 6 mm. The student added 50 mm^3 of cinnamon oil into the well.

Calculate the minimum depth of the well to allow the addition of 50 mm^3 of cinnamon oil.
Use the following equation in your calculation:

$$\text{Volume of a cylinder} = \pi r^2 \times l$$

Use 3.14 as the value for π.

Show your working.

[2 marks]

Answer _____ mm

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0 4 Ecologists investigated changes in grassland communities on large islands off the coast of Scotland between 1975 and 2010. On each island, they used data from a number of sites to determine the change in mean species richness and the change in mean index of diversity.

0 4 . 1 **Table 1** shows plant species recorded at one site, on one island, in 1975.

Table 1

Species	Number of individuals
Hydrocotyle vulgaris	3
Plantago maritima	19
Ranunculus acris	3
Hieracium pilosella	3
Calliergon cuspidatum	10
Prunella vulgaris	16
Pseudoscleropodium purum	6

Calculate the index of diversity for this site using the formula:

$$d = \frac{N(N-1)}{\Sigma n(n-1)}$$

[2 marks]

d = _____

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Question 13 · information from earlier in the question

1 0 Read the following passage.

Complete achromatopsia is a form of complete colour blindness. It is caused by having only rods and no functional cone cells. People with complete achromatopsia have difficulty in seeing detail. Complete achromatopsia is caused by an autosomal recessive allele and is usually very rare in populations with only one in 40 000 being affected. However on the Pacific island of Pingelap ten percent of the population are affected.

One form of red-green colour blindness is caused by a sex-linked recessive allele which affects more men than women. People with this red-green colour blindness are unable to distinguish between red and green, and also between other colours. They have green-sensitive cones but the photoreceptive pigment they contain does not function.

Scientists investigated the use of gene therapy to correct red-green colour blindness in monkeys. They injected viruses containing the gene for the green-sensitive pigment directly into the eyes of the monkeys. Although the monkeys maintained two years of colour vision, there is debate on whether this form of gene therapy is worthwhile. No clinical trials of this procedure have been carried out on humans. Current research into the treatment of red-green colour blindness involves the use of induced pluripotent stem cells (iPS cells). The use of iPS cells could have advantages over the use of gene therapy.

Use the information in the passage and your own knowledge to answer the following questions.

Question 13 · A level Paper 2 · June 2018 · Q10.2 · 2 marks

1 0 . 2 Ten percent of the population on the Pacific island of Pingelap are affected by complete achromatopsia (lines 3–6).

Use the Hardy-Weinberg equation to calculate the percentage of this population who are heterozygous for this disorder.

Show your working.

[2 marks]

Answer = _____ %

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Question 14 · A level Paper 3 · June 2025 · Q06.3 · 2 marks

0 6 . 3 Lung volume can be determined with a spirometer using the helium dilution method.

The lung volume (V2) is calculated using the equation:

$$V2 = \frac{V1(C1 - C2)}{C2}$$

where

C1 = the initial concentration of helium in the spirometer
C2 = the helium concentration in the spirometer when equal with the lungs
V1 = volume of gas in the spirometer.

A student used a spirometer with a volume of 3250 cm^3 and an initial concentration of 10% helium. They found C2 was 3.78%

Use the equation to calculate this student's lung volume in dm^3

Show your working.

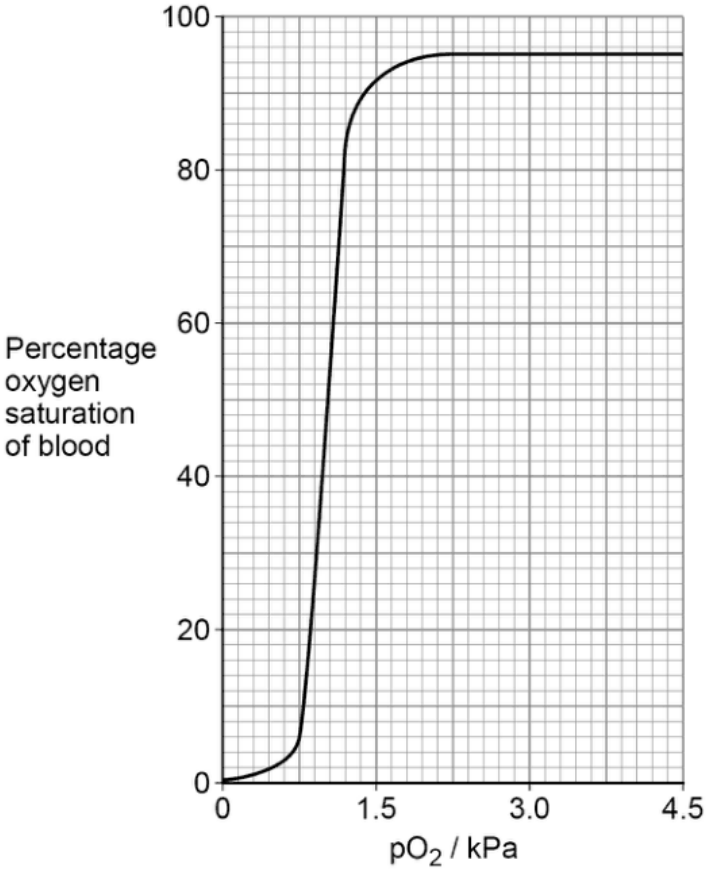
[2 marks]

Lung volume = _____ dm^3

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0 4 . 2 **Figure 4** shows the oxyhaemoglobin dissociation curve for a lugworm.

Figure 4



The oxygen saturation in the blood of a lugworm is 92%

The lugworm has 0.2 cm^3 of blood.

Calculate the volume of dissolved oxygen in the blood of this lugworm using this equation

$$pO_2 = \frac{CdO_2}{0.000\ 031}$$

CdO_2 is the concentration of dissolved oxygen in the blood, with units cm^3 oxygen per cm^3 of blood.

Show your working.

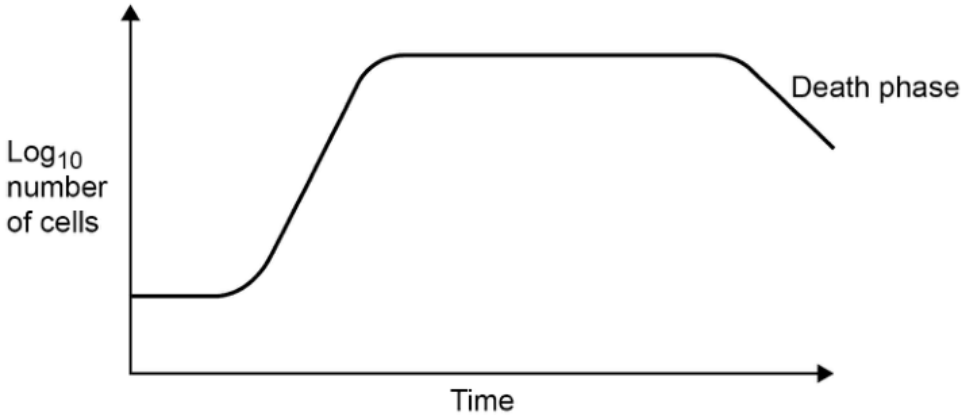
[3 marks]

Answer cm^3

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Figure 4 shows a typical population growth curve for yeast under laboratory conditions.

Figure 4



0 3 . 4 Explain why a log scale is used to record the number of cells.

[1 mark]

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Question 17 · information from earlier in the question

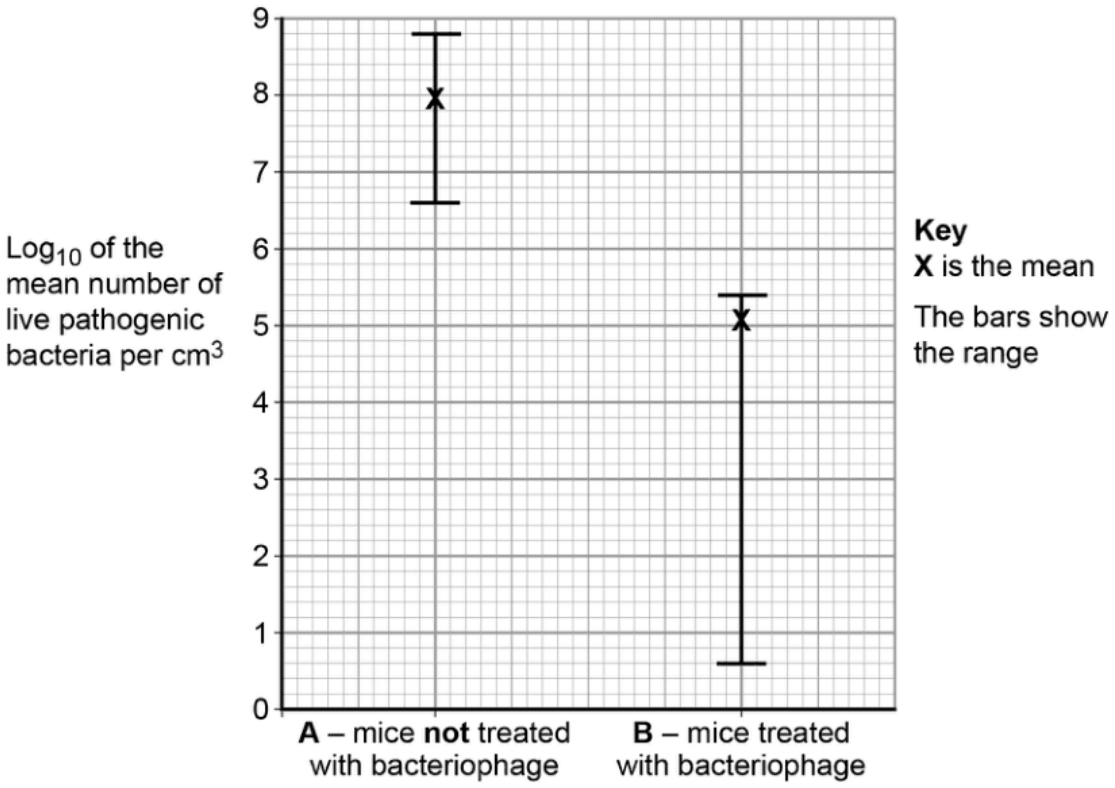
0 2 . 3 Scientists investigated the use of bacteriophages to treat lung infections caused by bacteria. They infected the lungs of mice with a pathogenic species of bacterium. The mice were then divided into two groups, **A** and **B**.

- The mice in group **A** were **not** treated with bacteriophage.
- The mice in group **B** were treated by breathing in a spray containing bacteriophage particles.

After 3 days, the scientists killed the mice and removed their lungs. They washed out each set of lungs with a set volume of liquid. The scientists determined the number of live bacteria in the liquid.

Figure 3 shows the scientists' results. **Figure 3** shows the mean and the range of the data about the mean for each group. Standard deviations of the means are **not** shown.

Figure 3



What would the scientists' null hypothesis be for this investigation?

[1 mark]

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Question 17 · A level Paper 3 · June 2017 · Q02.4 · 2 marks

0 2 . 4 With some samples, the scientists decided they needed to carry out a series of dilutions of the sample before counting the bacteria.

Use evidence from **Figure 3** to explain why dilutions were necessary for some samples but not for others.

[2 marks]

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Mark schemes

Question 1 · AS Paper 2 · June 2018 · Q07.5 · 1 mark

07.5	$\frac{\text{Initial Mass} - \text{Final Mass}}{\text{Initial Mass}} \times 100$ 1	Accept ((final mass – initial mass) ÷ initial mass) x100 OR ((change in mass) ÷ initial mass) x100 OR 100 – ($\frac{final\ mass}{initial\ mass}$ x 100) OR (1 – (F/I)) x100 OR ((I – F) ÷ I)x100 / ((F – I) ÷ I) x100 OR ((15 – final mass) ÷ 15)x100 / ((final mass - 15) ÷ 15) x100

Question 2 · A level Paper 3 · June 2019 · Q01.3 · 1 mark

01.3	17.4; 1	Accept any number of fours after the decimal point.

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Question 3 · A level Paper 2 · June 2022 · Q05.4 · 1 mark

05.4	3; 1 (AO2)	Ignore any wording provided e.g. lemurs.

Question 4 · AS Paper 2 · November 2020 · Q03.4 · 2 marks

03.4	2 marks for correct answer = 130 (beats min^{-1});; 1 mark for correct stroke volume = 104	2

TOTAL		**9**

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03.2	Two marks for correct answer in range of 1.75 to 1.76032;;	2

Accept for 1 mark, incorrect answer using radius 0.87 / 0.88 / 0.880 / 0.8802 / 0.88015;

OR

Accept for 1 mark, incorrect answer with correct rearranged equation, e.g.,

Radius = $\sqrt{(\text{surface area} \div 4\pi)}$

OR

$= \sqrt{9.73 \div 12.56}$

OR

$= \sqrt{0.77} / \sqrt{0.774} / \sqrt{0.775}$

OR

$r^2 = \text{surface area} \div 4\ \pi$

OR

$r^2 = 9.73 \div 12.56$

OR

$r^2 = 0.77 / 0.774 / 0.775$

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03.4	Correct answer for 2 marks, 75 (µm);; Accept for 1 mark, evidence of $\textit{Real/actual} = \frac{\textit{Image}}{\textit{Mag(nification)}}$ (correct rearranged magnitude <u>word</u> equation) **OR** ÷ 40 (correct denominator from equation) **OR** 3000 (µm) (correct mean diameter)	2 (2 x AO2)
	OR × 1000 (correct conversion of mm to µm) **OR** 0.075 (correct calculation with incorrect units (mm)) **OR** Answer shows correct number but incorrect number of decimal places eg 0.75 / 7.5 / 750	

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Question 7 · A level Paper 1 · June 2022 · Q01.4 · 2 marks

01.4	Correct answer for 2 marks, 0.7– 0.71;; Accept for 1 mark, 0.29 – 0.3 (correct calculation not subtracted from 1) **OR** 120 (correct total shoot biomass)	2 (2 x AO2)

A common correct answer is 0.707 Accept numbers rounding down to 0.71

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Question 8 · A level Paper 2 · June 2025 · Q06.4 · 2 marks

06.4	Correct answer of 0.687 = **2 marks**;; Answer shows 687 (ignore position of decimal point and preceding / subsequent zeros i.e. incorrect order of magnitude) = **1 mark** **OR** Answer of 0.687 (to more than 3 significant figures e.g. 0.6874 / 0.68737) = **1 mark** **OR** Answer of 0.69 / 0.7 (i.e. to fewer than 3 significant figures) = **1 mark** **OR** Answer of 0.688 (incorrect rounding) = **1 mark** **OR**	2 (2 x AO2)
	Answer of 1.54 (added rather than multiplied by BMI) = **1 mark** **OR** Answer of 1.81×10^{-4} (multiplied by (216 x BMI) rather than added) = **1 mark;**	

Question 9 · AS Paper 2 · June 2023 · Q07.4 · 2 marks

07.4	Correct answer of 20 = **2 marks**;; **1 mark** for evidence of 2×10^{-8} ($m\ s^{-1}$)	2 (2 x AO2)

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Question 10 · A level Paper 2 · June 2018 · Q03.3 · 2 marks

03.3	1. Correct answer in range of 4.9×10^{-4} to 4.91×10^{-4} = **2 marks**;; 2. Incorrect answer buts shows division by 24 = **1 mark** **OR** Incorrect answer but shows a number from 1175 to 1178 (ignore position of decimal point, standard form and any numbers that follow) = **1 mark**; **OR** Incorrect answer but show the number 49 (ignore position of decimal point, standard form and any numbers after 49) = **1 mark**;	2	1. Accept any equivalent mathematical representation of this answer

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Question 11 · A level Paper 1 · June 2023 · Q05.2 · 2 marks

05.2	Correct answer in range of 1.768 to 1.8 **OR** 2 = **2 marks** Accept for **1 mark**, evidence of 28/28.26/28.3 (correct calculation, π x 3^2) **OR** 28.27433 (correct calculation using π value on calculator) **OR** 0.4423 (correct calculation using diameter rather than radius) **OR** 1.76 (correct calculation but incorrectly rounded);	2 (2 x AO3)

A common correct answer for 2 marks is 1.77

Accept correct rounding of figures

Question 12 · A level Paper 3 · June 2017 · Q04.1 · 2 marks

04.1	Correct answer of 4.92, 2 marks;; If N(N-1) = 3540, **OR** ∑n(n-1) = 720, then award 1 mark	2	Accept 4.916/4.917/4.9

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Question 13 · A level Paper 2 · June 2018 · Q10.2 · 2 marks

10.2	1. Correct answer in range 42 – 44% = **2 marks**;; 2. Incorrect answer but shows that understanding that 2pq = heterozygous/carriers = **1 mark**;	2	2. Accept $1 - (p^2 + q^2)$ 2. Accept understanding of 2pq by using calculation involving 2 × two different numbers

Question 14 · A level Paper 3 · June 2025 · Q06.3 · 2 marks

06.3	Answer of 5(.347883598) = **2 marks**;; Evidence of correct answer but incorrect rounding e.g. 5.34 = **1 mark** **OR** Evidence of 5347.883598 (answer in cm^3) = **1 mark** **OR** Evidence of numbers 5347883598 (ignore position of decimal point, incorrect order of magnitude) = **1mark** **OR** Evidence of 20 215/20.215 (calculated the numerator) = **1 mark**;	2 (2 x AO2)	Accept any correct rounding

Question 15 · AS Paper 1 · June 2022 · Q04.2 · 3 marks

04.2	Correct answer for 3 marks, 9.3×10^{-6} / 0.000 0093;;; MP1 – correct reading from graph (1.5) MP2 – correct rearrangement of equation ($CdO_2 = 0.000\ 031 \times$ their pO_2) MP3 – their $CdO_2 \times 0.2$ **OR** their $CdO_2 \div 5$	3 (3 x AO2)	Accept correct rounding of 9.3×10^{-6}

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Question 16 · A level Paper 2 · June 2018 · Q03.4 · 1 mark

03.4	Large range/difference/increase in numbers;	1	1. Accept reference to exponential (increase) 1. Ignore if the answer only refers to numbers being high I. Ignore to 'fit on the scale'

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02.4	1. Log scale (on graph) shows big range in number of bacteria OR Use of suitable data from log scale to give the range in number of bacteria; 2. Some samples too many to count (so dilute) but some countable (so don't dilute) **OR** Use of figures from graph relating to ease (or otherwise) of counting Example. 631 000 000 bacteria would be too big to count (without serial dilution), 100 000 bacteria is small enough to count;

2	1 and 2 **Do not** accept simple statements of $\log_{10}$ values from graph Look for answers in standard form **Group A** Mean between 79 million and 100 million Range 4 million to 631 million **Group B** Mean between 100 thousand and 126 thousand Range 3.98/4 up to

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