Algebra (M2): OCR A Level Biology Exam Questions by Topic

16 questions · 31 marks · about 37 minutes. Answer in the spaces, then check the mark schemes at the end.

Question 1 · information from earlier in the question

1 Sago pondweed is an underwater plant that grows in many regions of the world.

Fig. 1.1 shows a transmission electron micrograph of a sago pondweed cell.

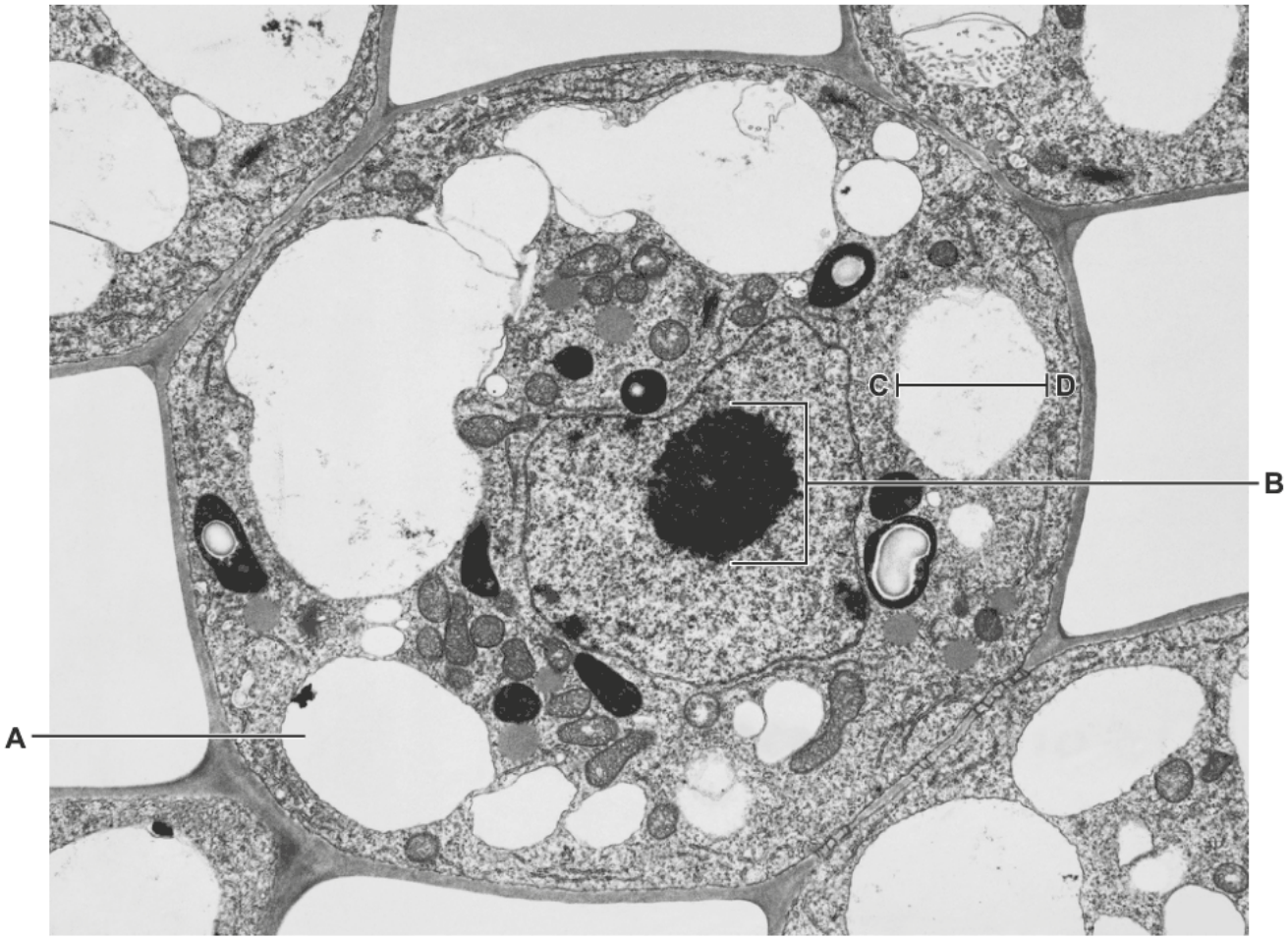


Fig. 1.1

(a) (i) Identify the **cellular components** shown at **A** and **B**.

A .....

B .....

[2]

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Question 1 · A level Paper 3 · June 2019 · Q1(a)(ii) · 2 marks

(ii) The real size of the line between **C** and **D** on Fig. 1.1 is 1.4×10^{-6} m.

Calculate the magnification that was used to produce the image in Fig. 1.1.

Give your answer to **2 significant figures**.

magnification = ... **[2]**

Question 2 · information from earlier in the question

4 (a) **Fig. 4.1** shows a light micrograph of cells in the blood.

Cell **X** plays a role in the immune response.

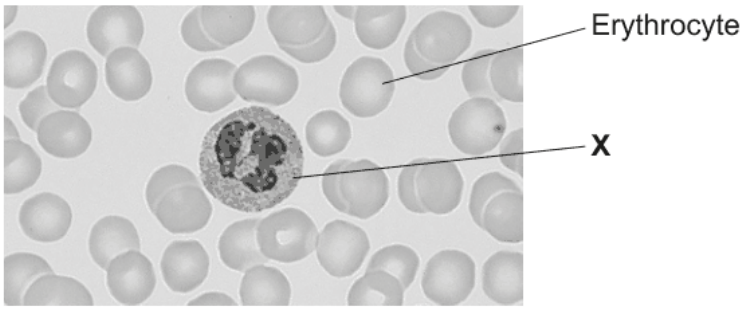


Fig. 4.1

(i) Name cell **X**.

..... **[1]**

Question 2 · AS Paper 2 · June 2022 · Q4(a)(ii) · 2 marks

(ii) The magnification of the microscope used to observe the cells in **Fig. 4.1** was ×950.

Calculate the diameter of cell **X** in **Fig. 4.1**.

Give your answer in micrometres.

Diameter = ... μm **[2]**

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Question 3 · A level Paper 3 · November 2021 · Q1(c)(i) · 1 mark

(c) Lungs are the specialised gas exchange surfaces in mammals. Dogs are mammals.

A disease called canine pulmonary fibrosis (CPF) can affect lung function in dogs. CPF can reduce the tidal volume of a dog's lungs.

(i) The West Highland Terrier develops CPF more often than other breeds of dog.

The lung function of a West Highland Terrier was tested. At rest, its ventilation rate was $1.44\,dm^3\,min^{-1}$ and its breathing rate was 24 breaths min^{-1}.

Calculate the tidal volume of the West Highland Terrier in cm^3.

Tidal volume = ... cm^3 **[1]**

Question 4 · AS Paper 2 · June 2025 · Q6(a)(i) · 2 marks

6

(a) Spirometer readings were taken from a person at rest and during exercise.

- Their tidal volume at rest was $480\,cm^3$.
- Their ventilation rate at rest was $5\,dm^3$ per minute.
- During exercise their tidal volume increased by 70%.

(i) Calculate the breathing rate of the person at rest.

Give your answer to the nearest whole number.

Breathing rate = ... breaths per minute **[2]**

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(b) A scientist sampled the species of trees present in two different habitats containing *Pinus glabra*.

The results of the sampling are shown in Table 5.

Species	Number of individuals in habitat A	Number of individuals in habitat B
P. glabra	45	60
M. grandiflora	23	10
F. grandiflora	55	20
L. styraciflua	0	10
L. tulipifera	0	0
S. shumardii	23	4

Table 5

Using Simpson's Index of Diversity, the scientist calculated the biodiversity (*D*) of Habitat A as 0.71.

Use the formula given to calculate the biodiversity of Habitat B.

Show your working.

State which habitat, A or B, has the greater biodiversity.

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

D (Habitat A) = 0.71

D (Habitat B) = ...

Habitat with the greater biodiversity = ...

[2]

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(c) Some students investigate the biodiversity of flying insect species in different parts of their school grounds.

The school has an area of wildflower meadow and some planted flower beds.

This is the method they use:

1. Select an area of wildflower meadow.
2. Pass a sweep net back and forward 5 times.
3. Shake the net into a tray and close with a transparent lid.
4. Use a key to identify the types of insect.
5. Release insects.
6. Repeat the procedure 9 times in different areas of the wildflower meadow.
7. On the same day, repeat steps 1 to 6 for the planted flower beds.

Their results for the wildflower meadow are shown in the table below.

Category	**Number of individuals**		
Bumblebees	15		
Other bees	32		
Ladybirds	2		
Other beetles	5		
Painted lady butterfly	2		
Red admiral butterfly	3		
Other butterflies	5		
Wasps	25		
Flies	11		
Total			

(i) Calculate the Simpson's Index of Diversity for the wildflower meadow.

Use the formula: $D = 1 - \left(\sum\left(\frac{n}{N}\right)^2\right)$

You may use the table above for working out.

Give your answer to **2** significant figures.

D = ... **[3]**

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Question 7 · AS Paper 1 · June 2022 · Q22(b)(i) · 2 marks

(b) During the 20th Century, there was a very large decrease in the size of wild populations of the cheetah, *Acinonyx jubatus*. This decrease was largely due to hunting. Recent research shows that wild populations of the cheetah have a very low number of polymorphic genes.

There are 17 863 gene loci in the genome of the cheetah and now only 10% of these gene loci are polymorphic in wild populations.

Scientists investigated the genetic biodiversity of cheetah populations in European zoos. They sampled 256 gene loci and found 18 gene loci to be polymorphic.

(i) Calculate the proportion of polymorphic gene loci in the European zoo population.

Proportion = ... **[2]**

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(b) Two of the insect species that were sampled were the large heath butterfly and the bog hoverfly.

The ecologists used the capture-mark-recapture technique and estimated population sizes using two different calculations: the Lincoln estimate and the Chapman estimate.

(i) Calculate the population sizes of the two insect species using each of the formulae below.

Write your answers in the table.

Lincoln estimate formula: population size = $\frac{n1 \times n2}{m}$

Chapman estimate formula: population size = $\left(\frac{(n1 + 1) \times (n2 + 1)}{(m + 1)}\right) - 1$

n = number of individuals in a particular sample

m = number of marked individuals in the second sample

Species	Number captured and marked in sample 1	Total number in sample 2	Number of marked individuals in sample 2	Population estimate (number of individuals)	
				Lincoln estimate	Chapman estimate
large heath butterfly	77	73	4		
bog hoverfly	5	6	1		

[2]

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Question 9 · A level Paper 3 · June 2019 · Q5(a) · 2 marks

5 All organisms exchange gases with their environment.

(a) Organisms can use simple diffusion to exchange gases when the diffusion pathway is less than 1 mm.

A beet armyworm larva:

- has a cylindrical shape
- is 15 mm long
- has a volume of 30 mm^3.

Calculate the diffusion pathway of the larva and state whether it **could** or **could not** rely on simple diffusion across its external surface to meet its gas exchange requirements.

Use the formula: Volume of a cylinder = $\pi r^2 l$

diffusion pathway = ... mm

larva ..... rely on simple diffusion
[2]

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Question 10 · A level Paper 3 · June 2022 · Q5(c) · 2 marks

(c) The Hardy-Weinberg principle can be used to calculate allele and genotype frequencies in populations.

The common morning glory plant, *Ipomoea purpurea*, has a range of flower colours.

Two colours, purple and pink, are determined by a single gene.

The allele, **F**, coding for purple flowers is dominant to the allele, **f**, coding for pink flowers.

A field contained 600 *I. purpurea* plants, 150 of which had pink flowers.

Using the Hardy-Weinberg principle, calculate the number of plants that had a homozygous dominant (FF) genotype.

Use the equations:

$p + q = 1$

$p^2 + 2pq + q^2 = 1$

Number of plants with genotype FF = ... **[2]**

Turn over

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Question 11 · A level Paper 2 · June 2025 · Q20(b)(i) · 3 marks

(b) In pea plants, flower colour is controlled by two alleles: purple (dominant) and white (recessive).

- 600 pea plants are growing in a large greenhouse.
- 564 of the plants have purple flowers.

(i) Use the Hardy–Weinberg principle to calculate the number of heterozygous individuals in the greenhouse.

Use the equations:

$p + q = 1$

$p^2 + 2pq + q^2 = 1$

Number of heterozygous individuals = ... **[3]**

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(c) One student's results are shown in **Table 17.2**.

The results have been rounded to the nearest 5%.

Positive values represent increased growth and negative values represent decreased growth.

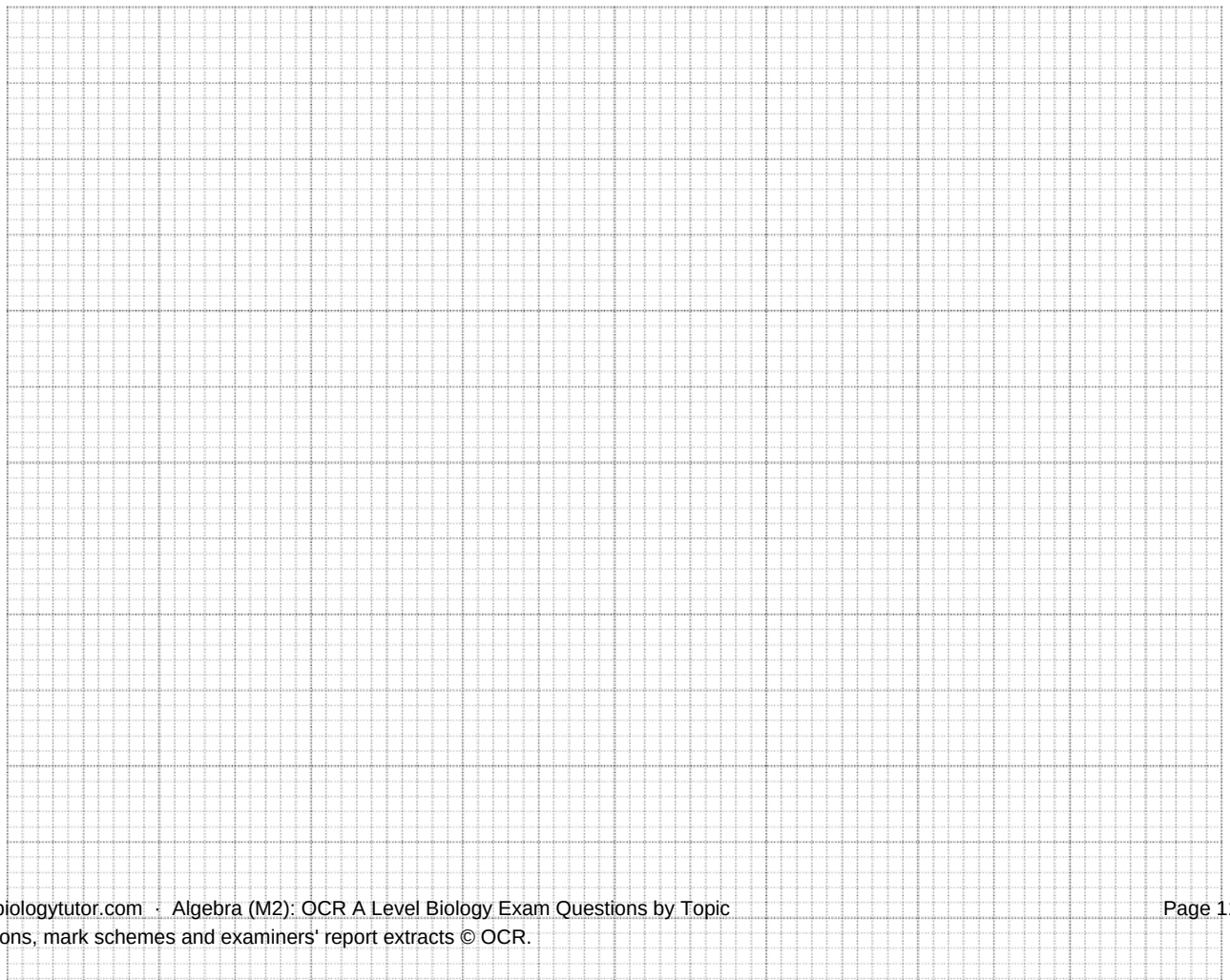
The concentration of IAA was measured in parts per million (ppm).

Table 17.2

Concentration of IAA (ppm)	% change in length	
	Root	Shoot
1×10^{2}	–100	0
1×10^{1}	–100	+200
1×10^{0}	–75	+140
1×10^{-1}	–45	+70
1×10^{-2}	+25	+30
1×10^{-3}	+65	+10
1×10^{-4}	+70	0
1×10^{-5}	+55	0

21

(i) Plot a graph of the data in **Table 17.2**. **[4]**



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Question 12 · A level Paper 1 · June 2023 · Q17(c)(iv) · 1 mark

(iv) Suggest why the range of IAA concentrations could be described as logarithmic.

.....

..... **[1]**

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17 Cirrhosis of the liver can result from long-term liver damage. Alcohol or other toxins can cause this damage.

Scientists have suggested that cirrhosis can be detected by taking samples of body fluids and testing them for two different molecules: C-reactive protein and copeptin.

The liver produces these two molecules, and increased levels can indicate liver damage due to cirrhosis.

Different bodily fluids from a patient suspected of having cirrhosis were tested for C-reactive protein and copeptin.

Fig. 17.1 is a graph of the results.

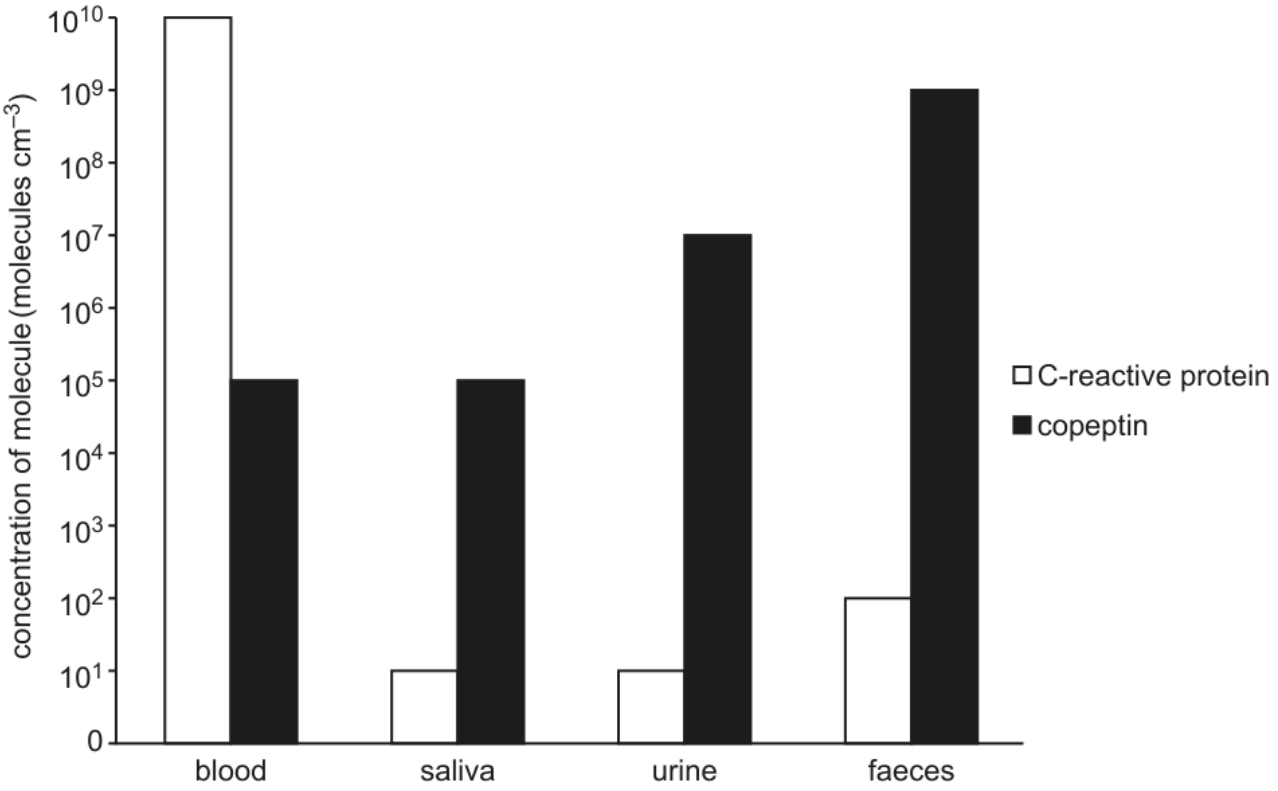


Fig. 17.1

(a) Different bodily fluids have different concentrations of the different molecules.

(i) Calculate the order of magnitude by which concentration of copeptin in the **faeces** is higher than the concentration of C-reactive protein in the **saliva**.

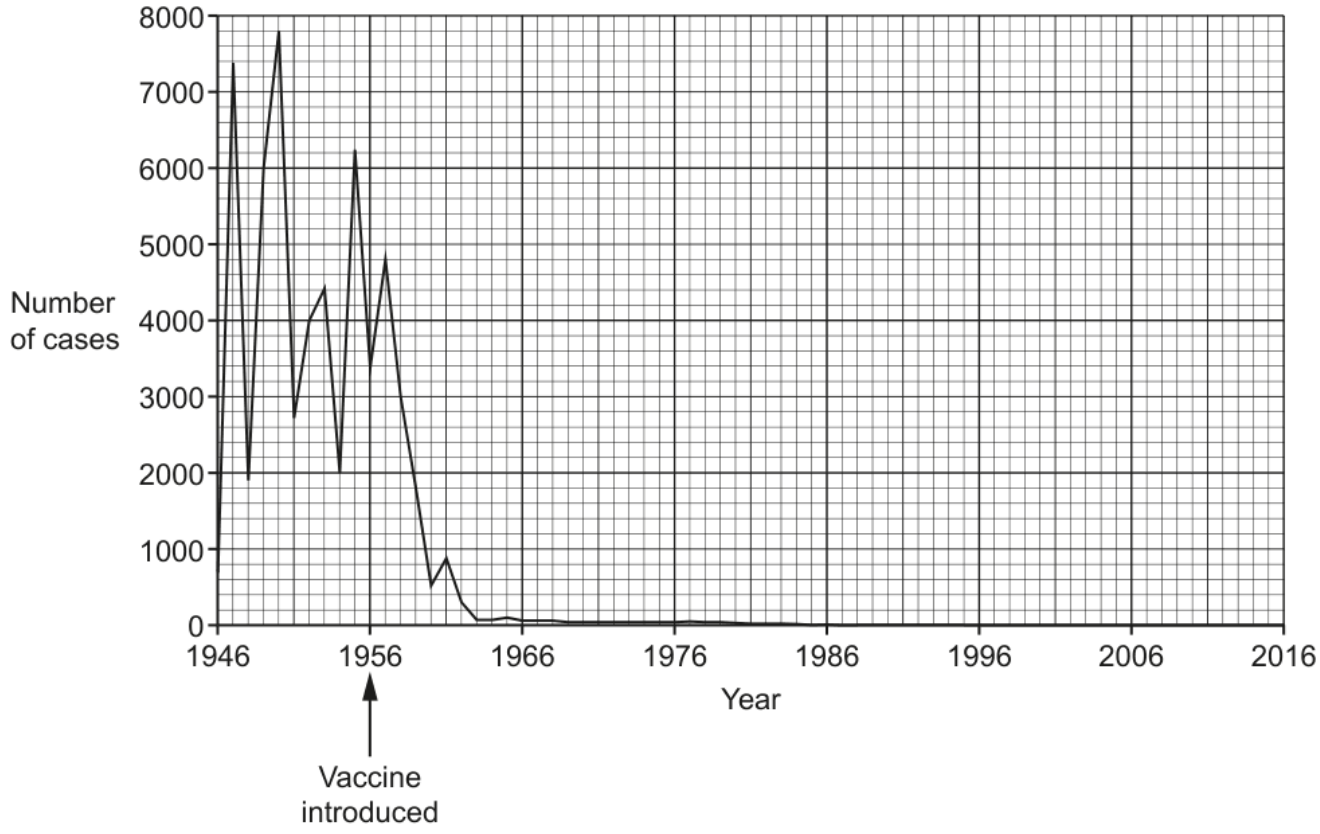
Show your working.

Answer = ... molecules cm^{-3} **[2]**

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Question 14 · information from earlier in the question

(b) The graph shows the number of cases of polio in England and Wales between 1946 and 2016.



(i) Calculate the percentage decrease in cases between 1956 and 1960.

% decrease = ... **[2]**

Question 14 · A level Paper 2 · June 2024 · Q19(b)(iii) · 1 mark

(iii) There were cases of polio in England and Wales in the 1980s.

The scale used on the graph is not sensitive enough to show changes in the number of cases during the 1980s.

Suggest **one** way in which the *y*-axis scale could be changed in order that changes in the 1950s and 1980s were both visible.

.....

..... **[1]**

Questions, mark schemes and examiners' report extracts © OCR.

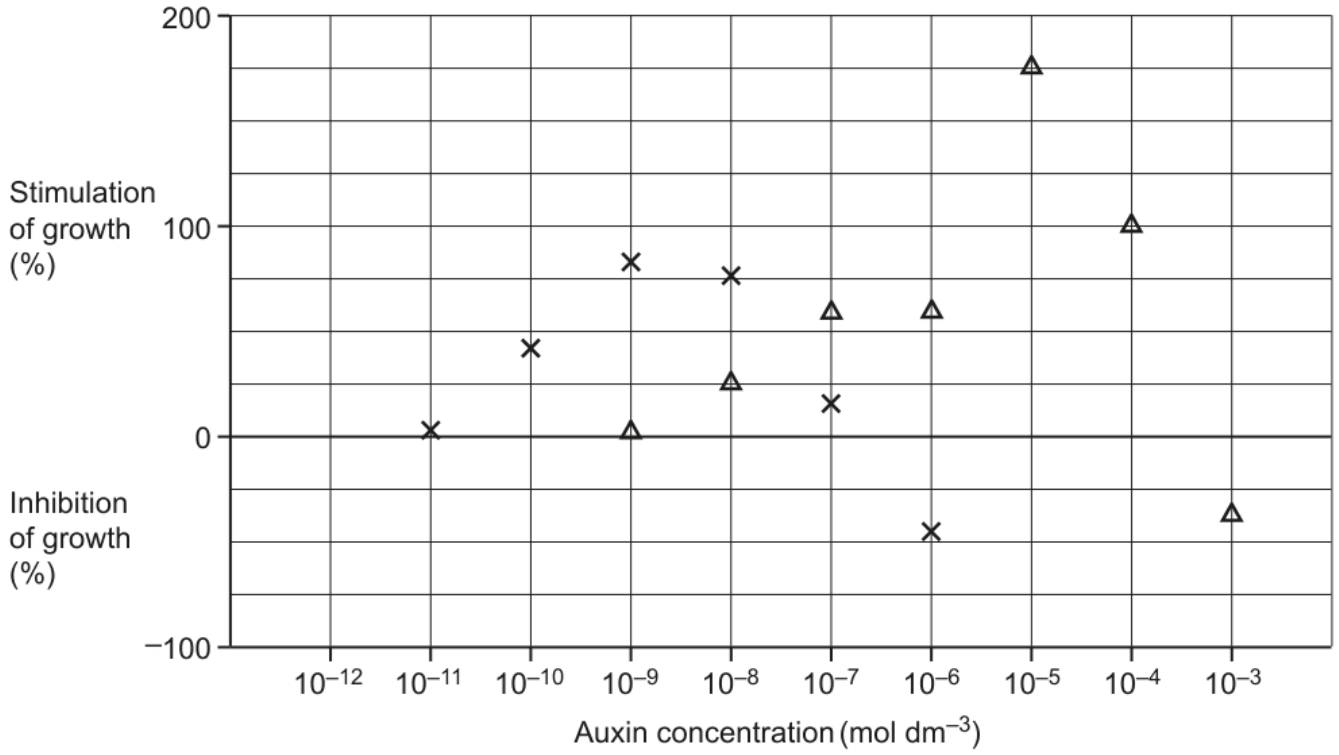
(b) The student investigated the effect of auxin concentration on the growth of shoots.

The student applied different concentrations of auxin to the apical shoot and the lateral shoots.

The student measured the percentage of growth stimulation or inhibition compared to normal.

Normal growth was represented by 0%.

The student's results are shown in the graph.



Key: × = lateral shoots

Δ = apical shoot

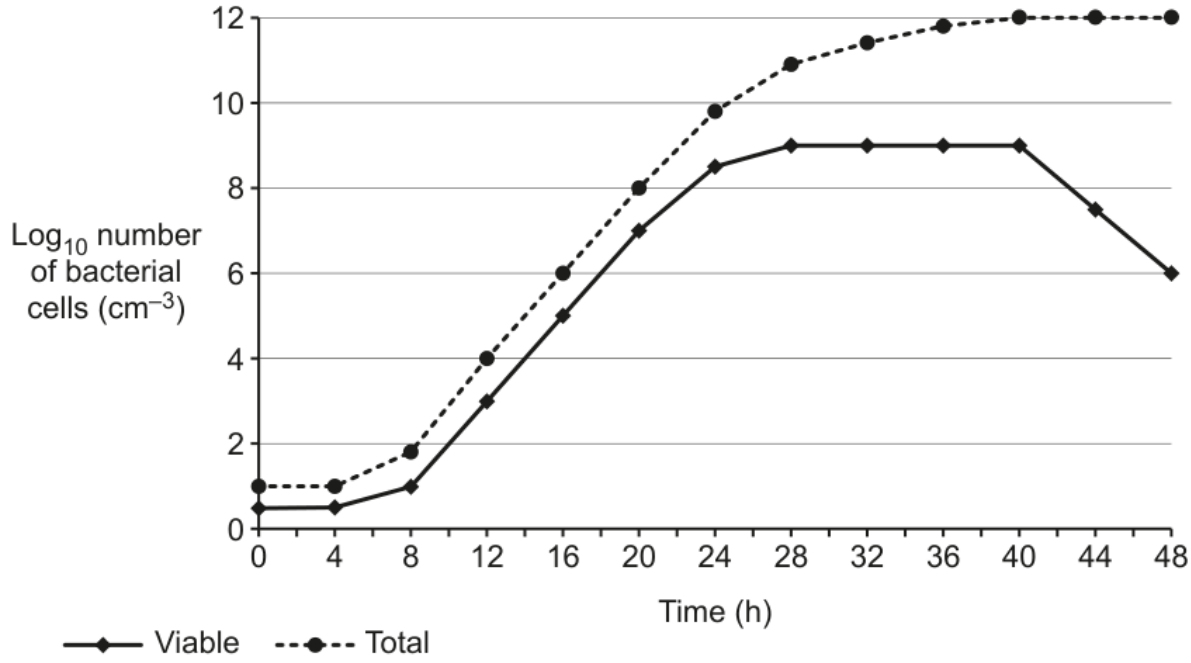
(i) Use the graph to estimate the auxin concentration at which inhibition of lateral shoots is 100%.

Auxin concentration = ... mol dm^{-3} **[1]**

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Question 16 · information from earlier in the question

(c) The graph shows the students' results.



(i) Explain, with reference to the graph, why the students used a logarithmic scale on the *y*-axis.

.....

.....

.....

.....

..... **[2]**

Question 16 · A level Paper 2 · June 2022 · Q17(c)(ii) · 3 marks

(ii) Calculate the percentage decrease in the viable population between 40 h and 48 h.

Give your answer to **3** significant figures.

Percentage decrease = ... % **[3]**

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Mark schemes

Question 1 · A level Paper 3 · June 2019 · Q1(a)(ii) · 2 marks

li	(x)14000 / 1.4 x 10^4 ✓✓	**2**	If the answer is incorrect, award one mark for a correct calculation not rounded to 2 s.f. (e.g. 0.02 / 0.0000014 = 14285.71429 20000 / 1.4 = 14285.71429) **ALLOW** 0.019/0.0000014 = 13571.428 **or** 0.021/0.0000014 = 15000 for 1 mark

Question 2 · AS Paper 2 · June 2022 · Q4(a)(ii) · 2 marks

4	**(a)**	**(ii)**	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 14 or 15 (µm) award 2 marks** 14mm ÷ 950 = 0.0147mm ✓ 0.0147 x 1000 = 15µm ✓	**2**

AO 2.8	**ALLOW** answer given to **3 significant figures for 2 marks** e.g. 13.7 / 14.2 / 14.7µm If answer given to **more than 3** sig. fig. **max 1 mark** **ALLOW** (13 000 ÷ 950) = 13.7µm **for 2 marks** **ALLOW** (13 500 ÷ 950) = 14.2µm **for 2 marks** If final answer incorrect **award 1 mark** for **two clearly shown** correct steps in working (other than 1 plus 4). **IGNORE** crossed-out working. **steps in working:** **1** (diameter with units =) 13 / 13.5 / 14mm **OR** 1.3 / 1.35 / 1.4cm **2** divide by 950 **3** convert **EITHER** original diameter **OR** answer to µm (mm → µm x 1000, cm → µm x 10 000) **4** round to 2 significant figures

Questions, mark schemes and examiners' report extracts © OCR.

Question 3 · A level Paper 3 · November 2021 · Q1(c)(i) · 1 mark

c	**i**	60 (cm^3) ✓		**1**	2.2

$1.44\ dm^3 = 1440\ cm^3$

$1440 / 24 = 60$

Question 4 · AS Paper 2 · June 2025 · Q6(a)(i) · 2 marks

6	**(a)**	**(i)**	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 10 award 2 marks** breathing rate = ventilation rate/tidal volume ventilation rate = 5dm^3 per minute = 5000cm^3 per minute breathing rate = 5000$cm^{3/}$ 480cm^3 = 10.4167 = 10 *5000 / 480* ✓ *correct rounding to nearest whole number* ✓	**2**	**2.4**

Question 5 · A level Paper 3 · June 2018 · Q5(b) · 2 marks

b	(Habitat B =) 0.61 ✓ Habitat with the greatest biodiversity = A ✓	**2**

DO NOT ALLOW mp 2 if value of D not calculated

ALLOW ECF if B has been identified as the habitat with greatest biodiversity, (if value of D calculated for habitat B greater than 0.71)

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Question 6 · A level Paper 2 · June 2025 · Q18(c)(i) · 3 marks

18	**(c)**	**(i)**	**FIRST CHECK ON ANSWER LINE** **If answer = 0.79 award 3 marks** N = 100 ✓ $\Sigma(n/N)^2 = 0.206(2)$ ✓	**3**	**2.4**

Correct answer to wrong number of s.f. = 2 marks, e.g. 0.8 / 0.794 / 0.7938

IGNORE significant figures for $\Sigma(n/N)^2$

ALLOW 1 mark for candidate's $\Sigma(n/N)^2$ value correctly subtracted from 1 to 2 s.f. (if working shown)

Question 7 · AS Paper 1 · June 2022 · Q22(b)(i) · 2 marks

22	**(b)**	**(i)**	0.07(03125) ✓✓	**2**

FIRST CHECK THE ANSWER ON ANSWER LINE
If answer = 0.07(03125) award 2 marks
ALLOW correct answer anywhere in answer space

ALLOW 7(.03125)% for two marks

If correct answer not given then:
ALLOW one mark for:
number of polymorphic gene loci / total gene loci
OR
18 / 256
OR
9 / 128

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Question 8 · A level Paper 3 · November 2020 · Q5(b)(i) · 2 marks

b	**i**	large heath butterfly	1405 **and** 1153 ✓	**2**	2.8
		bog hoverfly	30 **and** 20 ✓		

Answers must be rounded to nearest whole number

Question 9 · A level Paper 3 · June 2019 · Q5(a) · 2 marks

5	**a**		radius (of larva) = 0.8 mm **AND** (larvae) could (rely on simple diffusion) ✓✓	**2**

ALLOW calculator value (i.e. 0.79788456) or any correctly rounded value.

ALLOW correct calculation with incorrect or no conclusion for 1 mark

ALLOW ecf for correct conclusion drawn from incorrect calculation

Award 0 marks for conclusion alone

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5	(c)	**FIRST CHECK ON ANSWER LINE** **If answer = 150 award 2 marks** 150/600 = 0.25 (q^2) square root of 0.25 = 0.5 (q) ✓ p = 1 - 0.5 = 0.5 $p^2 = 0.5^2 = 0.25$ 0.25 x 600 (= 150) ✓	**2**	2.2

ALLOW 0.25 for 1 mark

ALLOW 1 mark for any 2 correct steps of process
Step 1 150/600 = 0.25 (q^2)
ALLOW ECF for steps 2 -5
2. Find square root of q^2 (q)
3. Subtract figure(q) from 1 (p)
4. Multiply p x p (p^2)
5. (p^2) x 600

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Question 11 · A level Paper 2 · June 2025 · Q20(b)(i) · 3 marks

20	(b)	(i)	**FIRST CHECK ON ANSWER LINE** **If answer = 222 or 221 or 220 award 3 marks** $q^2 = 0.06(0)$ ✓ $q = 0.245$ $p = 0.755$ $2pq = 0.37(0)$ ✓ $600 \times 0.37 = 222$ ✓	3	2.4

ALLOW 1 mark for candidate's 2pq (stated) x 600

ALLOW 2 marks for whole number answers:
$(q = 0.06)$ answer = 67 or 68
$(p^2 = 0.94)$ answer = 35
$(q = 0.24)$ answer = 218 or 219

Question 12 · A level Paper 1 · June 2023 · Q17(c)(iv) · 1 mark

17	(c)	(iv)	because each interval is a factor of 10 / AW ✓	1	2.4

DO NOT ALLOW e.g. change by 10 each time

Question 13 · A level Paper 1 · June 2017 · Q17(a)(i) · 2 marks

17	(a)	(i)	10^8 **OR** 1×10^8 **OR** 100 000 000 ✓✓	2	**If answer is incorrect ALLOW one mark** *For evidence of correct working* i.e. $10^9 \div 10^1$

Question 14 · A level Paper 2 · June 2024 · Q19(b)(iii) · 1 mark

19	(b)	(iii)	use a log(arithmic) scale ✓	1	3.3	
Question			**Answer**	**Mark**	**AO Element**	**Guidance**

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Question 15 · A level Paper 3 · June 2022 · Q3(b)(i) · 1 mark

3	**(b)**	**(i)**	10^{-5} (mol dm^{-3}) ✓	**1**	2.8

ALLOW answers in range 9×10^{-6} to 1×10^{-5} (mol dm^{-3})

Question 16 · A level Paper 2 · June 2022 · Q17(c)(ii) · 3 marks

(ii)	**FIRST CHECK ON ANSWER LINE** **If answer = 99.9 award 3 marks** *Reading from graph* log 9 = 1×10^9 and log 6 = 1×10^6 ✓ *Calculating percentage* $\frac{1 \times 10^9 - 1 \times 10^6}{1 \times 10^9} \times 100$ ✓ *Correct processing* correct answer to 3 s. f. ✓	**3**	2.8

If the answer is not 99.9…

ALLOW −99.9 for 3 marks

ALLOW numbers not in standard form / 10^9 / 10^6

ALLOW substitution of incorrect numbers into the formula $\frac{\text{difference}}{\text{original}} \times 100$

and answer given to 3 s. f. (with correct sign) for **1** mark

AWARD 2 marks for 0.999

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