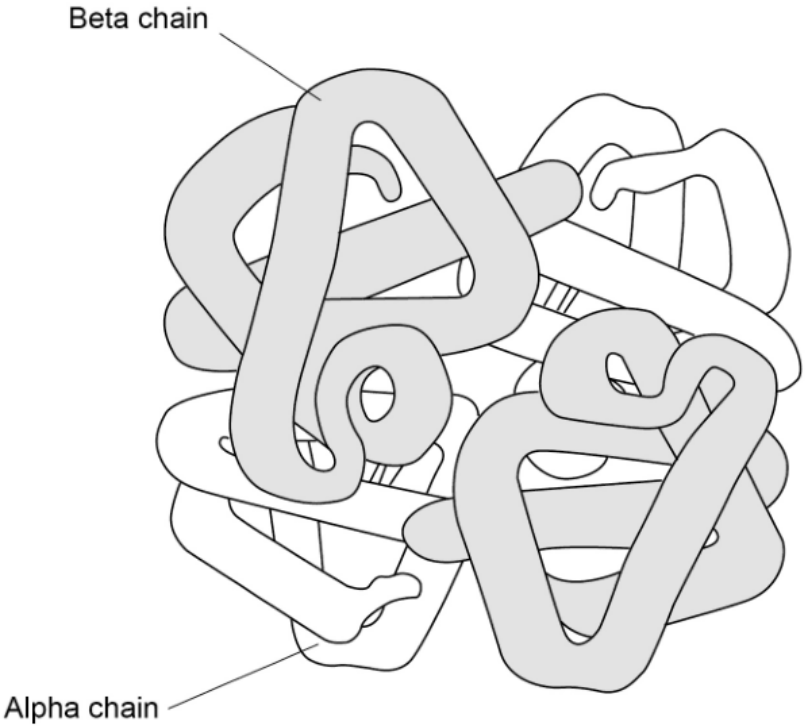
Handling Data: AQA A Level Biology Exam Questions by Topic

18 questions · 36 marks · about 47 minutes. Answer in the spaces, then check the mark schemes at the end.

Question 1 · A level Paper 3 · June 2022 · Q01.3 · 2 marks

Figure 2 represents the structure of adult human haemoglobin.

Figure 2



0 1 . 3 The number of amino acids in the beta chains in **Figure 2** is 3.546% greater than in the alpha chains. Each alpha chain contains 141 amino acids.

Calculate how many amino acids there are in total in the haemoglobin molecule shown in **Figure 2**. Give your answer to the nearest whole number.

[2 marks]

Answer _____ amino acids

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0 4 Scientists investigated the effect of different types of animal farming on the diversity and number of dung beetles. They determined the number of dung beetle species and their total number on intensive (**I**), rough grazing (**R**) and organic (**O**) farms.

Figure 4 and **Figure 5** show some of their results.

Figure 4

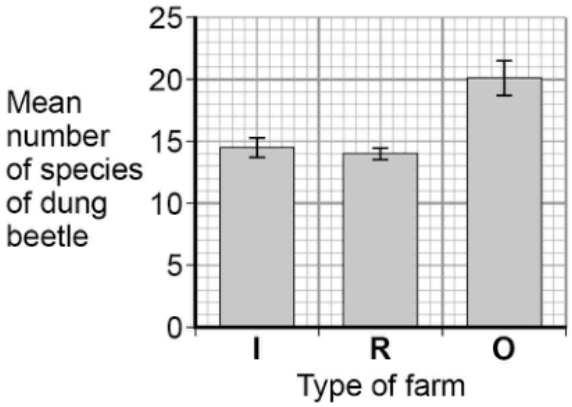
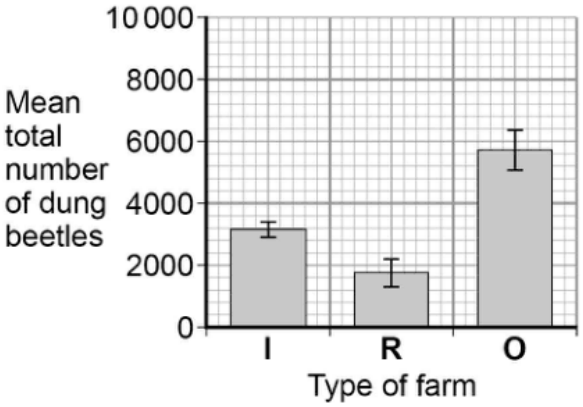


Figure 5



Key: I Standard deviation

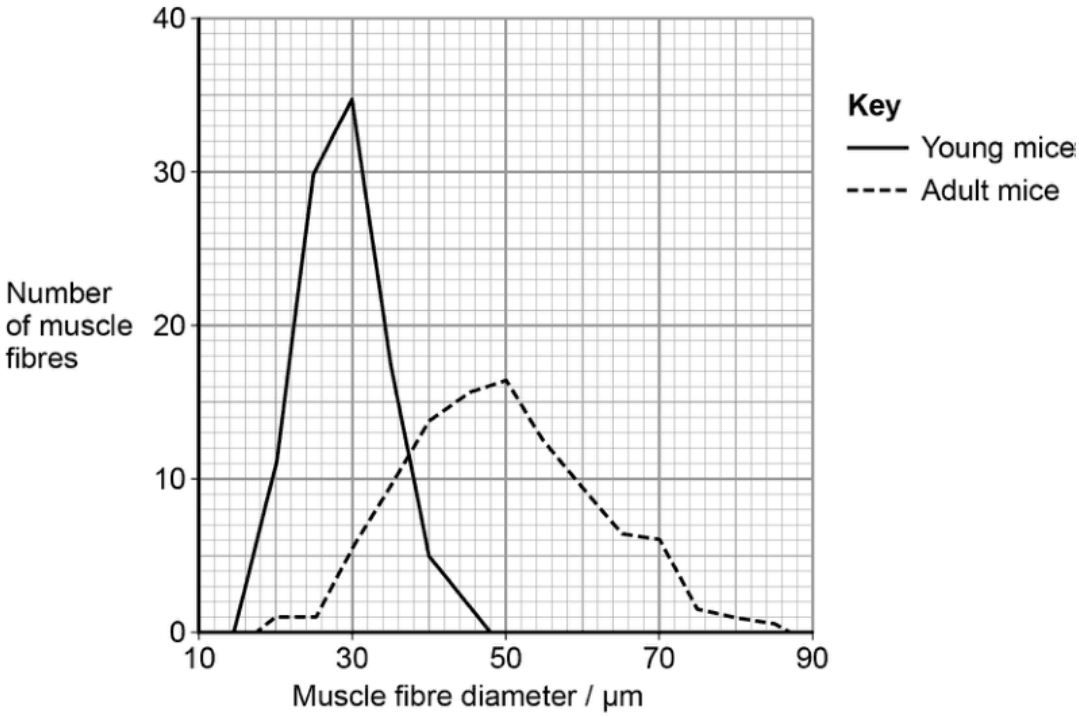
0 4 . 1 What is the mean species richness for dung beetles on the rough grazing farms?
[1 mark]

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0 3 . 4 The scientists also compared the diameter of samples of muscle fibres taken from young mice and adult mice.

Some of their results are shown in **Figure 4**.

Figure 4



Describe **two** differences between these samples of muscle fibres.

[2 marks]

1 _____

2 _____

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The student measured the distance the coloured water had travelled in eight celery stalks.
Her results are shown in **Table 1**.

Table 1

Distance / mm							
70	35	40	35	30	80	42	44

0 5 . 5 The student had to choose whether to summarise her measurements by calculating the mean, the median or the mode.

Circle the most appropriate measure for this set of measurements.
Give a reason for your choice and find the value using the measurements from all eight stalks.

[2 marks]

Mean* Median* Mode*

*circle one word.

Reason: _____

_____

_____

Calculation:

Answer = _____

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0 4 Osteoarthritis (OA) is a disease resulting in joint damage which causes stiffness.

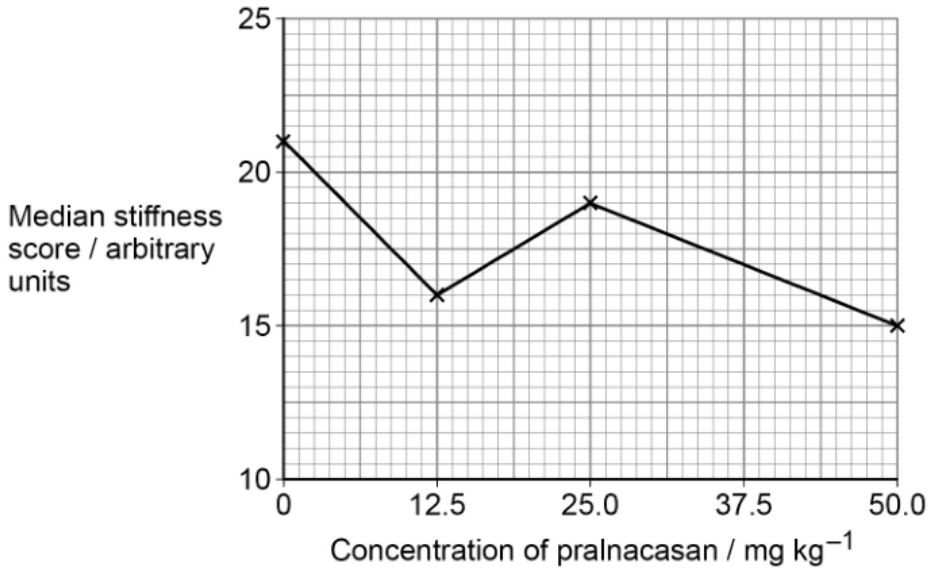
Scientists investigated the use of a drug called pralnacasan to treat OA in 80 mice.

The scientists:

- injected the knee joints of mice with an enzyme to cause joint damage
- split the mice randomly into 4 equal groups
- fed each group with food containing a different concentration of pralnacasan
- after 6 weeks, assessed the stiffness of the knee joints of the mice and scored them using an arbitrary scale.

Figure 3 shows their results.

Figure 3



0 4 . 1 Describe how the scientists determined the median of the stiffness scores.

[1 mark]

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Question 6 · information from earlier in the question

0 6

In humans, the ABO blood groups and Rhesus blood groups are under genetic control. The inheritance of the ABO blood groups is controlled by three alleles of a single gene, I^A, I^B and I^O. The alleles I^A and I^B are codominant, and the allele I^O is recessive to I^A and recessive to I^B.

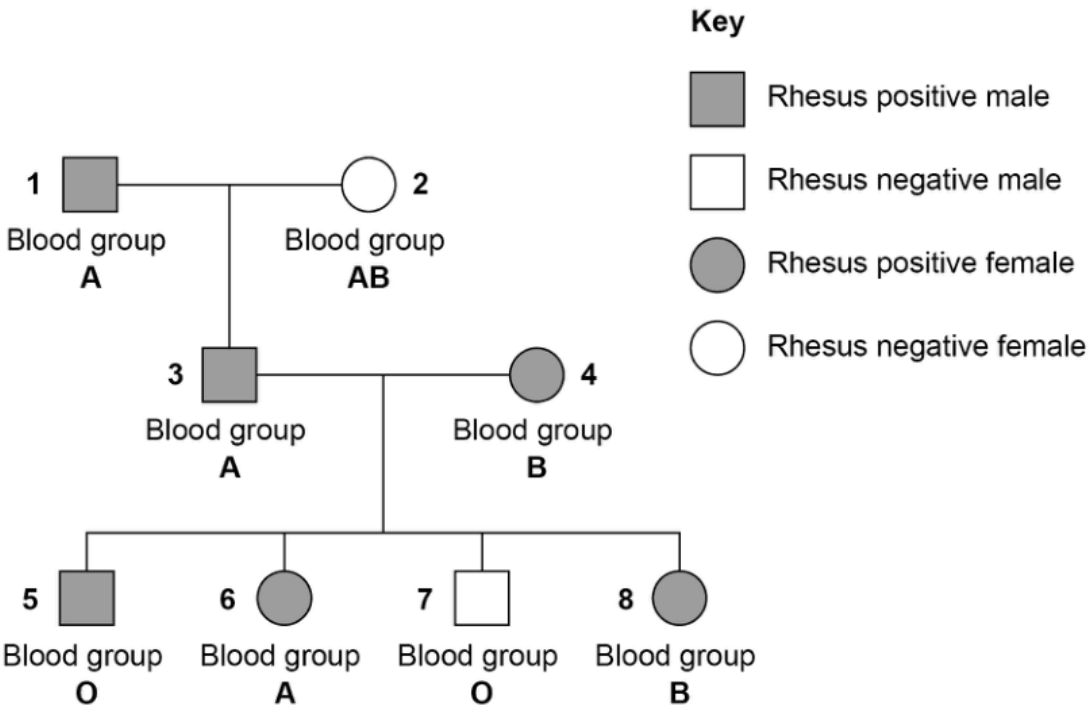
There are four ABO phenotypes, **A**, **B**, **AB** and **O**.

The gene for the Rhesus blood groups has two alleles. The allele for Rhesus positive, **R**, is dominant to the allele for Rhesus negative, **r**.

The genes for the ABO and Rhesus blood groups are **not** sex-linked and are **not** on the same chromosome.

Figure 3 shows the phenotypes in a family tree for the ABO and Rhesus blood groups.

Figure 3



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Question 6 · A level Paper 2 · June 2022 · Q06.3 · 2 marks

0 6 . 3 Calculate the probability of individuals **1** and **2** producing a Rhesus positive son with blood group **A** (individual **3**). You can assume that individual **1** is heterozygous for the Rhesus blood group.

Show your working.

[2 marks]

Probability _____

Question 7 · information from earlier in the question

0 4 Scientists investigated the effect of different types of animal farming on the diversity and number of dung beetles. They determined the number of dung beetle species and their total number on intensive (**I**), rough grazing (**R**) and organic (**O**) farms.

Figure 4 and **Figure 5** show some of their results.

Figure 4

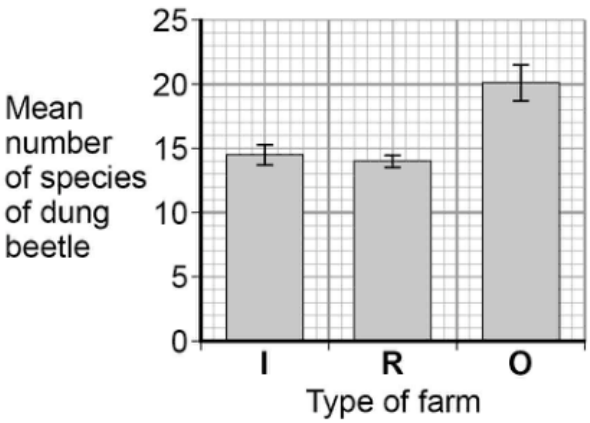
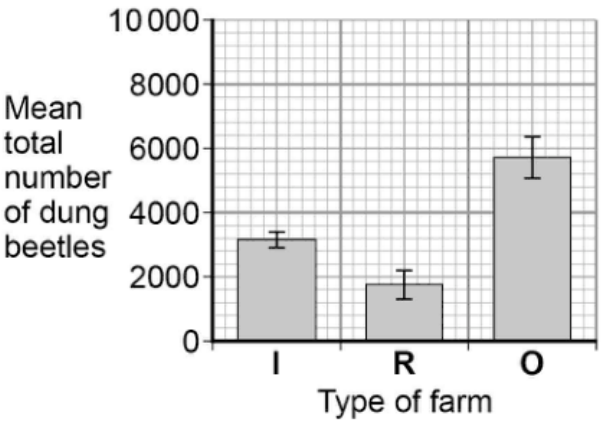


Figure 5



Key: I Standard deviation

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Question 7 · AS Paper 2 · June 2016 · Q04.4 · 1 mark

0 4 . 4 The scientists placed traps to collect the dung beetles at sites chosen at random.

Explain the importance of the sites being chosen at random.

[1 mark]

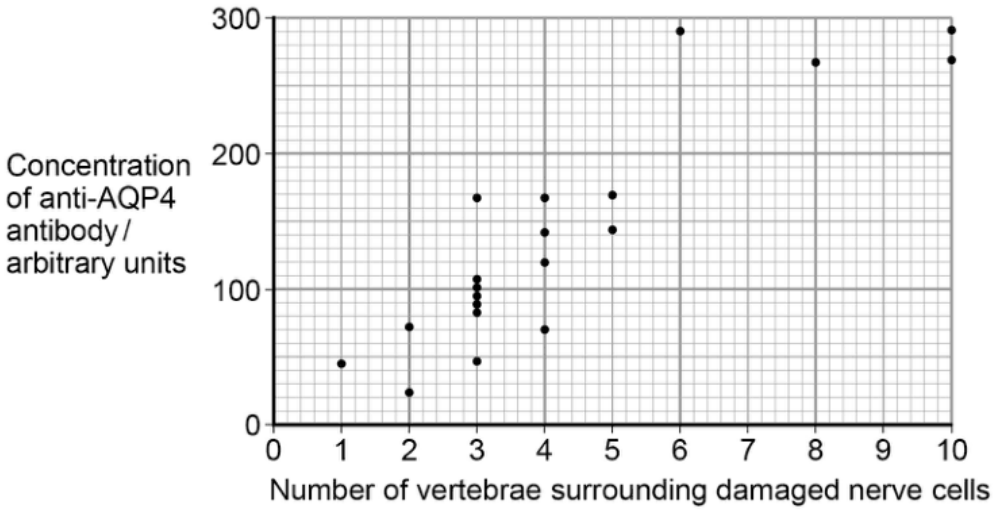
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0 7 . 2 Scientists measured the concentration of anti-AQP4 antibody in the blood of people with NMO.

The spinal cord is surrounded by small bones called vertebrae. For each person, the scientists also determined the number of vertebrae surrounding damaged nerve cells.

Their results are shown in **Figure 7**.

Figure 7



A scientist suggested that the concentration of anti-AQP4 antibody in a person's blood could be used to predict the number of vertebrae surrounding damaged nerve cells they are likely to have.

Use **Figure 7** to suggest reasons why this suggestion might **not** be valid.

[3 marks]

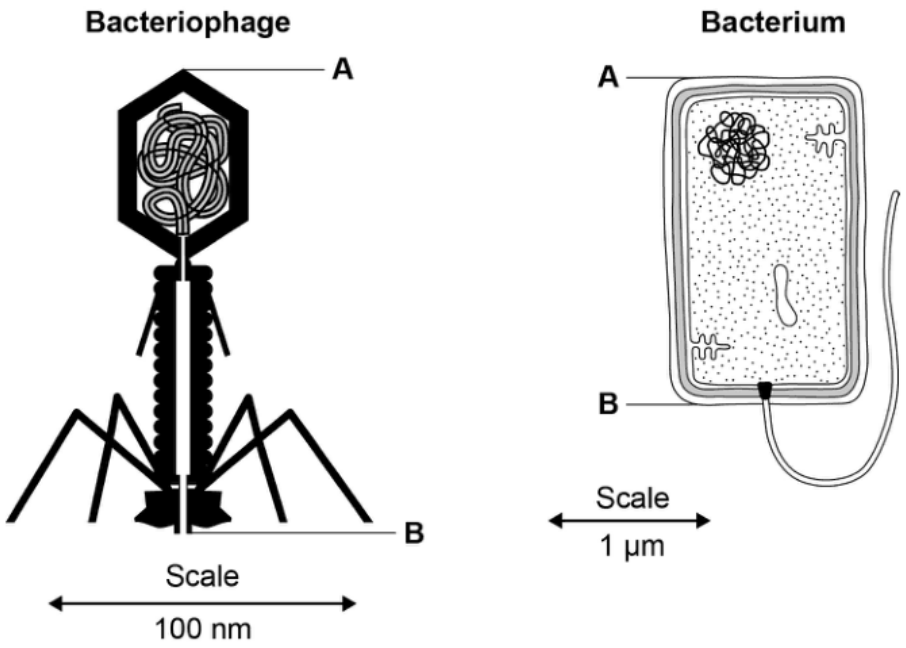
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Question 9 · information from earlier in the question

0 2 Bacteriophages are viruses that kill bacteria.

Figure 2 shows drawings of a bacteriophage and a bacterium.

Figure 2



Question 9 · A level Paper 3 · June 2017 · Q02.2 · 2 marks

0 2 . 2 Using the scales in **Figure 2**, calculate how many times longer the bacterium is than the bacteriophage.

Use the distance between the points labelled **A** and **B** on each drawing in your calculations. Show your working.

[2 marks]

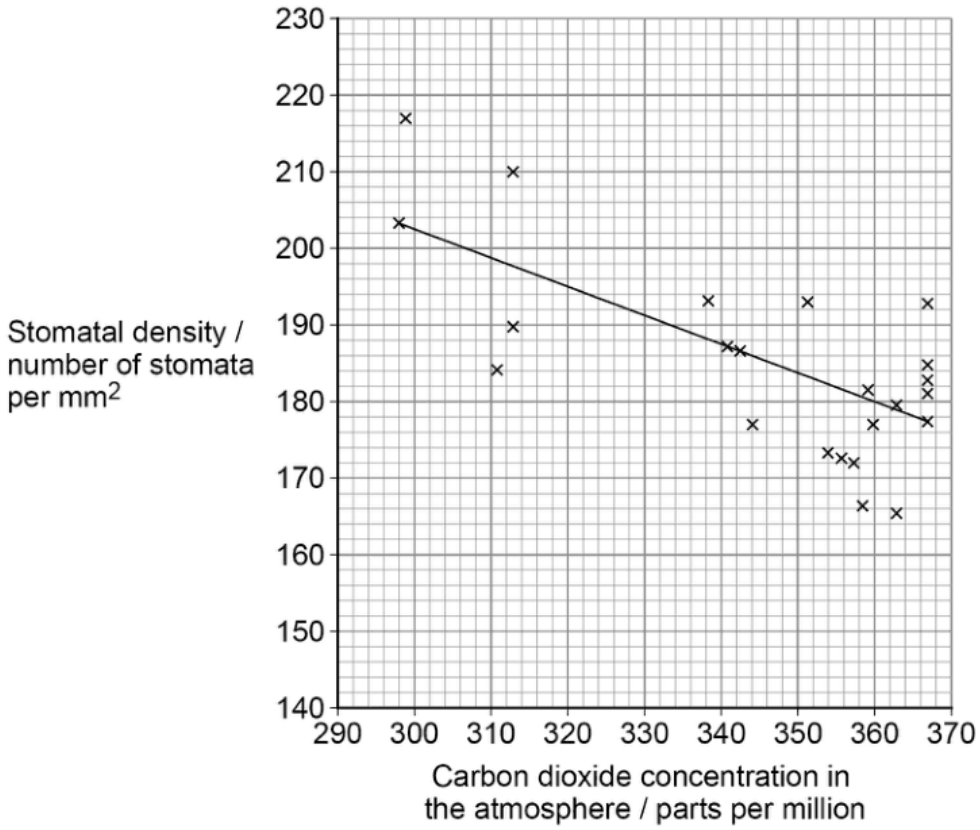
The bacterium is _____ times longer

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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

0 9 . 2 Give a null hypothesis for this investigation **and** name a statistical test that would be appropriate to test your null hypothesis.

[2 marks]

Null hypothesis _____

_____

_____

Statistical test _____

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0 5 . 4 The scientists used a statistical test to determine whether there was a significant difference in the amino acid concentration in the two types of white wine.
They obtained a value for P of 0.04.

Name the statistical test the scientists used and give a reason for your answer.

Was the difference significant? Give a reason for your answer.

[3 marks]

Name of statistical test _____

Reason for choice _____

_____

_____

Explanation of test result _____

_____

_____

_____

_____

_____

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Question 12 · information from earlier in the question

0 6 . 2 If two diploid (2n) gametes fuse at fertilisation, it can result in the growth of a tetraploid plant which has 4 copies of each chromosome.
Red clover is a plant grown to produce cattle feed. Tetraploid red clover plants produce a higher yield than diploid red clover plants.
Whether a red clover plant produces 2n gametes is genetically controlled.

Scientists investigated the possibility of breeding red clover plants that only produced 2n gametes.

- In breeding cycle 0, they grew red clover plants and identified plants that produced 2n gametes.
- In breeding cycle 1, they used the plants producing 2n gametes to produce offspring.
- In breeding cycles 2 and 3, they identified plants producing 2n gametes and used these to produce offspring.

Their results are shown in **Table 3**.

Table 3

	Observed		**Expected**	
Breeding cycle	Number of plants that **did not** produce 2n gametes	Number of plants that **did** produce 2n gametes	Number of plants that **did not** produce 2n gametes	Number of plants that **did** produce 2n gametes
0	50	4	50	4
1	14	42	……..	……..
2	2	44		
3	0	56		

The scientists used the following null hypothesis.

'The proportion of plants that produce 2n gametes will not change from one breeding cycle to the next.'

Complete **Table 3** to show the **expected number** of plants that **did not** produce 2n gametes and the expected number of plants that **did** produce 2n gametes after 1 cycle.
Give each answer to the nearest whole number.

[2 marks]

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Question 12 · A level Paper 1 · June 2018 · Q06.3 · 2 marks

0 6 . 3 The scientists tested their null hypothesis using the chi-squared statistical test.
After 1 cycle their calculated chi-squared value was 350
The critical value at P=0.05 is 3.841

What does this result suggest about the difference between the observed and expected results and what can the scientists therefore conclude?

[2 marks]

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0 8 . 2 Antibiotic resistance alleles are located in plasmids.

There are 11 different types of plasmid inside cells of the bacterium *Bacillus thuringiensis*.

A scientist determined the:

- length of each type of plasmid in kilobase pairs (kbp)
- mean plasmid copy number (mean number of each type of plasmid per cell).

Table 5 shows the scientist's results for 5 of these plasmids.

Table 5

Plasmid identity	Plasmid length / kbp	Mean plasmid copy number	Rank of plasmid length	Rank of mean plasmid copy number	Squared difference between ranks (d^2)
A	8	172	2	5	9
B	95	6	4	2	4
C	12	35	3	3	0
D	2	139	1	4	9
E	294	3	5	1	16

The Spearman rank correlation coefficient (r_s) between plasmid length and mean plasmid copy number is determined using this equation.

$$r_s = 1 - \frac{6 \sum d^2}{n (n^2 - 1)}$$

where

$\sum d^2$ = the sum of all d^2 figures

n = 5 (the highest rank number)

Use information in **Table 5** and the formula to calculate the r_s value for this set of data.

Show your working.

[2 marks]

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Question 14 · A level Paper 1 · June 2024 · Q05.3 · 2 marks

0 5 . 3 The scientist used data from **Figure 4** to calculate a correlation coefficient (r). The scientist then used a statistical test to determine the probability (P) associated with the value of r.

$r = -0.98$ ($P < 0.05$)

What can you conclude from this result?

[2 marks]

Question 15 · information from earlier in the question

0 9 A scientist produced transgenic zebrafish.

She obtained a gene from silverside fish. The gene codes for a growth hormone (GH).

She inserted copies of this *GH* gene into plasmids. She then microinjected these recombinant plasmids into fertilised egg cells of zebrafish.

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The scientist investigated whether the transferred *GH* gene increased the growth of transgenic zebrafish. She microinjected 2000 fertilised egg cells with the *GH* plasmid and left 2000 fertilised egg cells untreated. After 12 months, she determined the mean mass of the transgenic and non-transgenic fish.

The results the scientist obtained are shown in **Table 3**.

Table 3

A value of ±2 × SD from the mean includes over 95% of the data.

Type of zebrafish	Mean mass of zebrafish / g (± 2 × SD)
Transgenic	1.79 (± 0.37)
Non-transgenic	0.68 (± 0.13)

0 9 . 3 Using **Table 3**, what can you conclude about the effectiveness of the *GH* gene on the growth of zebrafish?

[2 marks]

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Scientists investigated how the diet of rabbits affected their digestion and absorption of protein. The scientists fed rabbits an identical mass of food but varied the percentage of protein in the food.

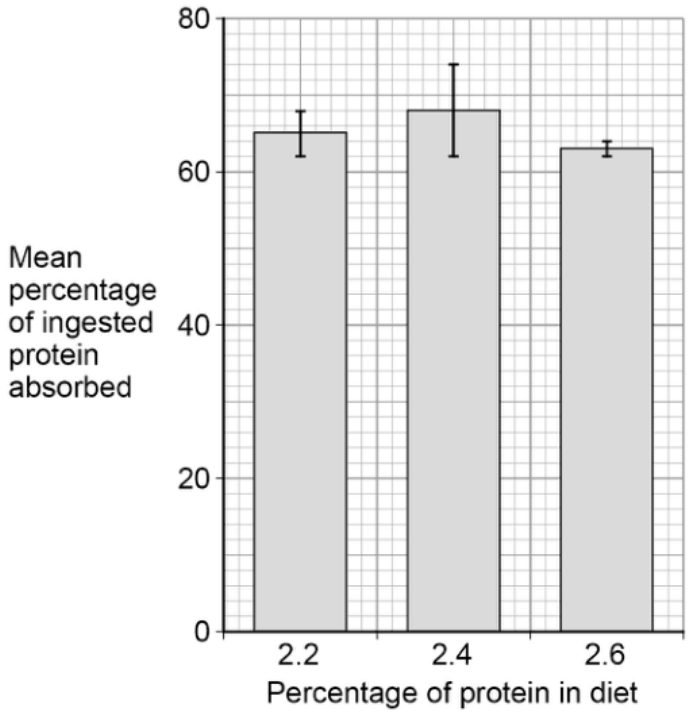
The scientists measured the mean mass of protein fed to the rabbits that was absorbed, which they then expressed as a percentage value.

The scientists' results are shown in **Figure 1**.

The error bars show ± 2 standard deviations.

± 2 standard deviations cover 95% of the data.

Figure 1



0 1 . 2 What can you conclude about the absorption of the products of protein digestion as the percentage of protein increased in the rabbits' food?

[3 marks]

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Question 17 · AS Paper 2 · November 2020 · Q08.1 · 2 marks

0 8 . 1 A scientist measured the pressure in a phloem tube in a willow plant stem. He repeated his measurements to obtain nine readings.

His results are shown in **Table 3**.

Table 3

Phloem pressure / arbitrary units								
7.4	8.0	7.0	8.6	8.2	9.3	7.4	9.1	8.8

The percentage error of the mean phloem pressure in this phloem tube is calculated using this equation.

$$\text{Percentage error} = \frac{\text{uncertainty in measurement}}{\text{mean}} \times 100$$

The uncertainty in measurement is half the range of the measured values.

Calculate the percentage error of the mean phloem pressure in this phloem tube.

Show your working.

[2 marks]

Percentage error _____ %

Question 18 · A level Paper 1 · June 2024 · Q03.5 · 2 marks

0 3 . 5 Give the uncertainty associated with taking a measurement using a ruler with 1 mm graduations.

Calculate the percentage error for a measurement using the ruler of 4 mm

[2 marks]

Uncertainty ± _____ mm

Percentage error _____

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Mark schemes

Question 1 · A level Paper 3 · June 2022 · Q01.3 · 2 marks

01.3	Correct answer of 574 (amino acids) = **2 marks**;; 573.99936 = **1 mark** **OR** 146/145.99986 = **1 mark** **OR** 287 = **1 mark** **OR** 292 = 1 mark;	2 (2 x AO2)

Question 2 · AS Paper 2 · June 2016 · Q04.1 · 1 mark

04.1	14;	1

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03.4	1. A numerical comparison of range = **2 marks** i.e. Young (fibres) range 14/15 – 47/48 (μm) **and** adult (fibres) 17/18 - 86/87/88 (μm) OR Young (fibres) range 32/33/34 **and** adult (fibres) range 68/69/70/71; 2. Comparison of range without numbers = one mark i.e. Adult (fibres) greater range/spread/variation (of diameters) OR Young (fibres) smaller range/spread (of diameters);
	3. Comparison of mode = one mark i.e. Adult (fibres) peak/most common/frequent/mode at 50 (μm) **and** young (fibres) peak/most common/frequent/mode at 30 (μm);
2 max	1. Accept: **one** mark for comparison of minimum values i.e. 14/15 compared to 17/18 Allow **one** mark for comparison of maximum values i.e. 47/48 compared to 86/87/88.

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Question 4 · AS Paper 2 · June 2019 · Q05.5 · 2 marks

05.5	Median (no mark) 1. (Presence of) outliers/80/70 **OR** Small sample size/8 (measurements); 2. 41; Accept for 1 mark, Mean of 47 OR Mode of 35	2	1. Accept anomalies / extremes for 'outliers'

TOTAL		**10**	

Question 5 · A level Paper 3 · June 2024 · Q04.1 · 1 mark

04.1	Put the (stiffness) scores (for each concentration) in (value/rank) order **and** found middle value;	1 (1 x AO1)

Accept descriptions of (rank/value) order, eg smallest to largest

Accept find the $(\frac{n+1}{2})^{th}$ term/value

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Question 6 · A level Paper 2 · June 2022 · Q06.3 · 2 marks

06.3	Correct answer of 0.125 / $^{1}/_{8}$ / 12.5% = **2 marks**;; Incorrect answer of 0.25 / $^{1}/_{4}$ / 25% = **1 mark**;

2 (2 x AO2)	Accept 1 in 8 for 2 marks or accept 1 in 4 for 1 mark. Accept equivalent raw fractions e.g., $^{2}/_{16}$ for 2 marks or $^{4}/_{16}$ for 1 mark. Accept 12.5 for 1 mark.

Question 7 · AS Paper 2 · June 2016 · Q04.4 · 1 mark

04.4	No bias; 1	Ignore: 'representative sample'.

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Question 8 · AS Paper 2 · June 2017 · Q07.2 · 3 marks

07.2	1. Only 20 in the study; OR Only one study; 2. For some concentrations of antibody there is a range in the number of vertebrae surrounding damaged nerve cells; 3. No statistical test used; 4. Correlation is weak;	3 max

1. Accept small sample 2. Accept suitable use of data 2. Accept converse

Question 9 · A level Paper 3 · June 2017 · Q02.2 · 2 marks

02.2	Correct number of times between 13.0/12.96 **and** 13.9/13.92 scores 2 marks;; One mark if correct sizes in ranges of 150.7nm to 154.4nm/ 0.151µm to 0.154µm **and** 1953.5nm to 2097.6nm/ 1.954µm to 2.098µm;	2	**Both** lengths required for 1 mark credit Accept refs to150/0.15 and 2000/2 Ignore number of sig fig

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Question 10 · A level Paper 1 · November 2020 · Q09.2 · 2 marks

09.2	1. There is no association/correlation/relationship between the concentration of carbon dioxide and the stomatal density OR The concentration of carbon dioxide does not affect the stomatal density; 2. Correlation coefficient;	2

1. Reject 'There is no difference between the carbon dioxide concentration and the stomatal density'.

1. Do not credit 'The stomatal density does not affect the carbon dioxide concentration'.

2. Accept 'Spearman's (rank)' or other named correlation coefficient.

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05.4	Choice: (Student's) *t*-test; Reason for choice: Looking for differences between two means; Explanation: Difference is significant / not due to chance because the P value is 0.04 / is less than 0.05;	3	Reason: Allow comparing contrasting two means Explanation: Assume 'it' means difference Explanation: Reject result / data is significant / not due to chance Explanation: do not accept P value is less than 0.04

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06.3

1. There is a less than 0.05/5% probability that the difference(s) (between observed and expected) occurred by chance; — 2 max
2. Calculated value is greater than critical value so the null hypothesis can be rejected;
3. (The scientists can conclude that) the proportion of plants that produce 2n gametes does change from one breeding cycle to the next;

1. Reject 'results (without reference to difference) occurring by chance'. Overall max 1 with this statement.

1. Accept 'there is a greater than 0.95/95% probability that the difference did **not** occur by chance'.

1. and 2. Ignore 'difference is significant'

2. Do not accept 'P value' for 'critical value'.

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08.2	Correct answer of – 0.9 = **2 marks**;; 228 (correct numerator) = **1 mark** **OR** 120 (correct denominator) = **1 mark** **OR** 1.9 (correct calculated quotient) = **1 mark** **OR** 0.9 (correct answer but positive integer) = **1 mark;**

2 (2 x AO2)	Accept for 2 marks, - 0.9 as a fraction

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Question 14 · A level Paper 1 · June 2024 · Q05.3 · 2 marks

05.3	1. Strong/significant negative (correlation); 2. (Because probability of) correlation occurring by chance is less than / < 0.05 / 5% **OR** (Because) more than / > 0.95 / 95% (probability) that correlation is not due to chance; 3. Reject null hypothesis;	Max 2 (2 x AO3)

2. Accept relationship for correlation 2. Reject 'statistical test' **OR** 'results' **OR** 'differences' are significant/not due to chance

Question 15 · A level Paper 2 · November 2020 · Q09.3 · 2 marks

09.3	1. No overlap in SDs; 2. Significant increase/difference (in growth/mass) **OR** Increase/difference (in growth/mass) is **not** due to chance;	2	2. Reject 'the results are significant or not due to chance'.

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Question 16 · AS Paper 2 · June 2019 · Q01.2 · 3 marks

01.2	1. No significant difference (in protein absorption); 2. (because ± 2) SDs overlap; 3. (So mean) <u>percentage</u> absorbed not affected by <u>percentage</u> in diet; 4. Amount of protein (in diet) is not a limiting factor **OR** Something else is limiting factor eg amount of protease; 5. (But) small range of protein in diet **OR** (Should) Investigate wider range;	3 max

Ignore reference to 'significance' unless qualified, eg 'difference'

2. Accept error bar for SD

Question 17 · AS Paper 2 · November 2020 · Q08.1 · 2 marks

08.1	Correct answer for 2 marks = 14/14.02/14.024;; Accept for 1 mark, mean = 8.2 **OR** uncertainty = 1.15	2

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03.5	1. (Uncertainty ±) 1 (mm); 2. (Percentage error) 25 (%);	2 (2 x AO2)	2. Accept, if incorrect uncertainty ÷ 4 and multiplied by 100 **OR** – for example 50% (if uncertainty is 2) **OR** 12.5% (if uncertainty is 0.5) **OR** 2.5% (if uncertainty is 0.1)

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