Handling Data and Statistics (Maths Skills MS1): Edexcel SNAB A Level Biology Exam Questions

20 questions · 41 marks · about 49 minutes. Answer in the spaces, then check the mark schemes at the end.

Question 1 · A level Paper 3 · June 2017 · Q4(a)(i) · 1 mark

4 A student investigated the effect of salt concentration on the growth of one species of brine shrimp.

The student placed 100 shrimp eggs in a beaker containing 1dm^3 of 3% salt solution. Three days after the eggs hatched, 10 shrimps were collected and their lengths measured. Seven days after hatching, another 10 shrimps were collected and their lengths measured.

The procedure was repeated using a 5% salt solution. All other variables were kept constant.

The results are shown in the table.

Specimen number	Length of specimen in 3% salt solution / mm		Length of specimen in 5% salt solution / mm	
	3 days after hatching	7 days after hatching	3 days after hatching	7 days after hatching
1	0.75	1.00	0.75	0.98
2	0.78	1.25	0.73	0.95
3	0.66	1.10	0.61	0.93
4	0.73	1.03	0.63	0.83
5	0.85	1.15	0.53	0.98
6	0.78	1.08	0.60	1.08
7	0.90	1.13	0.52	0.95
8	0.90	1.05	0.81	1.03
9	0.80	1.18	0.58	0.88
10	0.85	1.05	0.68	0.88
Mean	0.800	1.102		0.949

(a) (i) Calculate the mean length of shrimp three days after hatching in the 5% salt solution. Give your answer to an appropriate number of significant figures.

(1)

Answer ..... mm

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Question 2 · AS Paper 2 · June 2024 · Q8(d)(i) · 2 marks

(d) Cattle farming in Brazil has made use of monoculture pasture.

The native grassland ecosystem has been replaced with pastures sown with grass plants not native to Brazil.

This has resulted in a loss of biodiversity.

Agroforests have been introduced to enhance biodiversity. These aim to provide food for cattle and restore biodiversity.

Agroforest involves growing a mixture of trees, shrubs and grasses.

Scientists monitored the biodiversity of insect species in an area of monocultural pasture and an area of agroforest.

Some of their results are shown in the table.

Group of insects	Total number of insects		Number of species	
	Agroforest	Monocultural pasture	Agroforest	Monocultural pasture
Hemiptera (bugs)	23133	18571	111	89
Hymenoptera (bees and wasps)	12503	7075	348	270
Diptera (flies)	8184	15470	219	203
Coleoptera (beetles)	2772	171	348	306
Mantodea (mantids)	13	10	3	1

(i) Calculate the percentage change in the total number of Diptera insects found in agroforest compared with the monocultural pasture.

Give your answer to 3 significant figures.

(2)

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Question 3 · A level Paper 2 · June 2023 · Q3(c)(i) · 1 mark

(c) Keyhole surgery or open surgery can be used to treat ACL damage.

A study compared wound infections from these two types of surgery.

The table shows the results of this study.

Type of surgery	Number of surgeries	Number of wound infections after surgery	Ratio of wound infections to number of surgeries
Keyhole surgery	2623	2	0.0008 : 1
Open surgery	13 472	68	

(i) Complete the table to show the ratio of wound infections to number of open surgeries.

Give your answer to one significant figure.

(1)

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4 The photograph shows a plant called lantana (*Lantana camara*).



(Source: © Peter Vrabel/Alamy Stock Photo)

The leaves of lantana contain chemicals known to have antimicrobial properties.

The antimicrobial activity of lantana leaf extracts prepared using three different solvents, A, B and C, was compared.

Fresh lantana leaves were dried and powdered. The dried leaf material was mixed with the solvent and then the extract was purified and dried.

The mass of extract obtained from 5 g of powdered leaf, using each solvent, was measured.

Solvent used	Mean mass of extract ± SD / μg
A	501.3 ± 3.5
B	721.3 ± 1.5
C	245.6 ± 4.0

(a) The mass of dried and powdered lantana leaves is 10.5% of the mass of fresh leaves.

Calculate the mass of fresh leaves needed to produce 1 mg of extract using solvent A.

Give your answer to three significant figures.

(2)

.....

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Question 5 · AS Paper 1 · June 2024 · Q7(c) · 4 marks

(c) The table shows the number of deaths due to CHD in three countries.

Country	Number of deaths per 100 000	
	Men	Women
England	240	110
France	100	20
Russia	700	200

Plot these data in a suitable graphical form.

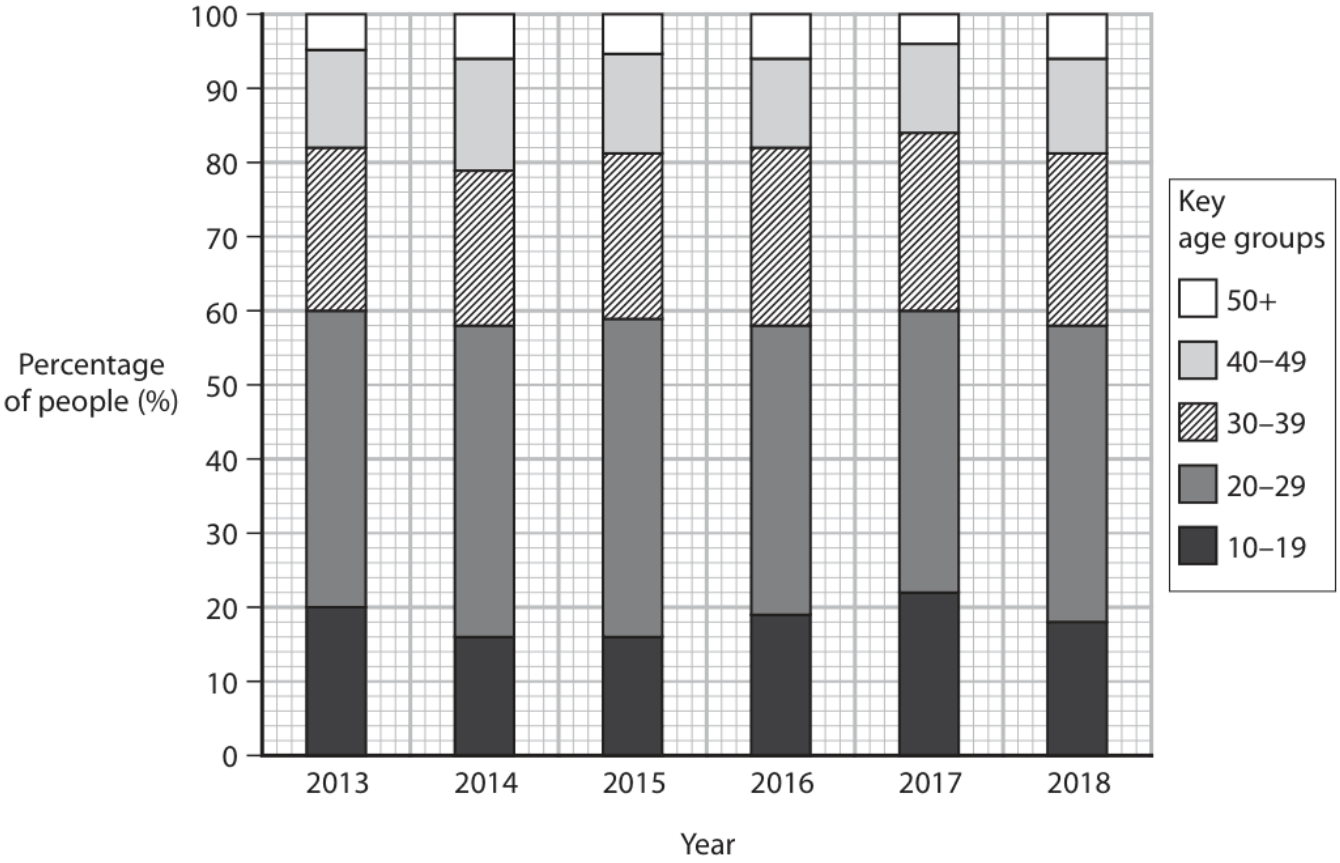
(4)



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Question 6 · A level Paper 2 · June 2023 · Q3(b) · 3 marks

(b) The graph shows the percentage of people in the UK who had ACL surgery from 2013 to 2018.



Comment on the effect of age on the percentage of people who had ACL surgery from 2013 to 2018.

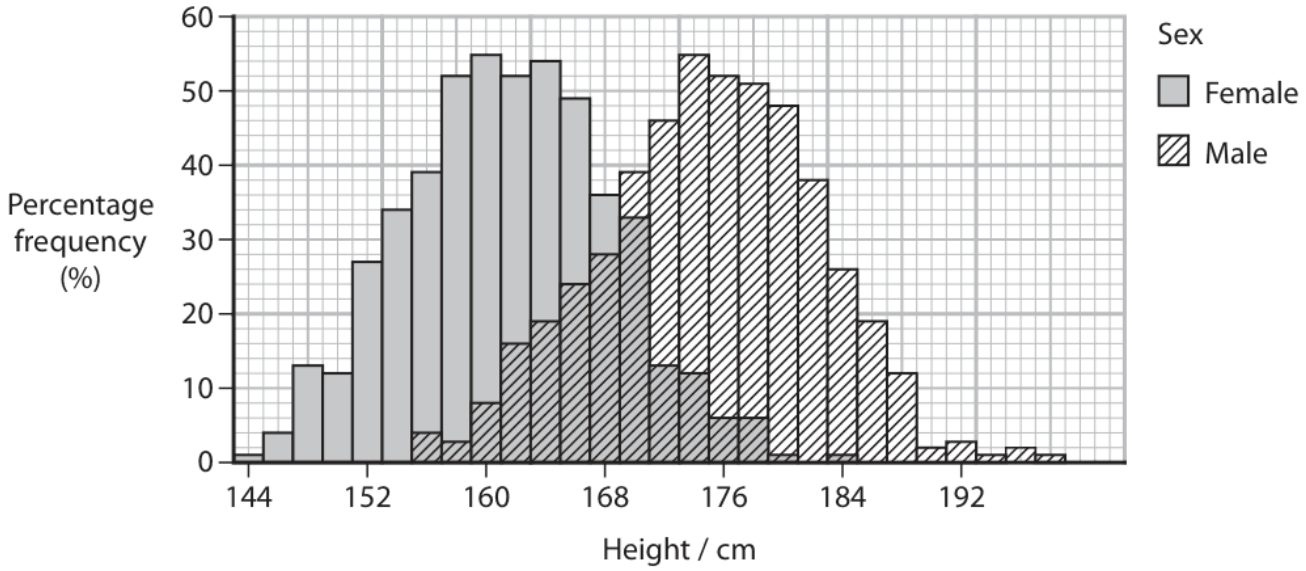
(3)

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Question 7 · AS Paper 2 · June 2023 · Q4(c)(i) · 1 mark

(c) Human height is another phenotype affected by polygenic inheritance.

The graph shows the frequency of height for two groups of adults.



(i) State the **mode** for height in males.

(1)

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Question 8 · AS Paper 1 · June 2023 · Q4(b)(i) · 2 marks

(b) Tay-Sachs disease is a genetic condition.

Individuals who are homozygous recessive for this condition usually survive for up to four years.

(i) Determine the probability of two individuals who are heterozygous for the Tay-Sachs gene having a child with this condition.

Use a genetic diagram, and the alleles **T** and **t**.

(2)

Probability .....

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(b) The presence of coastal tailed frogs in streams is used as an indicator of the health of an ecosystem.

In the past, scientists observed frogs and recorded their locations.

Scientists can now use eDNA to study the locations of these frogs. This method detects frog DNA collected from the water and amplified by PCR.

In one investigation, the two methods were compared.

Observational studies and eDNA methods were used to determine if coastal tailed frogs were present or absent in 45 streams.

The results were:

- Observational studies found these frogs in 9 of the 45 streams.
- Frog eDNA was also detected in those 9 streams.
- Frog DNA was also found in 21 streams in which these frogs were not observed.

(i) Calculate the percentage probability of coastal tailed frog eDNA being detected in a stream in which the frogs were not observed.

Give your answer as a whole number.

(2)

.....%

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Question 10 · information from earlier in the question

5 Egg cells vary in size between different species of animal.

Egg cells from different animals were measured and some further information about each species was recorded. The data are shown in the table.

Animal	Diameter of egg cell	Mass of adult / kg	Site of fertilisation	Site of offspring development
Domestic cow (mammal)	85 μm	540	inside the body	in the uterus
Human (mammal)	150 μm	62	inside the body	in the uterus
American eel (fish)	1.1 mm	6.8	in the sea	floating in the sea
Hermann's tortoise (reptile)	2.3 cm	3.4	inside the body	inside an egg shell, in a nest
Great spotted kiwi (bird)	7.8 cm	2.3	inside the body	inside an egg shell, in a nest

Question 10 · AS Paper 2 · June 2016 · Q5(c)(i) · 1 mark

(c) (i) Deduce the relationship between egg cell diameter and the mass of the adult animal shown by the data.

(1)

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Question 11 · AS Paper 2 · June 2016 · Q5(c)(ii) · 4 marks

(ii) Criticise this data set as evidence for a relationship between egg cell diameter and the mass of the adult.

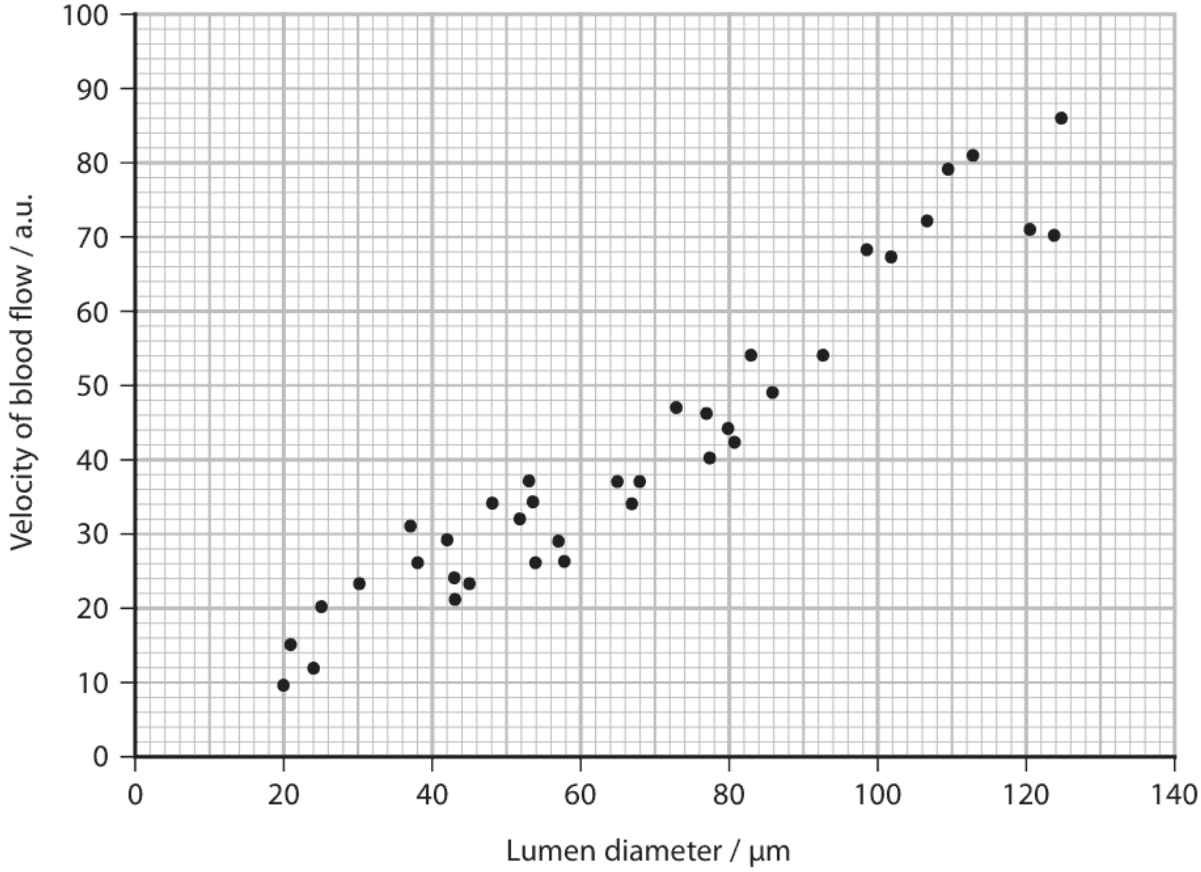
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Question 12 · A level Paper 3 · October 2020 · Q1(a) · 1 mark

1 The diameter of the inside of a blood vessel (lumen diameter) affects the speed of blood flow.

The graph shows the relationship between the lumen diameter of blood vessels and the velocity of blood flow.



(a) State the relationship shown in the graph.

(1)

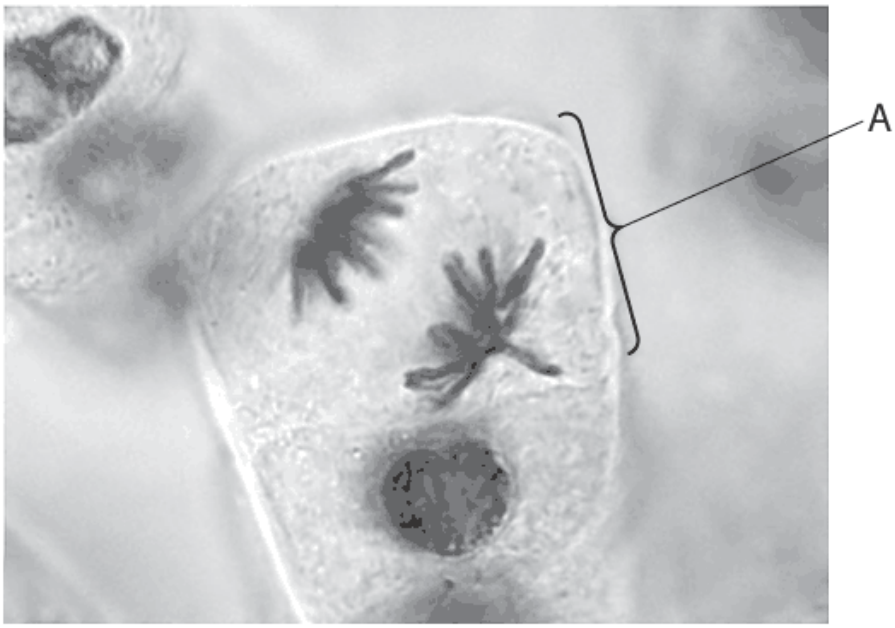
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Question 13 · information from earlier in the question

(b) The photograph shows a cell undergoing nuclear division, as seen using a light microscope.



Magnification ×800

Question 13 · AS Paper 2 · June 2019 · Q3(b)(ii) · 2 marks

(ii) The mean distance between the two sets of chromatids in the photograph of cell A is 1.5 cm.

Calculate the actual distance in μm.

(2)

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Question 14 · A level Paper 2 · June 2023 · Q5(a) · 3 marks

5 The bacterium *Escherichia coli* (*E. coli*) makes up about 1% of the human gut flora. Some strains of this bacterium aid our digestion but some strains are pathogenic.

(a) The width of the *E. coli* DNA is 250 times smaller than the width of the bacterium.

An image of *E. coli*, at a magnification of 20 000, had a width of 10 mm.

Calculate the width of its DNA.

Give your answer in micrometres (μm) and in standard form.

(3)

.....

Question 15 · A level Paper 3 · October 2020 · Q4(a)(i) · 1 mark

4 Global warming can affect abiotic factors that determine the distribution of organisms.

The presence of sodium chloride in soil is an abiotic factor that affects the germination of seeds.

The effects of sodium chloride solution and gibberellin on the germination of rice seeds have been investigated.

Gibberellin regulates developmental processes in plants.

Fifty seeds were placed in each of three Petri dishes containing different solutions.

The seeds were incubated for 96 hours and the number that germinated in each Petri dish was counted.

Treatment	Solution	Number of seeds germinating
Control	Distilled water	48
Sodium chloride	120 mmol dm^{-3} of sodium chloride	33
Sodium chloride and gibberellin	120 mmol dm^{-3} sodium chloride and 50 μmol dm^{-3} gibberellin	45

(a) (i) Give a null hypothesis for this experiment.

(1)

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Question 16 · A level Paper 3 · June 2022 · Q1(a)(ii) · 2 marks

(ii) The results of this investigation were analysed using the Student's t-test.

A p value of 0.05 was used to interpret the results of the t-test.

Explain what a p value of 0.05 means.

(2)

Question 17 · A level Paper 2 · November 2021 · Q9(b)(i) · 2 marks

(b) The scientists proposed a null hypothesis for the rate of breakdown of protein in the muscle cells of the two groups.

The data from this investigation showed that there was no significant difference at the 0.05 probability level.

(i) Explain what is meant by no significant difference at the 0.05 probability level for the rate of breakdown of protein.

(2)

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Question 18 · AS Paper 2 · November 2021 · Q3(c) · 3 marks

(c) Drug trials may last 15 years before the drug is licensed. The results of each stage are analysed before the drug trial can progress.

The results of a trial of a drug for lowering blood pressure are shown in the table.

Mean reduction in blood pressure / mmHg	
People given the drug	**People given a placebo**
7 ± 12	4 ± 8

Testing of this drug did not proceed beyond this stage.

Deduce why the drug trial was stopped at this stage.

(3)

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6 Anabolic steroids and testosterone have been used as performance-enhancing drugs by some athletes. These drugs can increase muscle mass and strength.

(a) An investigation was carried out to assess the effect of doses of testosterone on muscle size.

A group of men was randomised into four groups: A, B, C and D. Groups A and B were given a placebo. Groups C and D were both given doses of testosterone. Groups A and C had no exercise training. Groups B and D were given exercise training.

The cross-sectional area of the triceps muscle of each individual was measured at the start of the investigation and after 10 weeks.

The results are shown in the table.

Muscle	Mean cross-sectional area of muscle / mm^2 ± SD			
	Group A Placebo without exercise	Group B Placebo with exercise	Group C Testosterone without exercise	Group D Testosterone with exercise
Triceps – at the start	3621 ± 213	4052 ± 262	3579 ± 260	3483 ± 217
Triceps after 10 weeks	3539 ± 226	4109 ± 230	4003 ± 229	3984 ± 239

(i) Deduce the effect of testosterone on the size of the triceps muscle.

(2)

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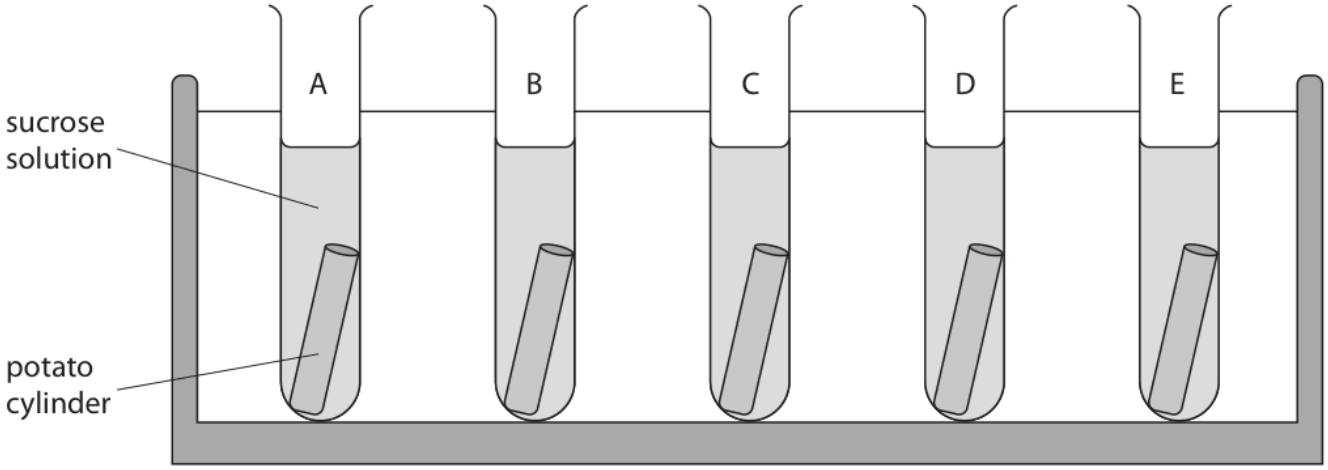
8 The effect of the concentration of sucrose solution on the mass of potato cylinders was investigated.

The cylinders were cut from the same potato and had the same volume. The initial mass of each cylinder was recorded.

The cylinders were left in the same volume of each solution for the same length of time. The final mass of each cylinder was recorded.

The diagram shows the five test tubes, A, B, C, D and E, that were set up in this investigation.

The investigation was then repeated twice.



(a) The table shows the results of this investigation.

Test tube	Concentration of sucrose solution / mol dm^{-3}	Mean initial mass of potato cylinder / g	Mean final mass of potato cylinder / g
A	0.0	2.79	3.82
B	0.4	2.75	2.67
C	0.6	2.68	2.31
D	0.8	2.71	2.21
E	1.0	2.79	2.01

(i) For test tube E the range of the initial mass was 2.79 ± 0.04 g and the range of the final mass was 2.01 ± 0.16 g.

Calculate the **largest** percentage change in mass for potato cylinders in 1.0 mol dm^{-3}.

(2)

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Mark schemes

Question 1 · A level Paper 3 · June 2017 · Q4(a)(i) · 1 mark

Question Number	Answer	Additional Guidance	Mark
4(a)(i)	• correct answer to four significant figures **(1)**	Example of calculation 6.44 ÷ 10 = 0.644 (mm)	**(1)**

Question 2 · AS Paper 2 · June 2024 · Q8(d)(i) · 2 marks

Question number	Answer
8(d)(i)	• correct values used to calculate change (1) • percentage calculated to 3sf (1)

Additional guidance	Mark
Example of calculation 15 470 - 8 184 = 7286 (7 286 ÷ 15 470) x 100 = 47.0976 Answer = 47.1 (%) ALLOW 1 mark for 47 (%) Correct answer with no working scores full marks	(2)

Question 3 · A level Paper 2 · June 2023 · Q3(c)(i) · 1 mark

Question Number	Answer	Additional Guidance	Mark
3 (c)(i)	• 0.005 : 1		**[1]**

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Question 4 · A level Paper 3 · June 2022 · Q4(a) · 2 marks

Question number	Answer
4(a)	• mass of dry powdered leaf (1) • mass of wet leaf (1)

Additional guidance	Mark
Example of calculation 5000 ÷ 501.3 = 9.97 (9.974 ÷ 0.105) = 95.0 (g) ALLOW 1 mark only for correct figures but to incorrect d.p. e.g. 9.50 ALLOW 1 mark only for 47.6 Correct answer with no working gains both marks	(2)

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Question 5 · AS Paper 1 · June 2024 · Q7(c) · 4 marks

Question Number	Answer
7(c)	A – Axes labelled including units (1) S – Scale on y axis linear (1) P – Plotting accurate (1) B – Bar chart drawn with key / labelling of bars if no key (1)

Additional Guidance	Mark
	(4)

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Question 6 · A level Paper 2 · June 2023 · Q3(b) · 3 marks

Question Number	Answer
3 (b)	An answer that makes reference to the following: • {no change / very little change} for each age group that had surgery (1) • the {20-29 age group had the greatest percentage / 50+ age group had the smallest percentage} who underwent surgery (1) • percentage undergoing surgery decreased as age increased from the 20-29 age group (1)

Additional Guidance	Mark
ALLOW 10-19 age group showed greatest variation from 2013-2018 ALLOW reference to fewer people playing sports such as football above the age of 29 / more people playing sport up to the age of 29	**[3]**

Question 7 · AS Paper 2 · June 2023 · Q4(c)(i) · 1 mark

Question Number	Answer	Additional guidance	Mark
4(c)(i)	• 174 (cm)		(1)

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Question 8 · AS Paper 1 · June 2023 · Q4(b)(i) · 2 marks

Question Number	Answer
4 (b)(i)	• correct genetic cross (1) • probability of 0.25/ 25% / $\frac{1}{4}$ (1)

Additional Guidance	Mark
<table><tr><td></td><td>T</td><td>t</td></tr><tr><td>T</td><td>TT</td><td>Tt</td></tr><tr><td>t</td><td>Tt</td><td>tt</td></tr></table>	**(2)**

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Question 9 · A level Paper 3 · June 2025 · Q6(b)(i) · 2 marks

Question number	Answer
6(b)(i)	An answer that makes reference to the following: • correct values from the data (1) • correct percentage given to a whole number (1)

Additional guidance	Mark
Example of calculation 45 – 9 = 36 streams with no frogs observed 21 of these with eDNA (21÷36) × 100 =58 (%) One mark if answer not given as a whole number e.g. 58.3 % Correct answer with no working gains full marks	(2)

Question 10 · AS Paper 2 · June 2016 · Q5(c)(i) · 1 mark

Question Number	Answer
5(c)(i)	• as adult mass increases, egg diameter decreases OR there is a negative correlation (between adult mass and egg diameter) (1)

Additional Guidance	Mark
ACCEPT converse	(1)

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Question 11 · AS Paper 2 · June 2016 · Q5(c)(ii) · 4 marks

Question Number	Answer
5(c)(ii)	An answer that makes reference to four of the following: • this data set includes only a few { species / animals } (1) • the species in the data are from different taxonomic groups (1) • there is no (evidence of) repeats / data for these individuals may not be representative (1) • the reproductive strategy of the species { is likely to influence egg size / should be controlled } (1) • there are other factors that { may affect the egg cell / may affect adult mass / should be controlled } (1)

Additional Guidance	Mark
ALLOW small sample size ALLOW more species needed NOT more groups / amphibians IGNORE ref to different species (alone) ALLOW similar species should be used NOT different kingdoms / phyla ALLOW an example e.g. site of fertilisation, where the embryo develops ALLOW an example of a relevant factor e.g. maternal diet, health, predation risk, age IGNORE height	(4)

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Question 12 · A level Paper 3 · October 2020 · Q1(a) · 1 mark

Question number	Answer	Additional guidance	Mark
1(a)	An answer that makes reference to the following: • (strong) positive correlation	ALLOW velocity of blood flow is (directly) proportional to the lumen diameter ALLOW description of relationship e.g. as lumen diameter increases velocity of blood flow increases	(1)

Question 13 · AS Paper 2 · June 2019 · Q3(b)(ii) · 2 marks

Question Number	Answer	Additional Guidance	Mark
3(b)(ii)	• correct conversion of units (1) • image size divided by magnification (1)	Example of calculation 15 (mm) x 1000 = 15000 (μm) 15000 ÷ 800 = 18.75 (μm) ALLOW 18.8 Correct answer with no working gains full marks	(2)

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Question 14 · A level Paper 2 · June 2023 · Q5(a) · 3 marks

Question Number	Answer
5(a)	• width of the bacterium calculated (1) • width of DNA calculated (1) • answer given in standard form (1)

Additional Guidance	Mark
<u>Example of calculation</u> 0.5µm / 0.0005mm / 5×10^{-1} µm / 5×10^{-4} mm 0.002 µm 2.0×10^{-3} ECF – ALLOW 1 mark for 2 or 2.0 as the answer ALLOW 2 marks for 2.0×10^{-6} in the working or answer Correct answer with no working gains full marks	[3]

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Question 15 · A level Paper 3 · October 2020 · Q4(a)(i) · 1 mark

Question number	Answer
4(a)(i)	An answer that makes reference to the following: • treatment of seeds with sodium chloride or sodium chloride and gibberellin has no effect on the number of seeds that germinate (1)

Additional guidance	Mark
	(1)

Question 16 · A level Paper 3 · June 2022 · Q1(a)(ii) · 2 marks

Question number	Answer
1(a)(ii)	An explanation that makes reference to the following: • {5% / 1 in 20} probability (1) • the results (obtained) occurred by chance (1) OR • 95% probability (1) • the results (obtained) did not occur by chance (1)

Additional guidance	Mark
IGNORE reference to null hypothesis ALLOW less than 5% ALLOW probability of 0.05 DO NOT ALLOW results are {accurate / correct / wrong}	(2)

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Question 17 · A level Paper 2 · November 2021 · Q9(b)(i) · 2 marks

Question Number	Answer
9(b)(i)	An explanation that makes reference to two of the following: • there is {more than a 5% likelihood / less than 95% likelihood} (1) • therefore the rate of protein breakdown is the same {in space as it is on Earth / for groups 1 and 2} (1) • the calculated value is less than the critical value (at p=0.05) (1)

Additional guidance	Mark
ALLOW: 'chance' for 'likelihood'	**(2)**

Question 18 · AS Paper 2 · November 2021 · Q3(c) · 3 marks

Question Number	Answer	Additional guidance	Mark
3(c)	An answer that makes reference to the following: • the drug did not show a significant improvement when compared with the placebo (1) • because the ranges overlapped (1) • because some people in the trial had an increased blood pressure (1)		**(3)**

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Question 19 · A level Paper 2 · June 2018 · Q6(a)(i) · 2 marks

Question Number	Answer
6(a)(i)	An answer that makes reference to two of the following: • increase in cross sectional area with testosterone (and not with placebo) (1) • greatest increase with testosterone and exercise (1) • significant difference for { testosterone plus exercise / group D } as the SDs (for start and after 10 weeks) do not overlap (1)

Additional Guidance	Mark
ALLOW increase in size (of triceps muscle)	**(2)**

Question 20 · AS Paper 1 · June 2023 · Q8(a)(i) · 2 marks

Question Number	Answer
8(a)(i)	• correct calculation of maximum decrease in mass for tube E (1) • correct calculation of percentage change in mass (1)

Additional Guidance	Mark
<u>Example of calculation</u> 2.83 - 1.85 = 0.98 (0.98 ÷ 2.83) × 100 = 35 / 34.6 (%) Correct answer with no working scores full marks.	**(2)**

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