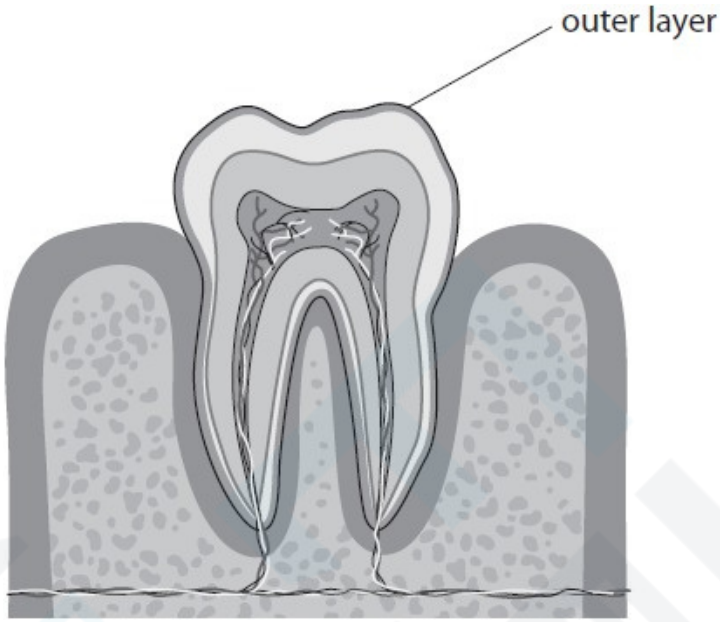
Q1.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

(a) The diagram shows a section through one type of tooth.



(i) State the name of this type of tooth.

(1)

.....

(ii) Which substance forms the outer layer of the tooth?

(1)

☒ **A** bone

☒ **B** dentine

☒ **C** enamel

☒ **D** pulp

(iii) Explain why this type of tooth is more likely to decay than other types of teeth.

(3)

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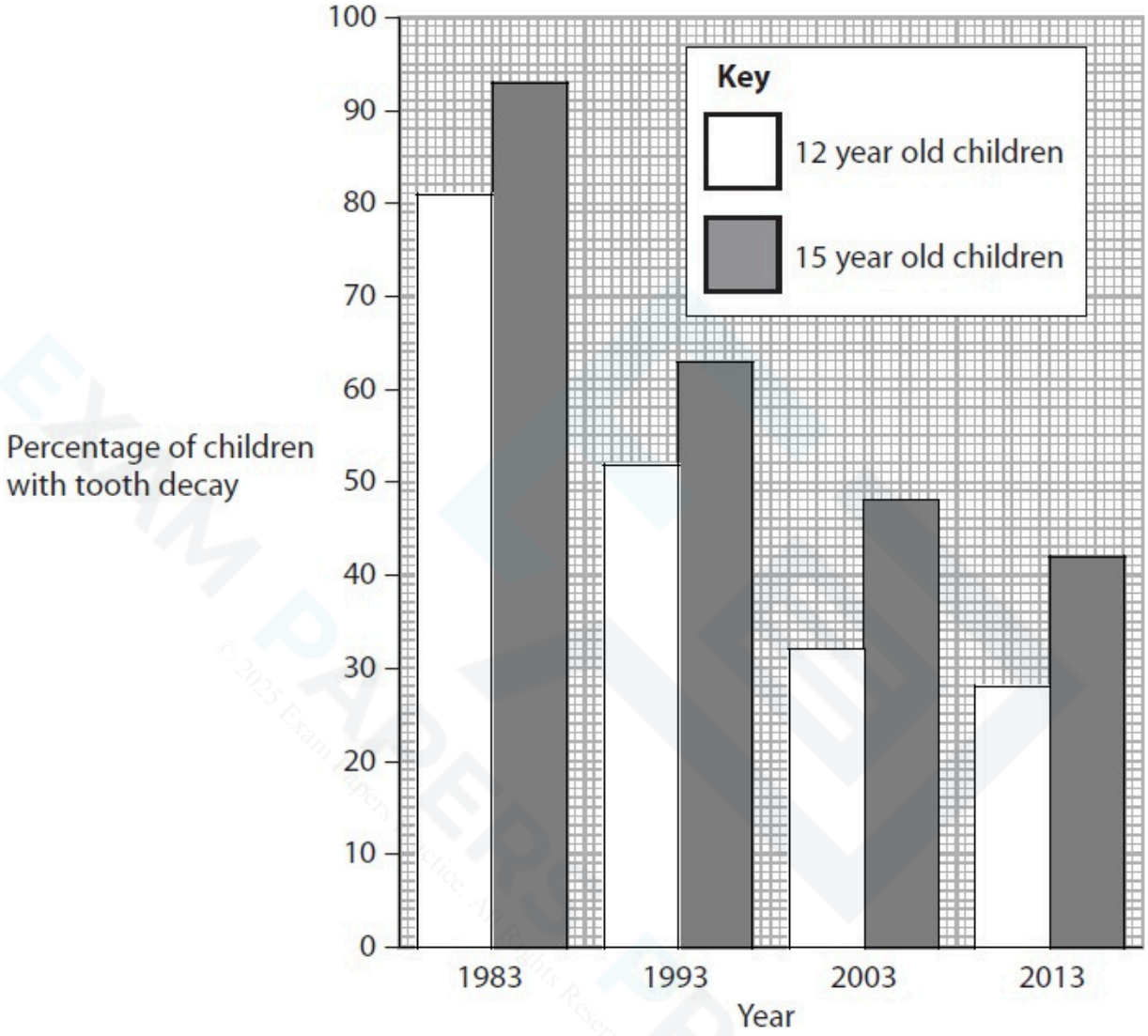
(b) The bar chart shows the percentage of children with tooth decay.

It gives this information for 12 and 15 year old children over a period of 30 years.



(i) Give two conclusions that can be made from the data in the bar chart.

(2)

1 .....

..... 2

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..... (ii)

Suggest a reason for the change in the percentage of children with tooth decay over the 30 year period.

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(1)

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(Total for question = 8 marks)

Q2.

Answer the questions with a cross in the boxes you think are correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Read the passage below. Use the information in the passage and your own knowledge to answer the questions that follow.

Sweating is normal when we are hot. It is part of our natural cooling mechanism. If you sweat visibly when you do not need to cool down, it can be a problem.

The sweating process is controlled by the brain, which sends signals down the nerves to the sweat glands.

Sweating is crucial to survival. We sweat to control body temperature and the sweat glands in our armpits can produce several litres of sweat in 24 hours. How much we sweat varies hugely from individual to individual and even from day to day.

Hyperhidrosis occurs when some areas of the body start sweating excessively. This affects about 1% of the population. There are two main types. The most common type is primary focal hyperhidrosis, which affects many parts of the body. There is no known cause, but it usually begins in childhood and often runs in families. Another type is secondary hyperhidrosis, which often doesn't begin until after the teenage years, and usually has an underlying medical cause. These causes can include diabetes, menopause or chronic infection. It can also be a result of eating certain foods. Stress can play a major role too.

(a) Which part of the brain controls sweating (line 4)?

☐ **A** cerebellum

☐ **B** cerebral hemispheres **(1)**

☐ **C** hypothalamus

☐ **D** pituitary gland

(b) Which type of nerve sends signals to the sweat glands (lines 4 and 5)?

☐ **A** connector

(1)

☒ **B** motor

☒ **C** relay

☒ **D** sensory

(c) Describe how sweating controls body temperature (lines 6 and 7).

(3)

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(d) Explain the evidence in the passage that indicates primary focal hyperhidrosis is a genetic condition.

(3)

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(e) Secondary hyperhidrosis can be caused by diabetes. Give one risk factor for diabetes (line 16).

(1)

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(f) The passage states that how much we sweat varies from individual to individual and from day to day.

Explain why this is the case in people without hyperhidrosis (lines 8 and 9).

(5)

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(Total for question = 14 marks)

Q3.

Food enters the alimentary canal through the mouth.

All undigested food leaves the body through the anus. **(3)**

(a) Name three structures the food passes through between the mouth and the anus.

1 .....

2 .....

3 .....

(b) Some of the food is digested by enzymes as it passes through the alimentary canal. (i) Name an enzyme that digests protein. **(1)**

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(ii) Describe the processes that occur in the mouth to digest food. **(4)**

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(c) Fibre in food cannot be digested. Explain the importance of fibre in the diet. **(3)**

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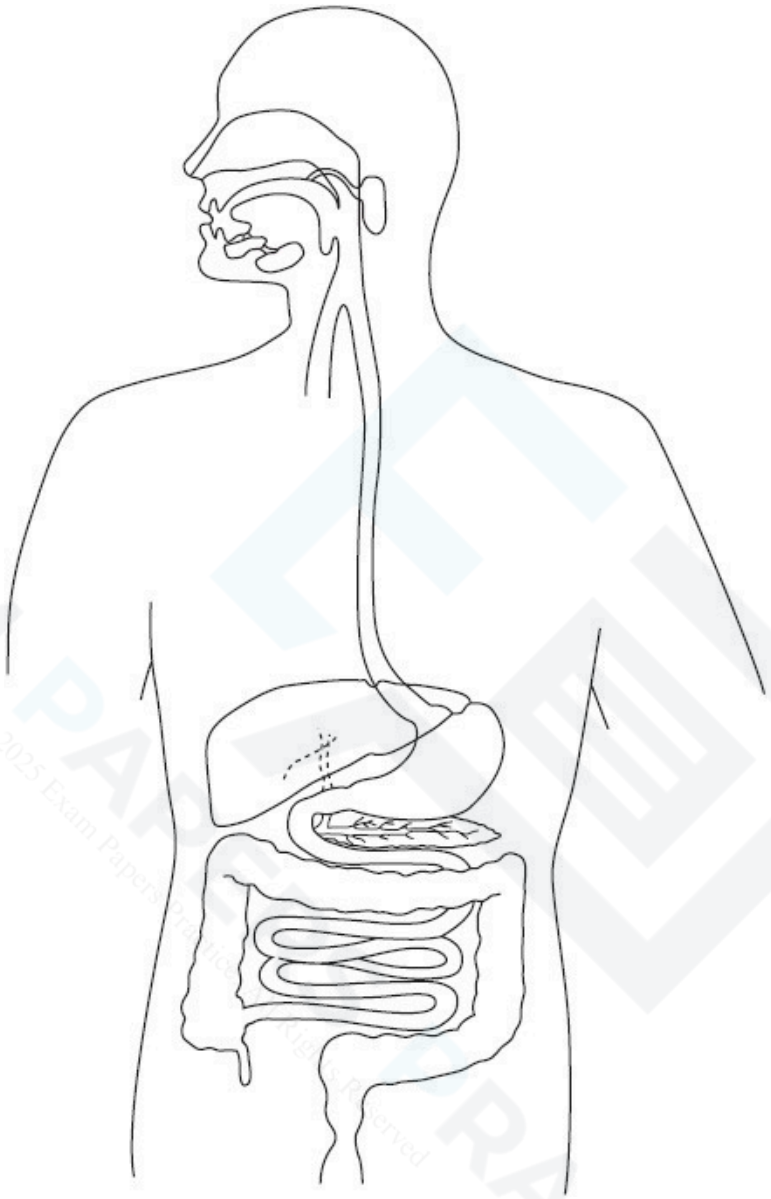
(Total for question = 11 marks)

Q4.

The diagram shows the alimentary canal.



(a) Identify these areas of the alimentary canal using label lines and the correct letters.

(i) Label with an X the area where starch digestion begins.

(ii) Label with a Y the area that has a pH of 2

(1)

(1)

(iii) Label with a Z the area where both lipid and protein digesting enzymes are produced.

(1)

(b) Some people have the condition known as coeliac disease. This results in the villi being flattened.
Explain why some people with untreated coeliac disease will eventually develop osteoporosis.

(4)

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(c) Another condition of the alimentary canal is colon cancer. This is often treated by removal of the large intestine. Explain why people who have this treatment often suffer from dehydration.

(2)

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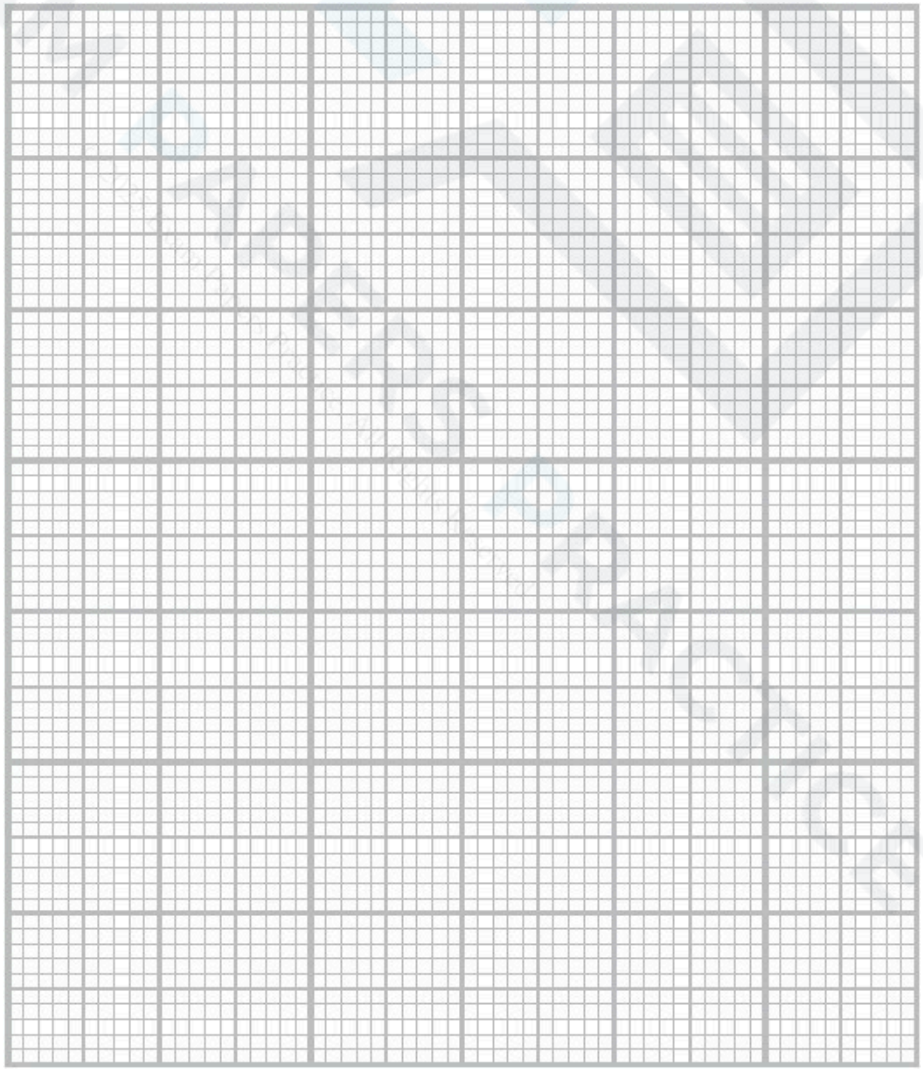
(Total for question = 9 marks)

Q5. The table shows the results of a survey about the number of teeth per student in a class of young students.

Number of teeth	Number of students
23	1
24	2
25	3
26	4
27	7
28	13

(4)

(a) (i) Draw a bar chart to show the results of the survey.



(ii) A full set of teeth for the students is 28

Calculate the percentage of the students in the class who have a full set of teeth.

(3)

percentage = ... %

(b) A full set of teeth for an adult is 32

Suggest why the full set of teeth for these students is only 28

(2)

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(c) (i) Explain how reducing the amount of sugar in foods helps prevent tooth decay.

(4)

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(ii) State two other methods that could reduce tooth decay.

1 ..... **(2)**

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2 .....

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(Total for question = 15 marks)

Q6.

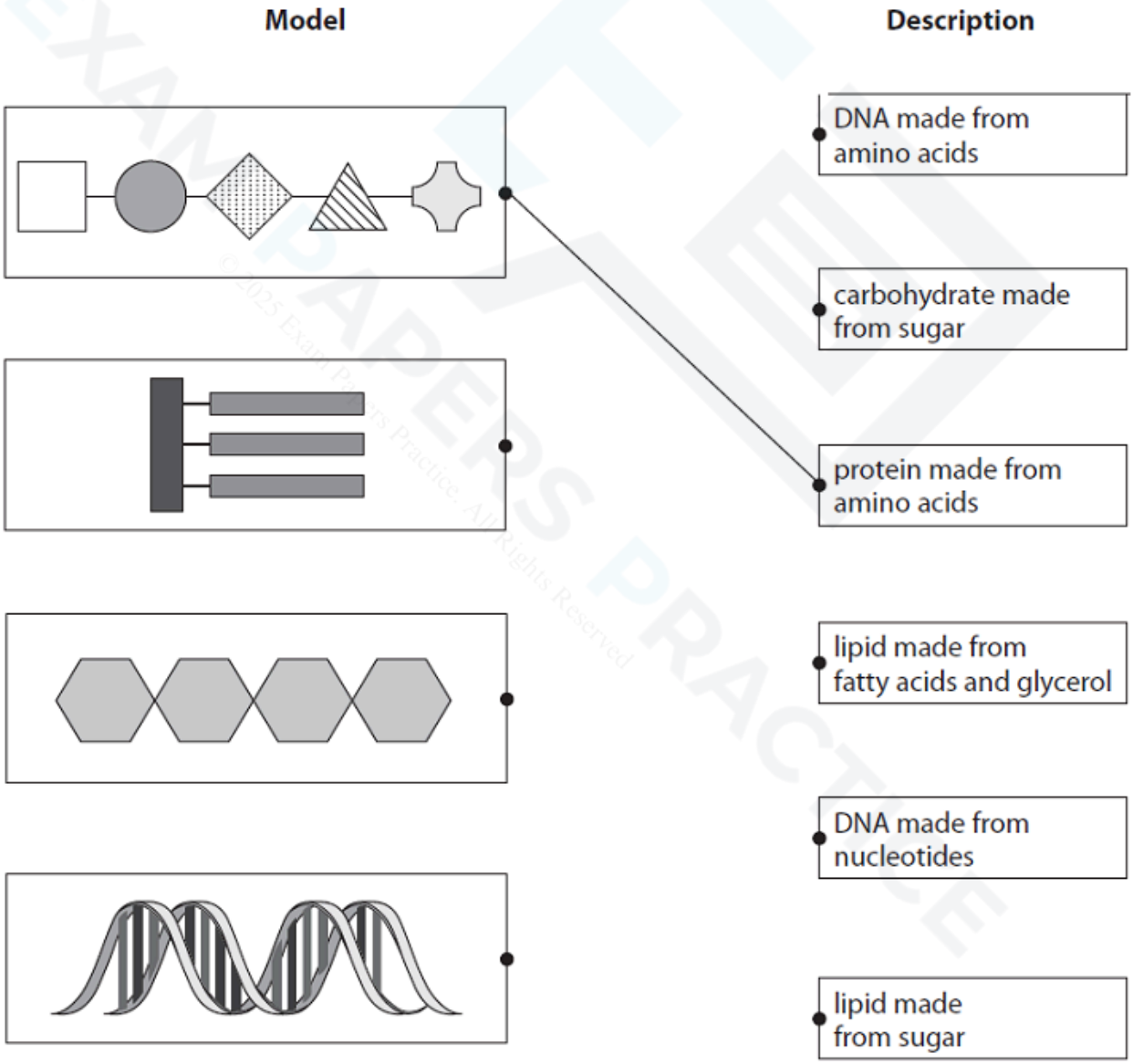
Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

(a) The diagram shows models of four biological molecules.

Draw a straight line from each model to its correct description.

One has been done for you.

(3)



(b) Which body organ produces enzymes that break down protein?

(1)

☒ **A** gall bladder

☒ **B** large intestine

☒ **C** mouth

☒ **D** stomach

(c) A student uses this method to test different substances for protein.

- grind solid substances into small pieces
- place substances into separate test tubes
- add a few drops of Biuret reagent to each substance
- record the colour change for each substance

The table shows the student's results.

Substance	Colour after Biuret test
milk	purple
pasta	blue
lemon juice	blue
cheese	purple
distilled water	purple

(i) In the student's test, how many of the substances give a positive result for protein?

(1)

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(ii) The result for distilled water is incorrect.

Suggest one mistake the student could have made to get this incorrect result.

(1)

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(d) The table shows an incomplete risk assessment for the Biuret test. Complete the table by describing how to reduce the risk of each hazard.

(2)

Hazard	Reducing risk
stools – trip hazard	keep stools under bench
broken glass – cuts	
Biuret reagent – irritant	

(Total for question = 8 marks)

Q7.

Answer the questions with a cross in the boxes you think are correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Read the passage below. Use the information in the passage and your own knowledge to answer the questions that follow. Obesity and diabetes have been linked to a 20% increase in the number of leg and foot amputations.

Data from Diabetes UK shows that there were 26 378 lower limb amputations related to diabetes from the period 2014 to 2017. This is an increase from the period 2010 to 2013 when there were 22 092 amputations related to diabetes.

Minor lower limb amputations are below the ankle and major lower limb amputations are below the knee. Minor lower limb amputations increased by 26.5% and major lower limb amputations increased by 4.0%.

In 2019 in the United Kingdom 3.8 million people had been diagnosed with diabetes and 90% of these people had Type 2 diabetes.

(a) (i) Describe the causes of obesity.

(3)

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(ii) Give two health risks, other than diabetes, associated with obesity.

(2)

1 .....

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2 .....

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(b) Diabetes is caused as a result of insulin not being secreted or not working correctly. (i)

Which organ secretes insulin?

(1)

☒ **A** kidney

☒ **B** liver

☒ **C** pancreas

☒ **D** thyroid

(ii) Insulin stimulates the conversion of glucose into glycogen.

In which organ does this occur?

(1)

☒ **A** kidney

☒ **B** liver

☒ **C** pancreas

☒ **D** thyroid

(c) (i) Calculate the percentage increase in the number of lower limb amputations between the period 2010 to 2013 and the
period 2014 to 2017.

(3)

percentage increase = ... %

(ii) Calculate the number of people in 2019 who had been diagnosed with Type 2 diabetes in the United Kingdom.

(1)

number of people = ... million

(d) Diabetes causes a narrowing of the arteries supplying blood to the lower limbs.

Suggest why this can lead to the need to amputate the lower limbs.

(3)

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(Total for question = 14 marks)

Q8.
(a) The type and amount of different nutrients needed for a balanced diet varies depending on several factors.
(i) Pregnant women are often advised by their doctor to take extra iron in their diet.
Which two foods are the best sources of iron?

(1)

☒ **A** fruit and green vegetables

☒ **B** dairy products and red meat

☒ **C** green vegetables and red meat

☒ **D** fruit and dairy products

(ii) Explain why a woman should have more iron in her diet when she becomes pregnant.

(4)

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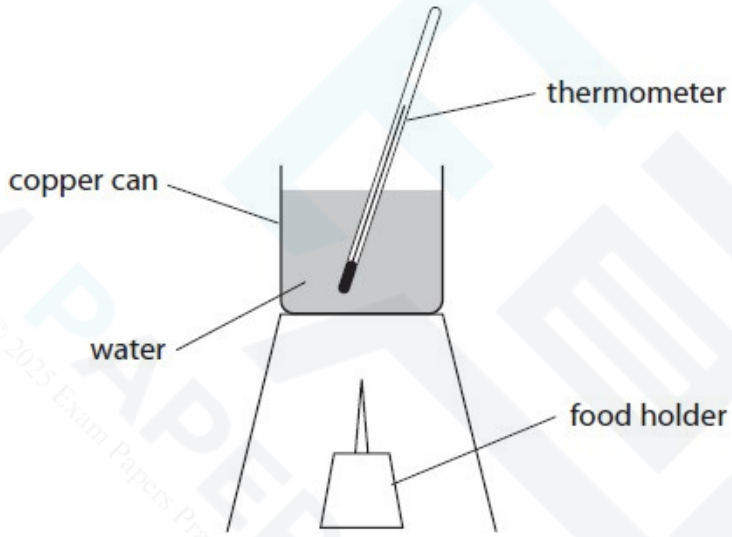
..... (b)

The diagram shows some apparatus that can be used to measure the amount of energy contained in different foods.



(i) Explain how the apparatus can be used to obtain data about the energy content of different foods.

(4)

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..... (ii)

Explain how this apparatus can be changed to improve the accuracy of the data collected for each food.

(3)

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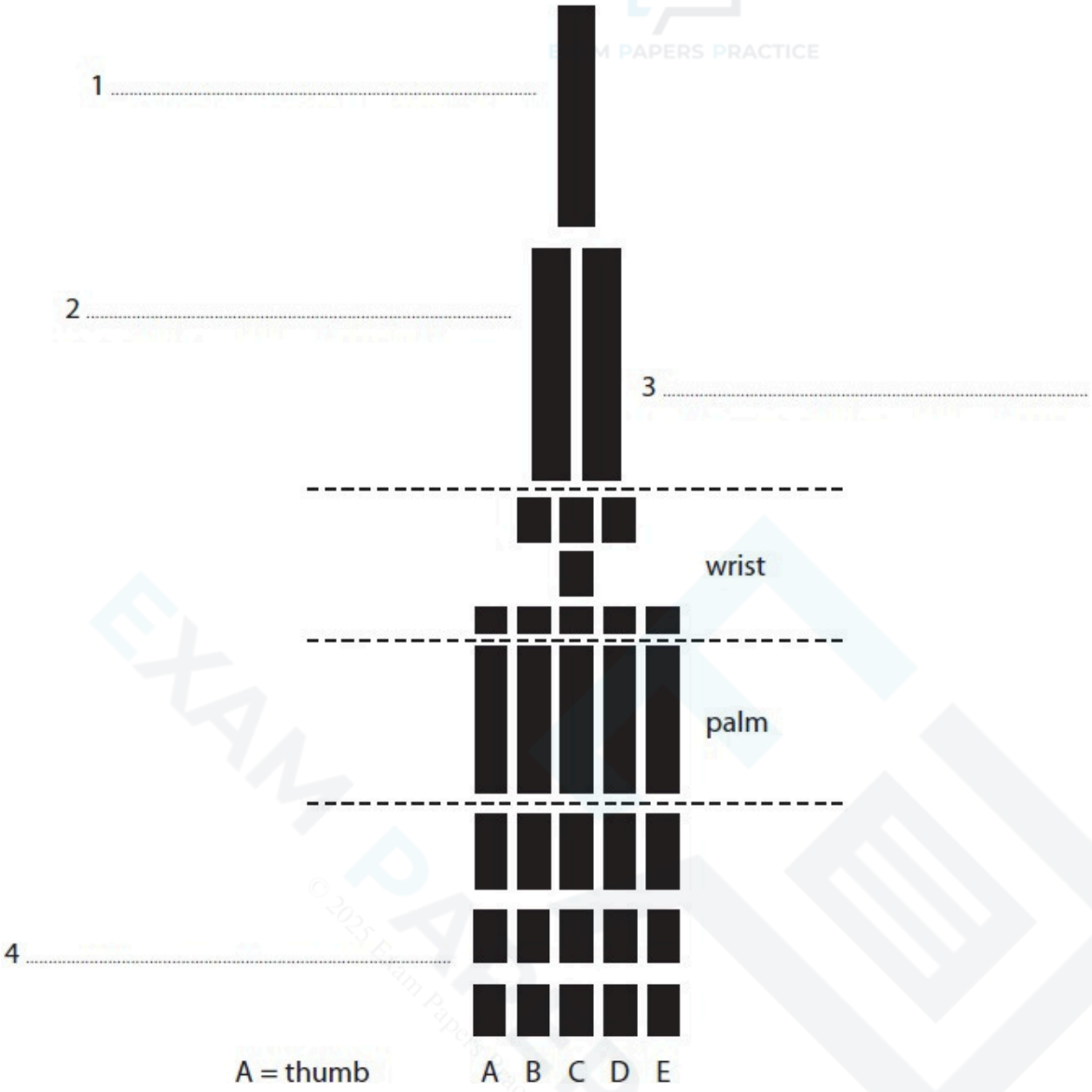
(Total for question = 12 marks)

Q9.

The diagram shows a model representing the arrangement of bones in the arm.



(a) (i) Name the bones labelled 1, 2, 3 and 4 on the diagram.

(4)

(ii) A hinge joint is a synovial joint.

Draw a circle on the diagram to show where a hinge joint is found.

(1)

(iii) Name two other types of synovial joint found in the skeleton.

(2)

1 .....

2 .....

(b) Vitamin D is important for the growth and development of healthy bones. Explain how vitamin D helps the growth and development of bones.

(3)

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(Total for question = 10 marks)

Q10.
Aspirin is the active ingredient used in some tablets to relieve pain.
Aspirin becomes acidic when it dissolves in the body. The faster aspirin dissolves, the faster it can relieve pain.
A student investigates if it is better to mix sucrose or starch with the active ingredient to make an aspirin tablet.
This is the student's method.

- add distilled water to three beakers, A, B and C
- add 1 aspirin tablet to each beaker
- add 5 g of sucrose to beaker B
- add 5 g of starch to beaker C
- measure the pH of the contents of each beaker at the start of the investigation
- measure the pH of the contents of each beaker every minute for 5 minutes

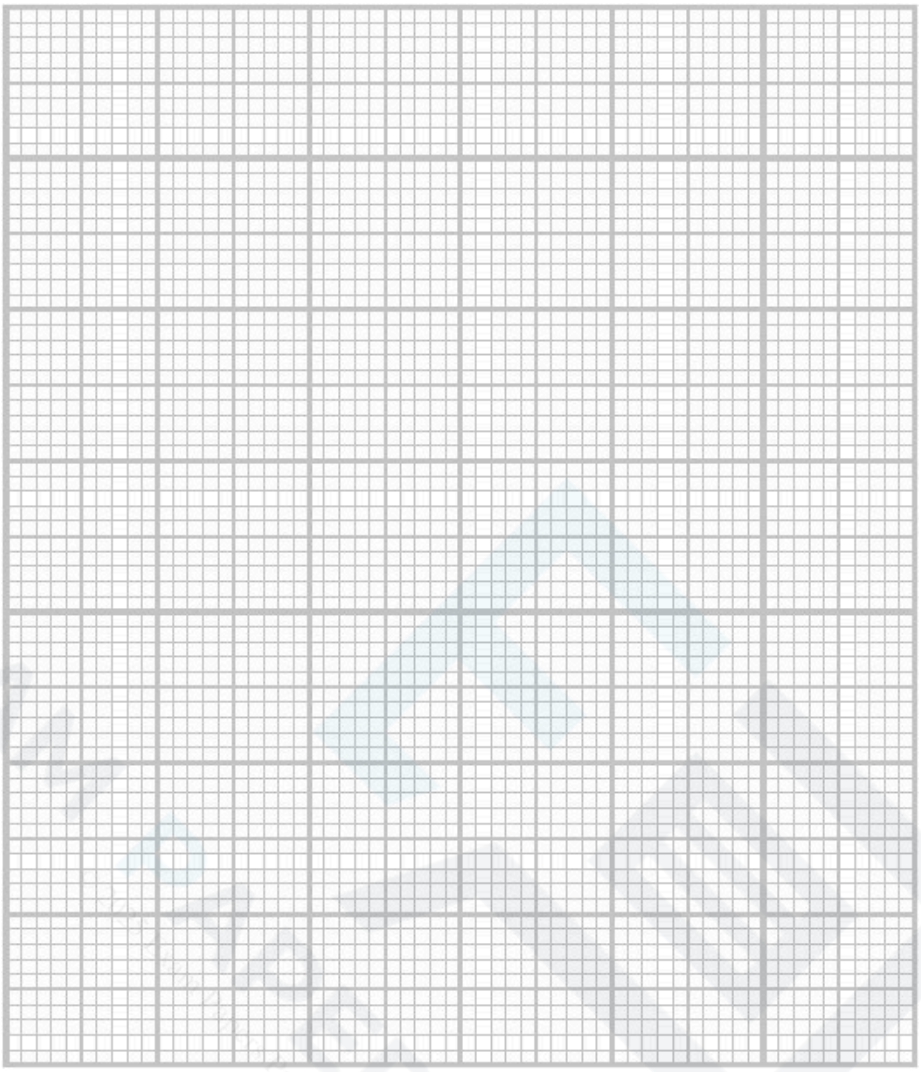
The table shows the student's results.

Beaker	pH of contents of beaker					
	at start	1 minute	2 minutes	3 minutes	4 minutes	5 minutes
A – aspirin	7.6	7.1	6.6	6.2	5.8	5.4
B – aspirin and sucrose	7.2	6.7	6.3	5.7	5.2	4.7
C – aspirin and starch	7.1	7.2	7.3	7.3	7.4	7.4

(a) (i) Plot a graph of the student's results.

Join the points with straight lines.

(5)



(ii) State two variables that should be controlled in this investigation.

(2)

1 .....

2 .....

(iii) Name the dependent variable in this investigation.

(1)

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(b) Explain how the results of this investigation could help a manufacturer improve the effectiveness of its aspirin tablets.

(3)

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(Total for question = 11 marks)

Q11.
The volume of alcohol in alcoholic drinks can be measured in units.
One unit is equivalent to 10 cm3 of pure alcohol.
The diagram shows a bottle of wine with 14% alcohol content and a glass containing 250 cm3 of this wine.

(a) Calculate the number of units of alcohol in the glass of wine.

(2)

number of units = ...

(b) It is illegal for a person to drive a motor vehicle if they have more than the legal limit of alcohol in their bloodstream.
It takes one hour for the body to process one unit of alcohol so that there is no alcohol left in the bloodstream.

(i) A person drinks three units of alcohol. This puts her at the legal limit.
Calculate the time it would take before a person can legally drive after drinking four glasses of Ruby Red wine.

(2)

Answer ..... hours

(ii) Suggest why it is illegal for people to drive a motor vehicle with more than the legal limit of alcohol in their bloodstream.

(2)

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(c) Drinking a lot of alcohol over a long period of time can cause a condition called cirrhosis. This condition prevents the cells of the liver from functioning normally. Explain the effect of cirrhosis on the digestion of food molecules.

(5)

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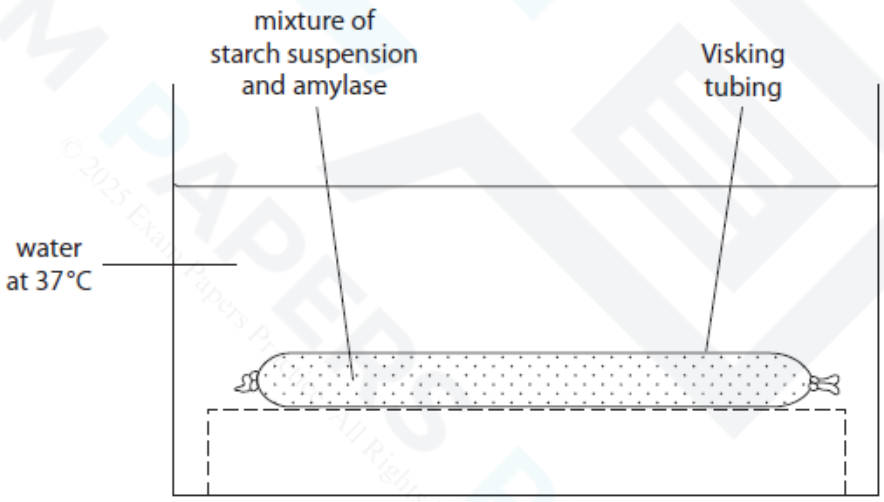
(Total for question = 11 marks)

Q12.
A student carries out an investigation to compare the rates that two different solutions of amylase, P and Q, digest starch.
The student mixes 5 cm3 of starch suspension with 5 cm3 of amylase P solution and pours it into the Visking tubing. This is then placed in a water bath at 37 °C, as shown in the diagram.

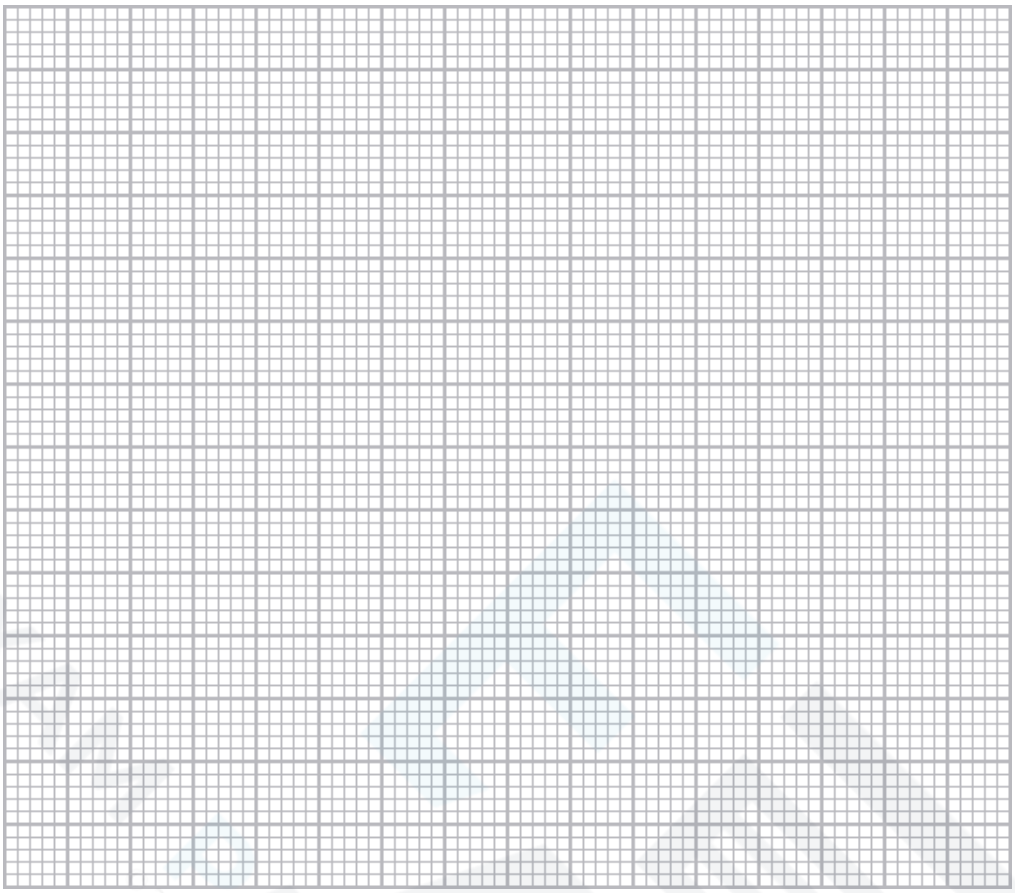


The experiment is left for four hours. Every hour, the Visking tubing is removed from the water bath. It is dried, weighed and returned to the water bath.
The experiment is repeated, with amylase Q solution instead of amylase P solution.
The table shows the results obtained by the student.

	Increase in mass of tubing / g	
Time / hours	amylase P	amylase Q
0	0.00	0.00
1	0.05	0.20
2	0.10	1.10
3	0.20	1.60
4	0.25	1.80

(a) Plot the results of this investigation joining the points with straight lines.

(5)



(b) (i) Explain why there is an increase in the mass of the Visking tubing during the investigation.

(3)

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(ii) Explain why the rate of increase of mass is lower after 3 hours in both investigations.

(2)

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(iii) Two factors that are kept constant in the investigation are the concentration of amylase and the pH of the solution.
Explain why these two factors should be kept constant.

(2)

concentration

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pH

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(c) State why the tubing is dried before each weighing.

(1)

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(d) State **two** places in the body where amylase is produced.

(2)

1 .....

2 .....

(e) Describe a test to detect glucose.

(3)

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(Total for question = 18 marks)

Q13.
Read the passage below. Use the information in the passage and your own knowledge to answer the questions that follow.

In 1916, an American doctor, Joseph Goldberger, noticed symptoms of a mystery disease that were common among his patients. These symptoms included headaches, swollen tongues, skin rashes, upset stomachs and mental illness. In one American state, North Carolina, 40% of the 30 000 people living in this area died from this mystery disease.

Goldberger investigated whether the symptoms of the mystery disease were caused by pathogens. His investigation involved injecting himself with the blood from one patient, eating the skin rash of another and swallowing fluid taken from the intestines of a third. Goldberger did not get the disease, although he did suffer from nausea and diarrhoea.

Goldberger concluded that the symptoms shown by the patients were not caused by an infectious disease. He decided that they were more likely to be caused by the poor diet of the patients.

(a) Calculate the number of people in North Carolina who died from this mystery disease (lines 4 to 5).

(2)

number of deaths = ...

(b) State the meaning of the term pathogens (line 7).

(1)

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(c) The people were suffering from a deficiency disease called pellagra, which is caused by a lack of vitamin B in the diet. State why deficiency diseases such as pellagra are not infectious diseases.

(1)

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(d) Describe a method that Goldberger could use to show that the symptoms of his patients were caused by a lack of vitamin B in their diet.

(3)

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(e) Scurvy is another deficiency disease. Scurvy affects the production of a protein called collagen. Collagen is a component of many body tissues including cartilage. Explain why a person with scurvy often experiences pain when walking.

(2)

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(Total for question = 9 marks)

Q14.
Homeostasis in humans involves the deamination of excess amino acids.
Deamination includes the removal of nitrogen from the amino acid and the formation of urea.
(a) (i) State what is meant by the term **homeostasis**.

(2)

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(ii) State where the process of deamination occurs.

(1)

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(b) Describe how a person obtains amino acids for the body to produce new proteins.

(3)

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..... (c) An investigation is carried out to show the daily amounts of nitrogen-containing compounds excreted in the urine of two people, A and B. The two people are on different diets. The results of the investigation are shown in the table.

Nitrogen-containing compound in urine	Mass excreted / g	
	person A	person B
urea	14.30	2.10
uric acid	0.16	0.08
ammonia	0.50	0.34
creatinine	0.60	0.60

(i) Explain how the diet of person **A** is different from the diet of person **B**.

Use information in the table to help you with your answer.

(4) .....
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(ii) The figures for creatinine do not vary even though the diets of person **A** and person **B** are different. State why the figures for creatinine do not vary.

(1)

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(d) If certain steroid drugs are taken, the balance of nitrogen-containing compounds in the body changes. This results in less nitrogen-containing compounds being excreted. Suggest the effect that taking these drugs could have on the body.

(1)

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(Total for question = 12 marks)

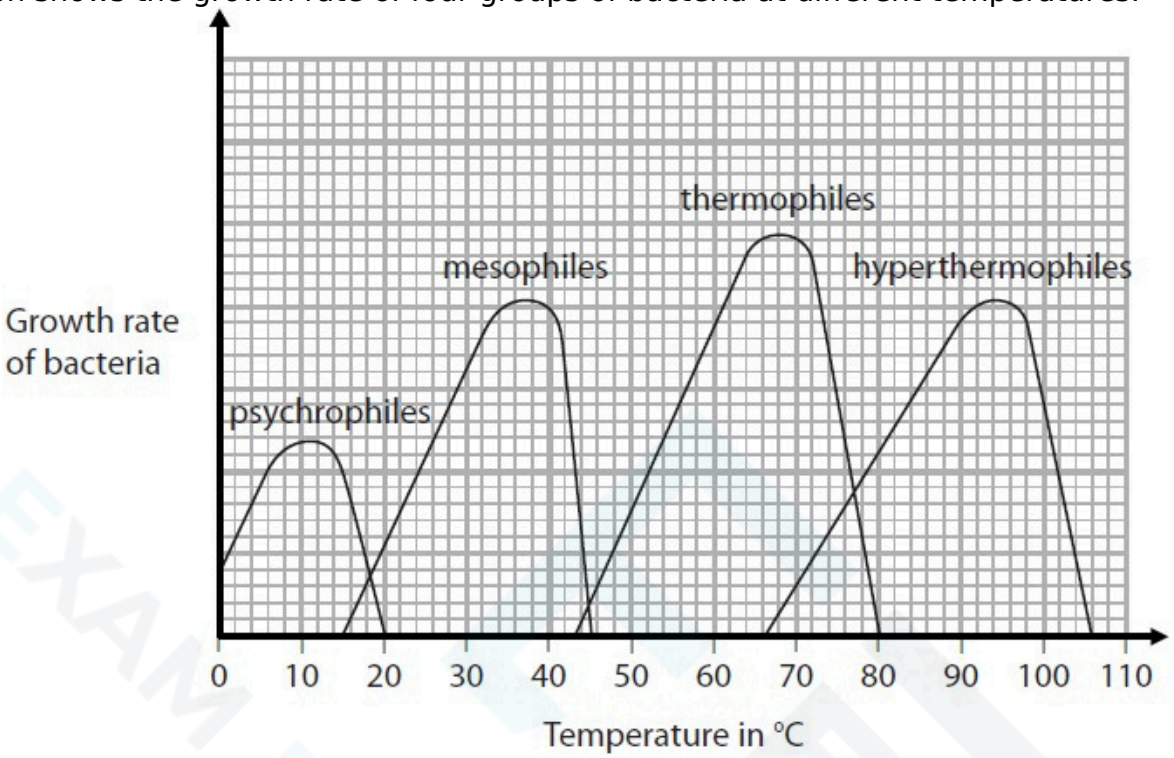
Q15.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

(a) Some bacteria in food can affect the digestive system and cause poor health.

Storing food at the correct temperature can reduce the growth of these bacteria.

The graph shows the growth rate of four groups of bacteria at different temperatures.



(i) Food kept in a fridge shows signs of contamination by bacteria.

Which group of bacteria is most likely to have caused this contamination?

(1)

☒ **A** psychrophiles

☒ **B** mesophiles

☒ **C** thermophiles

☒ **D** hyperthermophiles

(ii) Explain how cooking food at 65°C will affect thermophiles.

(2)

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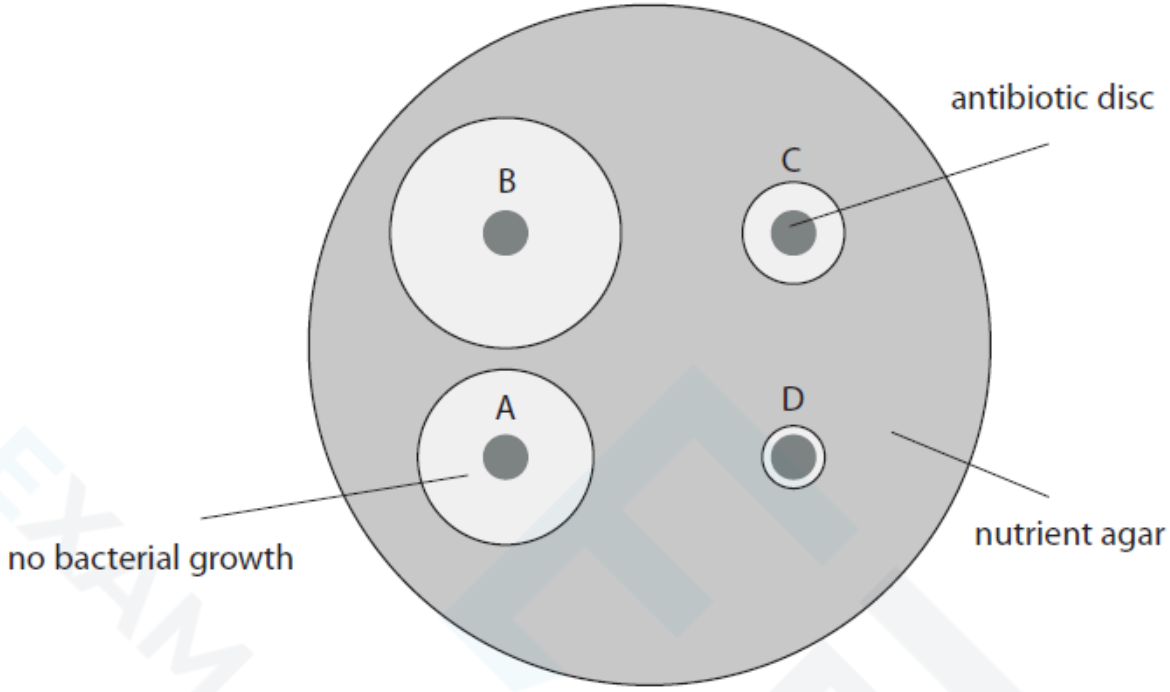
(b) A student investigates the effect of different antibiotics on the growth of bacteria. She uses this method.

- streak bacteria onto nutrient agar in a Petri dish

-
- place discs of different antibiotics, A, B, C and D, onto the nutrient agar
  incubate the Petri dish in a warm oven for one week



(i) Explain how the student could determine the effectiveness of each antibiotic.

(2)

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(ii) Explain safety precautions the student should take in this investigation.

(6)

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(Total for question = 11 marks)

Q16.

The table lists some features and regions of the human alimentary canal.

Tick (✓) one box in each row to show the region of the alimentary canal where each feature occurs.

(6)

Feature	Region of alimentary canal			
	mouth	stomach	small intestine	large intestine
starts protein digestion				
starts carbohydrate digestion				
has a pH of 2				
has villi				
absorbs most water				
connects with bile duct				

(Total for question = 6 marks)

Q17.

A student investigates the effect of bile salts on the digestion of lipids. The student uses milk as a source of lipids.
The student sets up three test tubes.

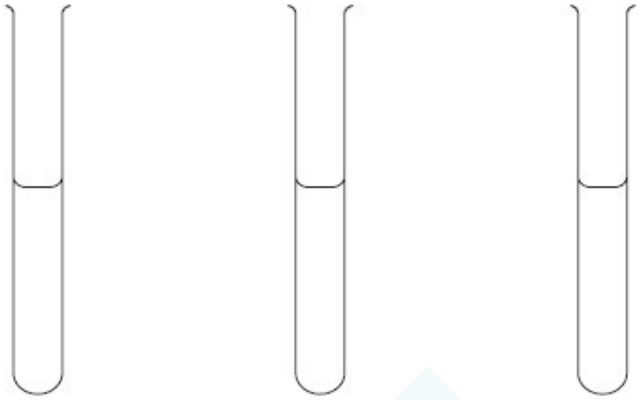

Table 1 lists the contents of each test tube.

Test tube A	Test tube B	Test tube C
5 cm^3 of milk	5 cm^3 of milk	5 cm^3 of milk
2 cm^3 of sodium hydrogencarbonate	2 cm^3 of sodium hydrogencarbonate	2 cm^3 of sodium hydrogencarbonate
6 drops of phenolphthalein	6 drops of phenolphthalein	6 drops of phenolphthalein
1 cm^3 enzyme	1 cm^3 enzyme	1 cm^3 boiled enzyme
distilled water	bile salts	bile salts

Table 1

The student records the colour of the contents of each tube at the start of the investigation, and at 5 minute intervals for 15 minutes.
Table 2 shows the student's results.

	Colour of contents		
	Tube A	Tube B	Tube C
at start	pink	pink	pink
after 5 minutes	pink	colourless	pink
after 10 minutes	pink	colourless	pink
after 15 minutes	colourless	colourless	pink

Table 2

Phenolphthalein is pink in solutions above pH 10 and colourless in solutions below pH 8.

(a) (i) Which enzyme is used in this investigation?

(1)

☒ **A** amylase

☒ **B** carbohydrase

☒ **C** lipase

☒ **D** protease

(ii) Which chemical elements are found in lipids?

(1)

☒ **A** carbon, hydrogen and oxygen

☒ **B** carbon, hydrogen, oxygen and nitrogen

☒ **C** carbon, hydrogen, oxygen and sulfur

☒ **D** carbon, hydrogen, oxygen, nitrogen and sulfur

(iii) Where in the body are bile salts produced?

(1)

☒ **A** brain

☒ **B** duodenum

☒ **C** liver

☒ **D** pancreas

(b) Explain the purpose of tube C.

(2)

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(c) Suggest one reason for the addition of the sodium hydrogencarbonate.

(2)

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(d) Describe the effect of bile salts on lipid digestion in this investigation.

(3)

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(Total for question = 10 marks)

Q18.

Chymosin is an enzyme found in young humans, but not in adults. It converts soluble proteins in milk into solid proteins.

(a) (i) Suggest the advantages to a young human of having chymosin in their alimentary canal.

(2)

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(ii) Explain why chymosin is only needed in young humans.

(2)

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(iii)

Describe a test to show that the solid formed by the action of chymosin on milk is a protein.

(3)

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(b) A student investigates the effect of carbon dioxide on the activity of chymosin. The student bubbles different volumes of carbon dioxide gas into five samples of milk. He then adds chymosin to each sample and records the time taken for the milk protein to become solid. The student repeats this method three times. The table shows the student's results.

Number of bubbles of CO_2	Time taken for chymosin to turn milk protein solid, in seconds				
	Test 1	Test 2	Test 3	Test 4	Mean
100	253	257	250	260	255
150	238	232	241	229	
200	216	214	219	211	215
250	208	202	212	198	205
300	210	200	199	311	203

(i) State three factors that the student should control.

(3)

1 .....

.....

2 .....

.....

3 .....

.....

(ii) Calculate the missing mean (average) time taken for 150 bubbles.

(2)

mean time taken = ...

(iii) In test 4 there is an anomalous result.

State how the student deals with this result.

(1)

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.....

(iv) State why recording the number of bubbles may produce inaccurate results.

(1)

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(Total for question = 14 marks)

Q19.

A teacher wants to calculate the body mass index (BMI) of a number of students.

(a) The teacher measures the height of students from four age groups.

There are two male and two female students in each age group.

The table shows the data collected.

Age in years	Height of student in cm				Mean height of students in cm
	Male		Female		
12	146.2	148.9	142.8	144.2	145.5
14	165.7	166.4	161.9	164.0	164.5
16	175.9	178.5	166.3	167.6	
18	180.9	181.3	171.2	174.3	176.9

(i) Calculate the mean height of the students aged 16.

Give your answer to one decimal place.

(2)

mean height = ... cm

(ii) State two conclusions that the teacher could make from the data in the table.

(2)

1 .....

.....

2 .....

.....

(iii) Give two ways the teacher could improve his investigation.

(2)

1 .....

.....

2 .....

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(b) The table shows data for two different students.

Student	Height in m	Mass in kg	BMI
X	1.69	62	21.7
Y	1.46	71	

(i) BMI is calculated using the equation

$$\text{BMI} = \frac{\text{mass}}{\text{height}^2}$$

Calculate the BMI of student Y.
[mass measured in kg, height measured in m]

(2)

BMI of student Y = ...

BMI	Classification
below 18.5	underweight
18.5 – 24.9	normal weight
25 – 29.9	overweight
30 – 40	obese
above 40	morbidly obese

Using information from the table, explain how the BMI of student Y could affect her health.

(2)

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(Total for question = 10 marks)