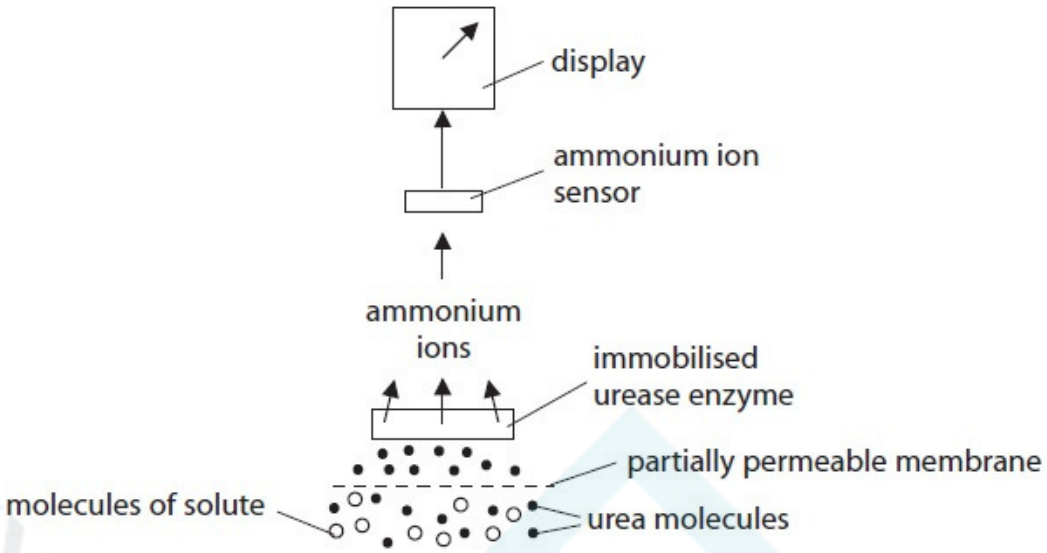
Q1.

The diagram shows a biosensor that can be used to measure the concentration of urea in urine.



(a) (i) The urea molecules are in solution.

State the name of the solvent.

(1)

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(ii) Explain the function of the partially-permeable membrane.

(2)

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(iii) Suggest the function of the urease enzyme.

(3)

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(b) A scientist wants to use the biosensor to compare the urea concentration of two urine

samples.

Explain why it is important to do the tests at the same temperature.

(4)

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(c) Immobilised enzymes are also used in industry to produce useful molecules. Give two advantages of using immobilised enzymes instead of enzymes that are free to move in solution.

(2)

1 .....
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2 .....
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(Total for question = 12 marks)

Q2.
Aspirin is a painkiller, but can also be prescribed to people who are at risk of having a stroke or a heart attack.
Aspirin dissolves blood clots and is also an enzyme inhibitor, which reduces the risk of more blood clots
forming in blood vessels.
(a) (i) Describe how a blood clot forms in a blood vessel.

(3)

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(ii) Explain how a blood clot in the coronary artery increases the risk of a heart attack.

(3)

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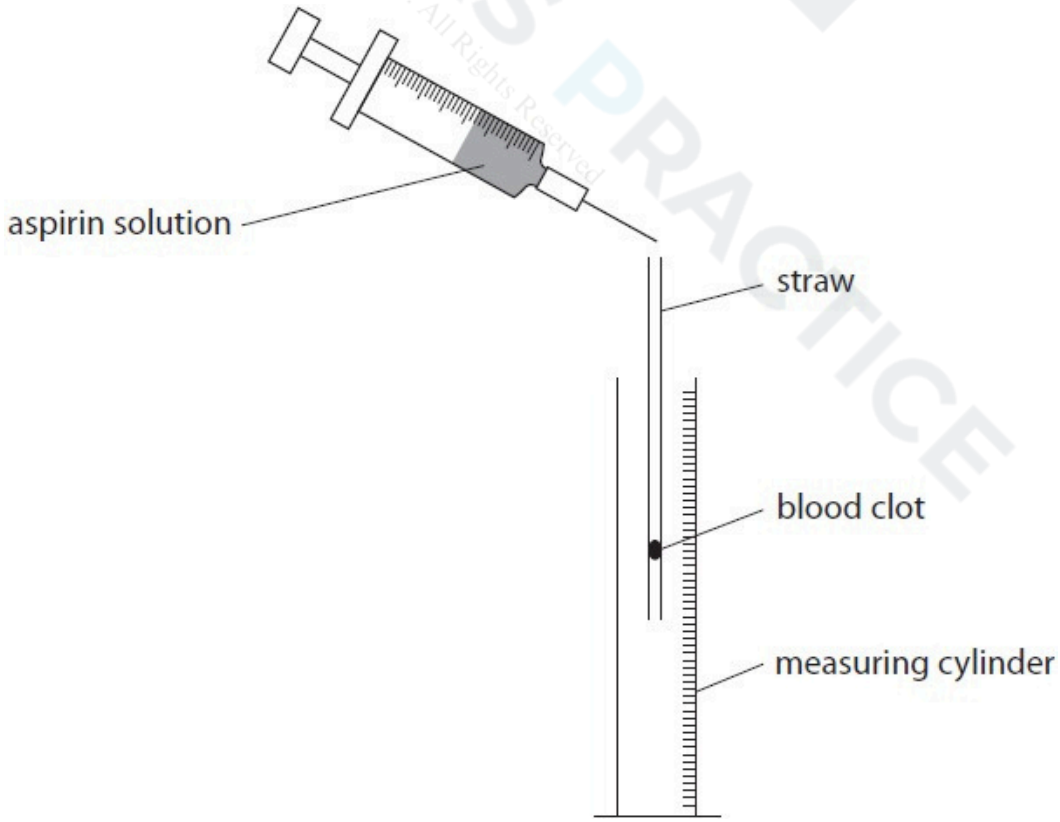
..... (b) A student uses this apparatus to investigate the effect of aspirin on the rate of blood flow through blood vessels.



The student uses this method.

- dissolve one aspirin tablet in water
- use a syringe to pass the aspirin solution through a straw containing a blood clot
- record the total volume of aspirin solution in the measuring cylinder every five minutes

The student repeats the method with solutions formed from two aspirin tablets and then from three aspirin tablets.

(i) Give a control variable for this investigation.

(1)

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(ii) Describe a suitable control test for this investigation.

(1)

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The table shows the student's results.

Time in minutes	Total volume of aspirin solution in the measuring cylinder in cm^3		
	1 aspirin tablet	2 aspirin tablets	3 aspirin tablets
5	0	0	0
10	0	0	0
15	0	0	1
20	0	1	2
25	1	1	3
30	1	2	4
35	2	4	6
40	5	7	9
45	10	12	16
50	17	19	22
55	25	27	31
60	35	37	39

(iii) Explain the pattern shown by the results.

(3)

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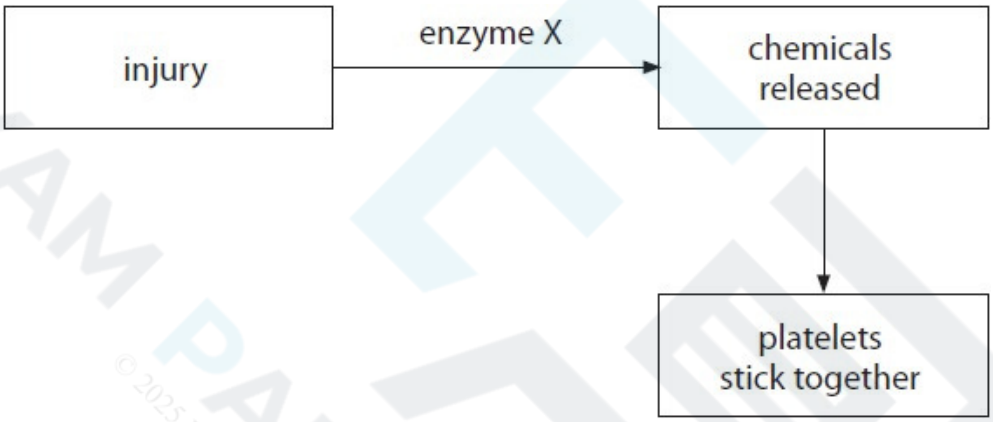
(c) The diagram shows a pathway involved in blood clotting.



Aspirin is an inhibitor of enzyme X.

Explain how the inhibition of enzyme X reduces the formation of blood clots.

(4)

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(Total for question = 15 marks)

Q3.
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 .....

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2 .....

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3 .....

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(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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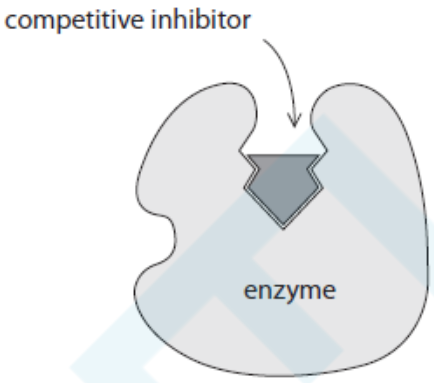
(Total for question = 14 marks)

Q4.

(a) The diagram shows how a competitive inhibitor reduces enzyme activity.



(i) Explain why the competitive inhibitor is able to bind to the enzyme.

Use the diagram to help with your answer.

(3)

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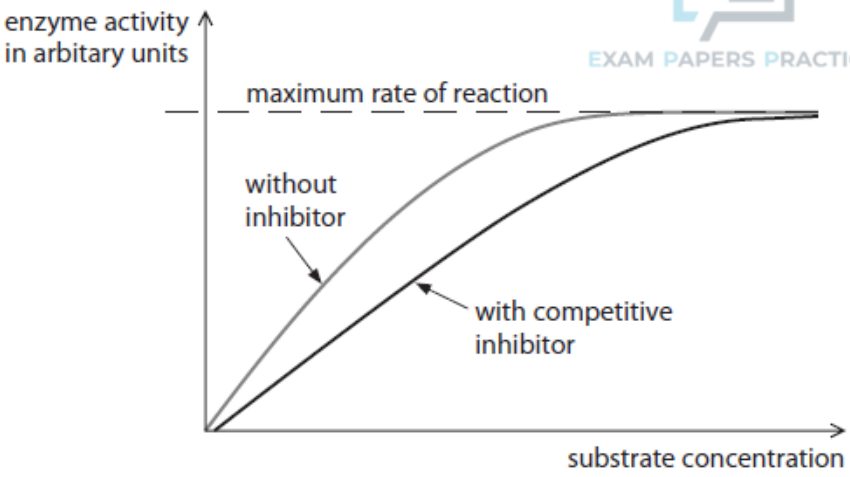
(ii) The graph shows how a competitive inhibitor affects enzyme activity.



Describe how enzyme activity is affected by the presence of a competitive inhibitor.

(2)

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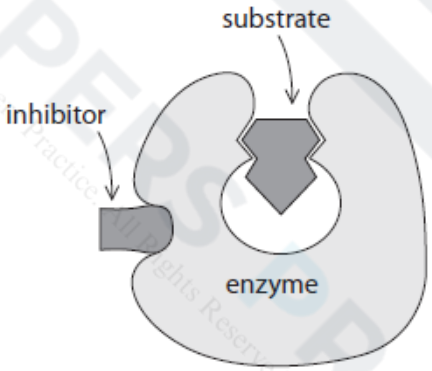
(b) The diagram shows how another type of inhibitor binds to an enzyme.



This inhibitor affects the enzyme in different ways to a competitive inhibitor.

Describe these differences.

(3)

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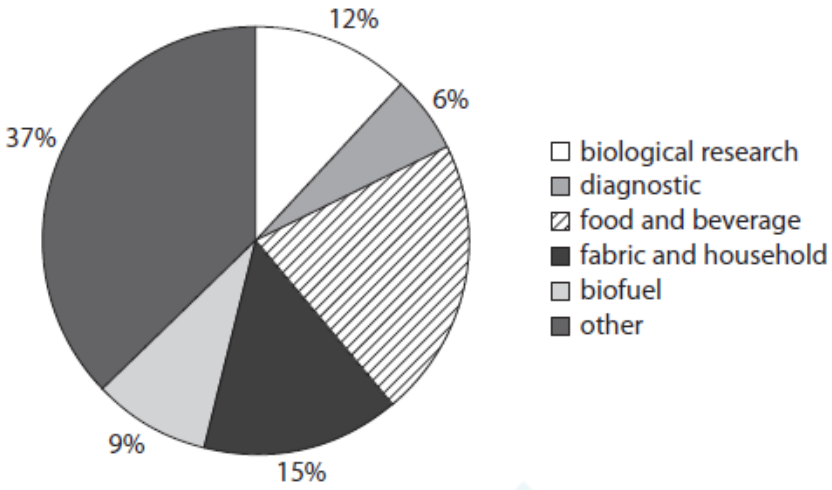
(c) The pie chart shows the worldwide industrial uses of immobilised enzymes.



(i) The total estimated market value of industries that use immobilised enzymes is £3.9 billion (£3 900 000 000).
Calculate the estimated value of immobilised enzymes in the food and beverage industry.

(2)

£ = ...

(ii) These statements are about the use of immobilised enzymes in the food and beverage industry.

1. Amylase is used to convert lactose to galactose and glucose in the production of lactose-free milk.
2. Glucose and fructose are produced from sucrose in the production of slimming foods.

Which of the statements are correct?

(1)

☒ **A** 1 only

☒ **B** 2 only

☒ **C** Both statements 1 and 2

☒ **D** Neither statement 1 nor statement 2

(d) Describe how immobilised enzymes are used to detect glucose in urine.

(4)

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(Total for question = 15 marks)

Q5.
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.

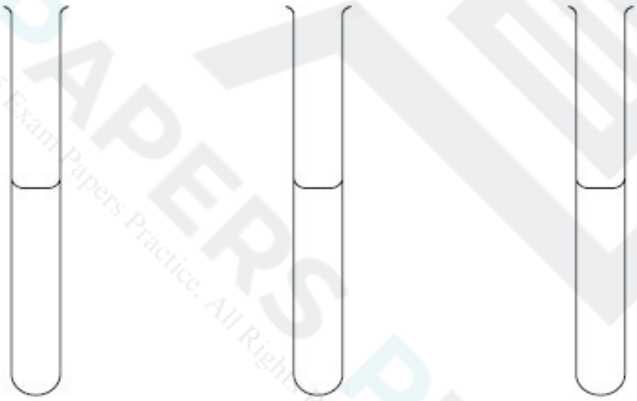

Table 1 lists the contents of each test tube.

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)

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 ☒.

Enzymes are protein molecules.

(a) (i) Which sub-units form enzymes?

(1)

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☒ **A** amino acids

☒ **B** fatty acids

☒ **C** glucose

☒ **D** glycerol

(ii) Describe how a solution can be tested to see if it contains protein.

(3)

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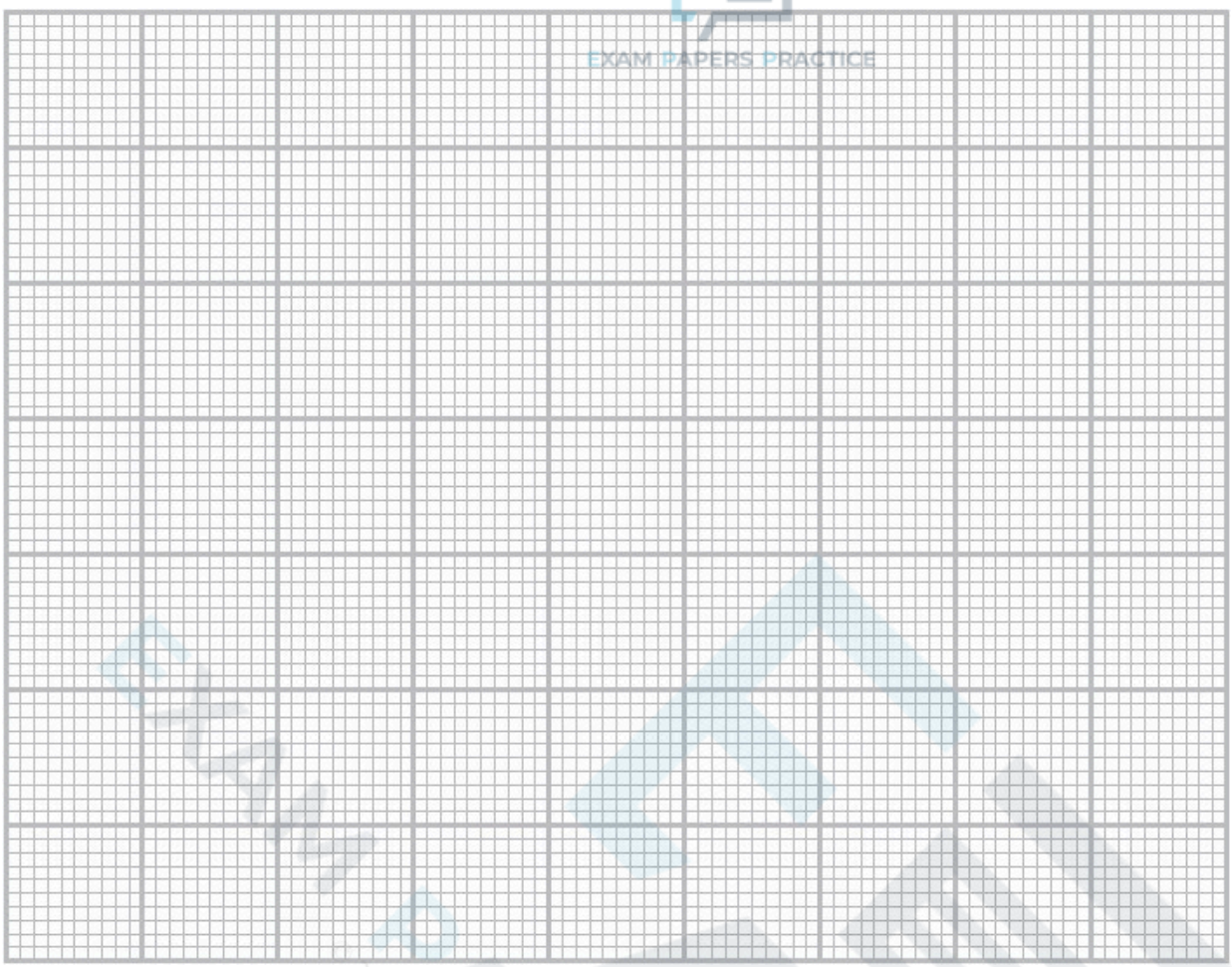
(b) A scientist investigates the effect of temperature on two different enzymes, A and B. Enzyme A and enzyme B both digest proteins. The results of the scientist's investigation are shown in the table.

Temperature in °C	Rate of protein digestion in arbitrary units	
	Enzyme A	Enzyme B
10	0	0
20	5	10
30	5	40
40	20	80
50	60	140
60	80	200
70	20	280
80	0	320
90	0	80

(i) Plot the scientist's results on the grid.

Draw the best fit curve for each enzyme.

(5)



(ii) Describe the effects on enzyme B of increasing the temperature from 80°C to 90°C.

(3)

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..... (iii) Describe the differences between the rate of protein digestion shown by enzyme A and enzyme B. Refer to the graph in your answer.

(3)

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(Total for question = 15 marks)

Q7.
The enzyme catalase is found in the liver.
Catalase acts as a catalyst when added to hydrogen peroxide solution, causing the solution to break down into water and oxygen.
A student investigates the increase in the rate of breakdown of hydrogen peroxide into water and oxygen using catalase.
This is the student's method.

- put 100 g of liver into 100 cm3 of water, and mix into a smooth paste
- put 10 cm3 of the paste into a beaker at room temperature
- add one drop of hydrogen peroxide to the paste
- assess how many oxygen bubbles are produced on a scale of 0 to 5, with 5 representing most bubbles and 0 representing no bubbles

The student repeats the investigation using different conditions.
The conditions he uses are:

- liver paste heated to 70 °C
- liver paste that has been kept at 3 °C for an hour
- acidified liver paste
- liver paste with an alkali added
- liver paste with no hydrogen peroxide added

These are the student's results.

room temperature = 5 heated to 70 °C = 0

kept at 3 °C = 1 acid added = 2 alkali added = 3

no hydrogen peroxide added = 0

(a) (i) Give the student's results in the form of a suitable table.

(3)

(ii) State why this investigation is not reliable.

(1)

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(iii) Give a reason why the results of this investigation are not accurate.

(1)

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(iv) Describe how the investigation could be improved so that the conclusions could be more accurate and reliable.

(3)

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(b) (i) State the condition where the enzyme was most active.

(1)

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(ii) State the reason for including the beaker with no hydrogen peroxide added.

(1)

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(iii) Explain the result obtained when the conditions were acidic.

(4)

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(Total for question = 14 marks)

Q8.

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 ☒.

Inheritance of blood group involves codominant inheritance.

(a) (i) Which statement describes codominant inheritance in ABO blood groups?

(1)

☒ **A** the inheritance of two different alleles, both of which are expressed

☒ **B** the inheritance of two different alleles, only one of which is expressed

☒ **C** the inheritance of multiple alleles, only two of which are expressed

☒

D the inheritance of multiple alleles, only one of which is expressed

(ii) State the possible genotypes of a person with blood group A.

(1)

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(b) (i) A person's blood group is determined by antigens.
These antigens are carbohydrate and protein molecules on the surface of red blood cells.
In 2007, a team of scientists used enzymes to convert blood groups A, B and AB into blood group O for transfusions.
Suggest how enzymes can convert blood groups A, B and AB into blood group O.

(3)

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(ii) Suggest an advantage of producing blood group O using enzymes, compared

with other methods of obtaining blood group O.

(1)

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(c) Haemophilia is a sex-linked blood disorder that reduces the ability of the blood to clot.

These are the genotypes of four offspring, P, Q, R and S.

P	Q	R	S
X^HX^h	X^hY	X^HX^H	X^HY

(i) Draw a genetic diagram to show how these offspring are produced from one set of parents.

(2)

(ii) These parents are expecting another baby.

Determine the probability that this baby will have haemophilia.

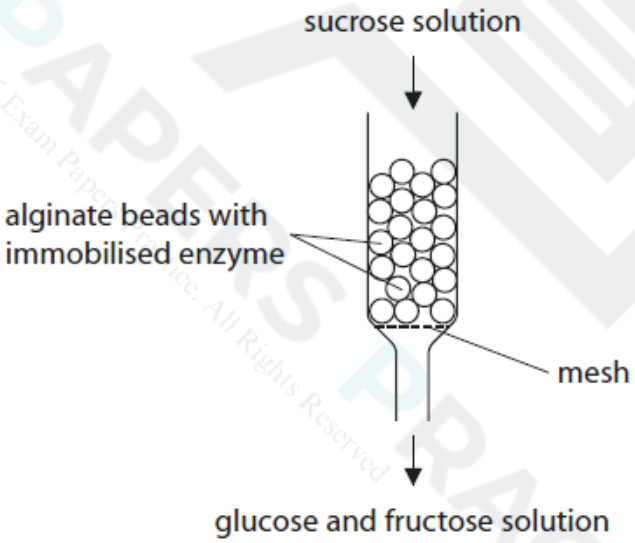
(1)

..... probability =

(Total for question = 9 marks)

Q9.

(a) The diagram shows how immobilised enzymes can be used to convert sucrose into glucose and fructose.



(i) Name the immobilised enzyme used in this process.

(1)

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(ii) One advantage of using immobilised enzymes is that they do not contaminate the products, glucose and fructose.

Explain how the products could be tested to show that they had not been contaminated by the enzyme.

(3)

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(iii) State two other advantages of using immobilised enzymes.

(2)

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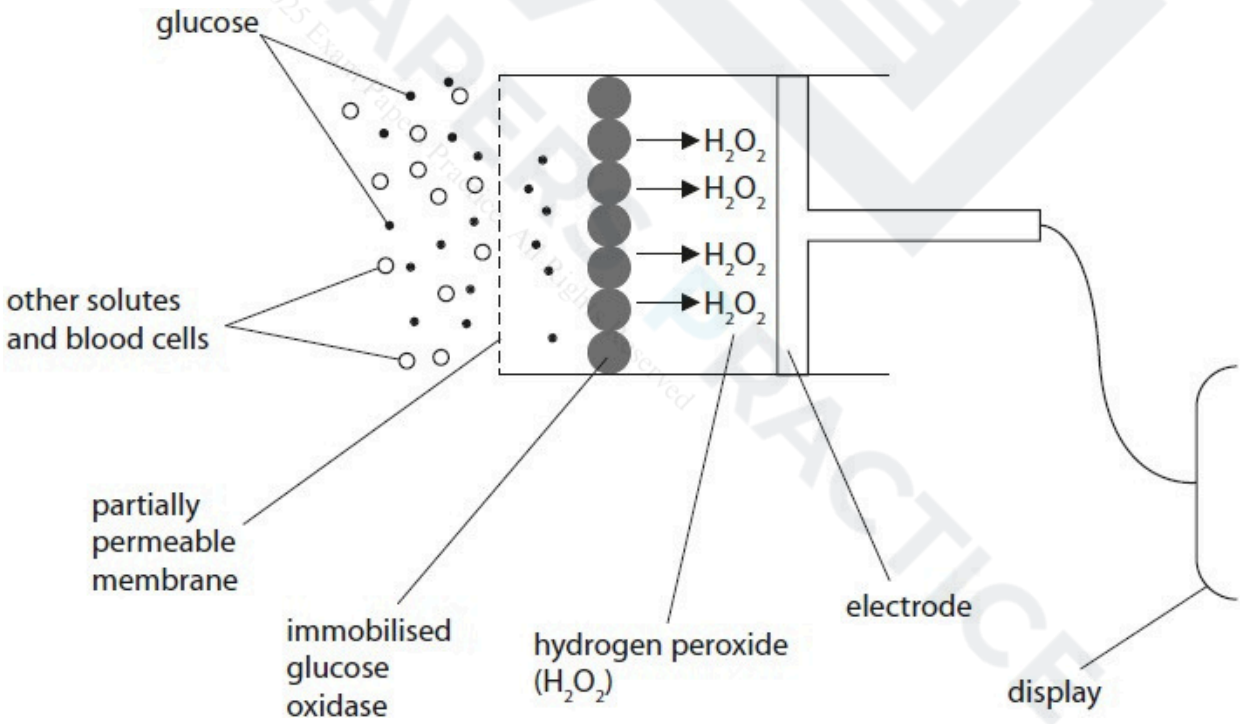
..... (b)

Biosensors that contain immobilised enzymes can be used to measure the levels of glucose in blood. The diagram shows this type of biosensor.



(i) Explain the function of the partially permeable membrane.

(2)

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(ii) Explain the function of the immobilised enzyme in the biosensor.

Use information from the diagram to help your answer.

(4)

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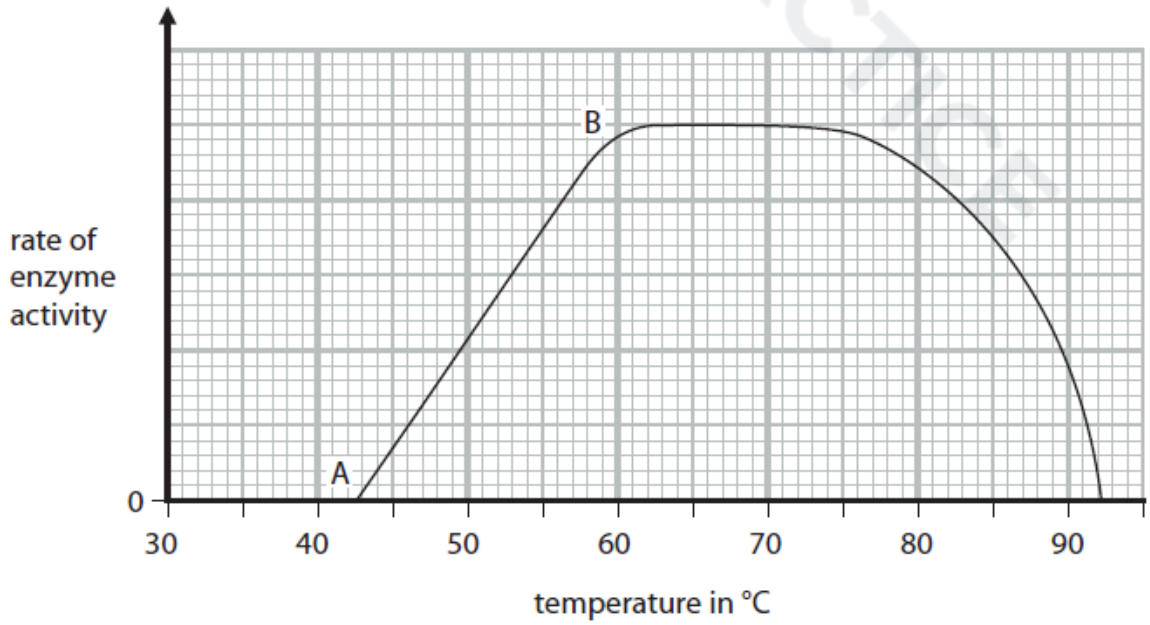
(Total for question = 12 marks)

Q10.

The graph shows the effect of temperature on the activity of a bacterial enzyme.



(a) Draw a curve on the grid to show the rate of enzyme activity for an enzyme from the human alimentary canal.

(2)

(b) Explain what is causing the change in enzyme activity from A to B.

(5)

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(c) Deduce which type of environment the bacterium lives in.

(2)

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(Total for question = 9 marks)

Q11.

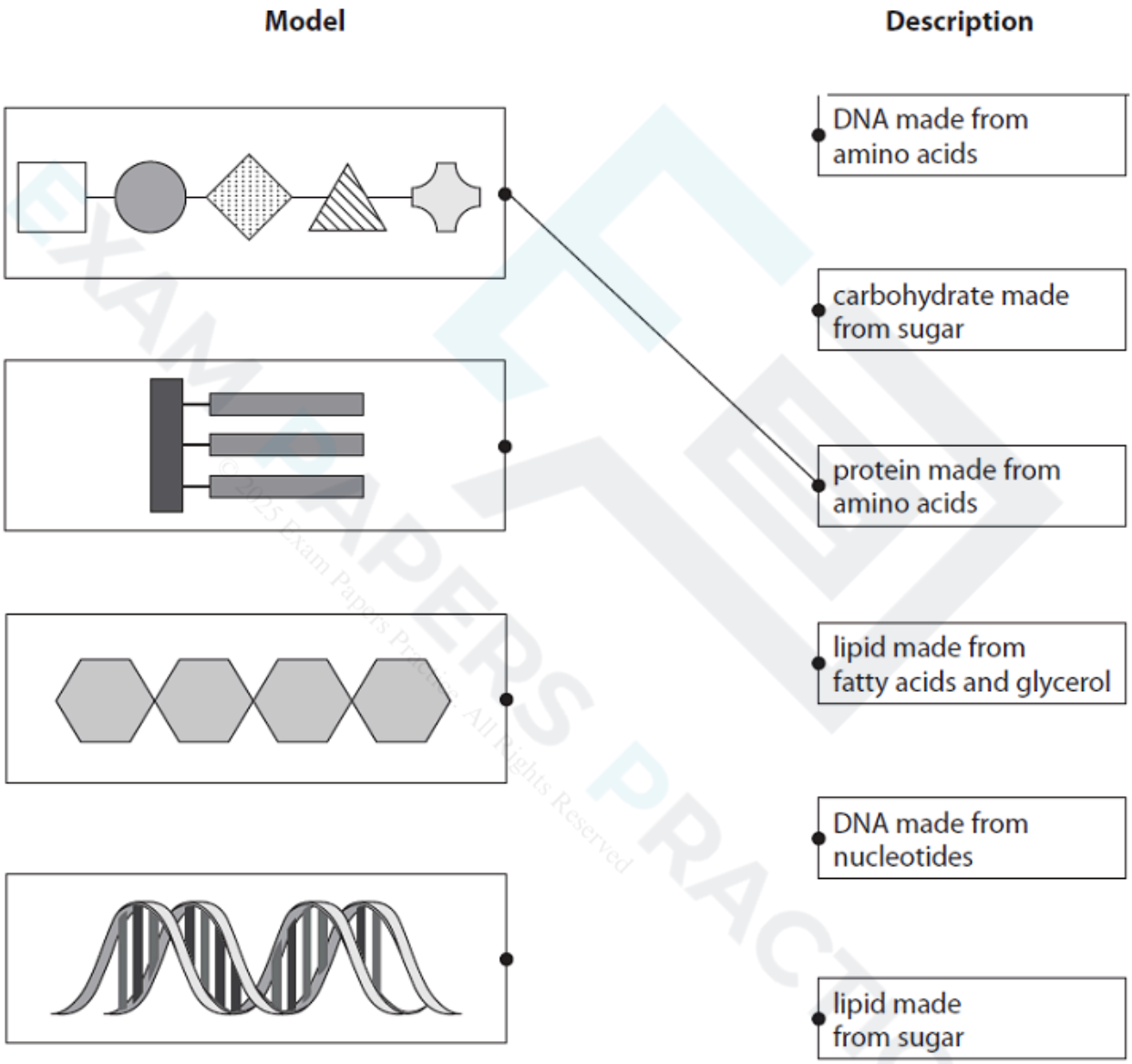
Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

(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)

Q12.
(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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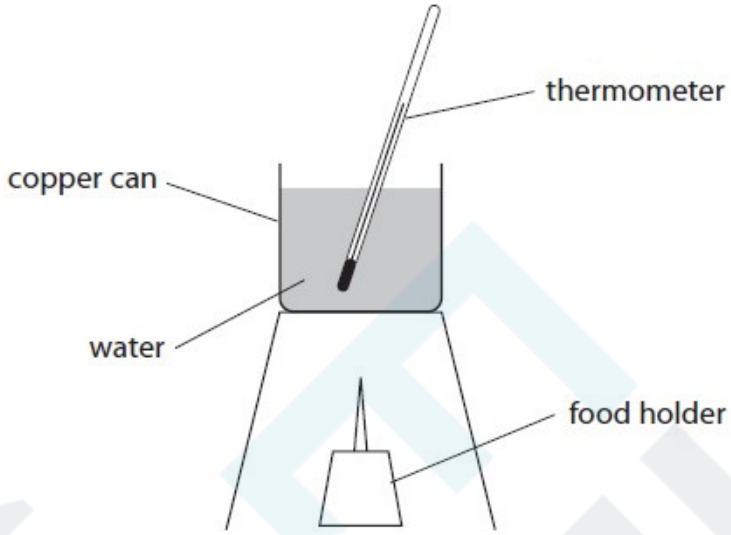
..... (b)

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)

Q13.
A student uses these three tests to identify the contents of four powders, W, X, Y and Z.

- iodine test
- Benedict's test
- biuret test

The table shows the student's results.

	Colour observed after testing			
Test	**Powder W**	**Powder X**	**Powder Y**	**Powder Z**
iodine	yellow / brown	black	black	yellow / brown
Benedict's	blue	brick red	blue	brick red
biuret	purple	blue	blue	purple

(a) Describe how the student should safely carry out the Benedict's test on the powders.

(4)

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(b) (i) Identify which powder gives a positive result for starch but a negative result for the two other tests.

(1)

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(ii) Identify which powders contain protein but no starch.

(2)

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(iii) Identify which powder contains reducing sugar but no protein.

(1)

.....

(iv) Give the contents of powder W.

(1)

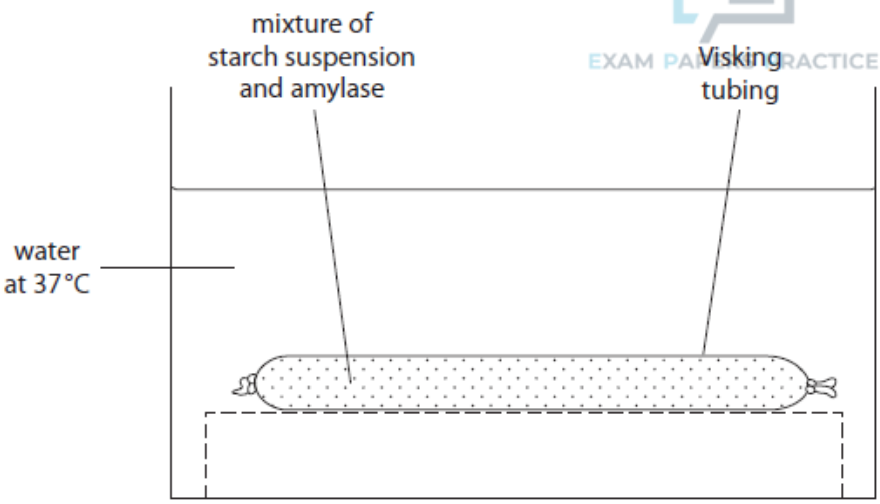
.....

(Total for question = 9 marks)

Q14.

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.

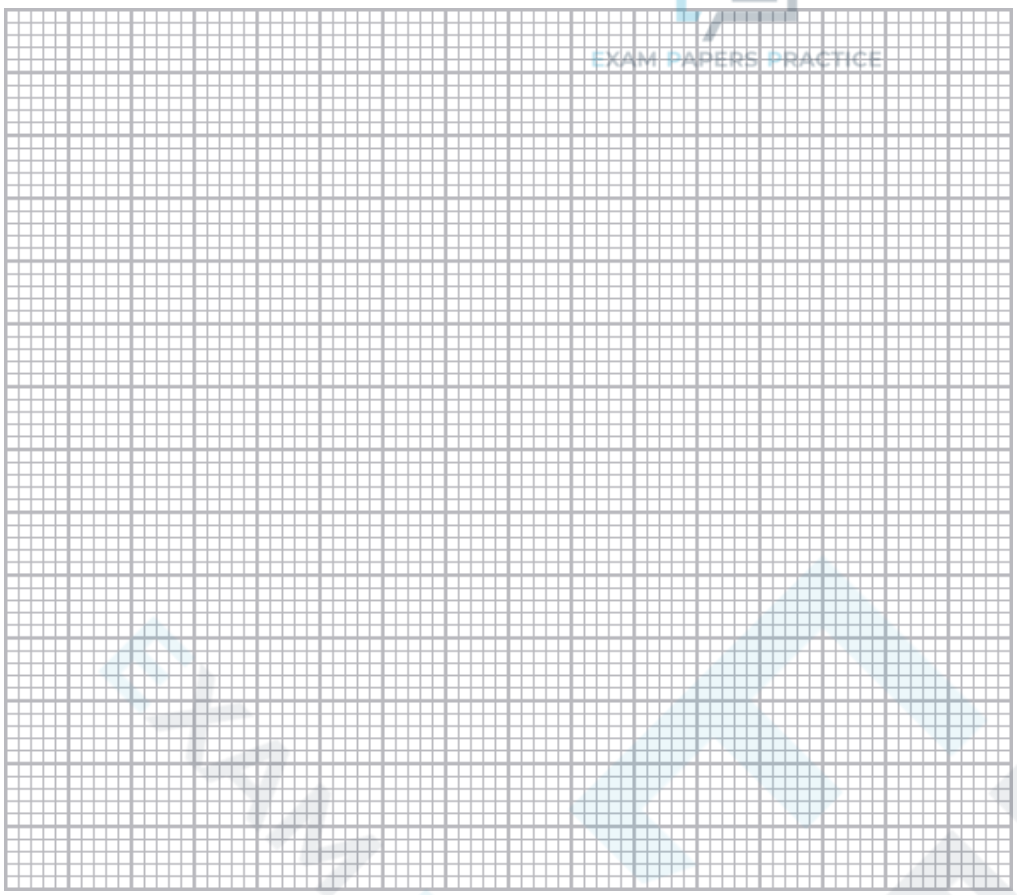


The experiment is left for four hours. Every hour, the Visking tubing is removed from the water bath. It is dried, weighed and returned to the water bath.
The experiment is repeated, with amylase Q solution instead of amylase P solution.
The table shows the results obtained by the student.

	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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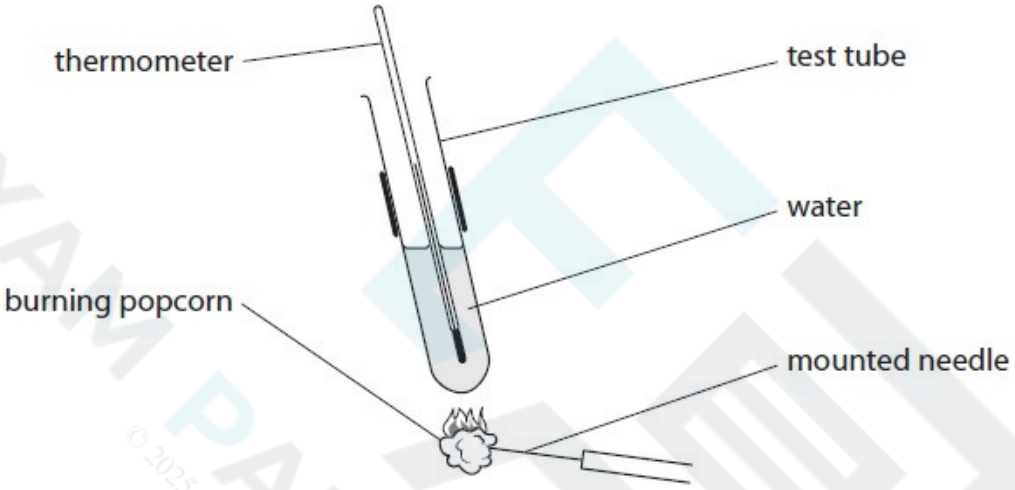
(Total for question = 18 marks)

Q15.

A student uses this apparatus to investigate the energy contained in popcorn.



This is the student's method.

- place 12 g of water in a test tube
- measure the initial temperature of the water
- place the popcorn on a mounted needle
- light the popcorn using a Bunsen flame
- place the burning popcorn under the test tube
- measure the maximum temperature of the water

(a) (i) State why the test tube should have thin glass walls.

(1)

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(ii) Explain one safety precaution that the student should take during the investigation.

(2)

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(b) The student uses this equation to calculate the energy released by the popcorn.

energy released = mass (g) × 4.2 × temperature rise (°C)

The initial temperature of the 12 g of water is 17 °C.

The maximum temperature of the water is 45 °C.

(i) Calculate the energy released when the student burns the popcorn.

Give your answer to 2 significant figures.

(3)

energy released = ... J

(ii) Explain why the calculated amount of energy released is not the same as the full amount of energy contained in the popcorn. **(3)**

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(c) The student wants to compare the energy content of popcorn with the energy content of two other foods. State four factors that the student should control to make sure the comparison is valid.

1 .....

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2 ..... **(4)**

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3 .....

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4 .....

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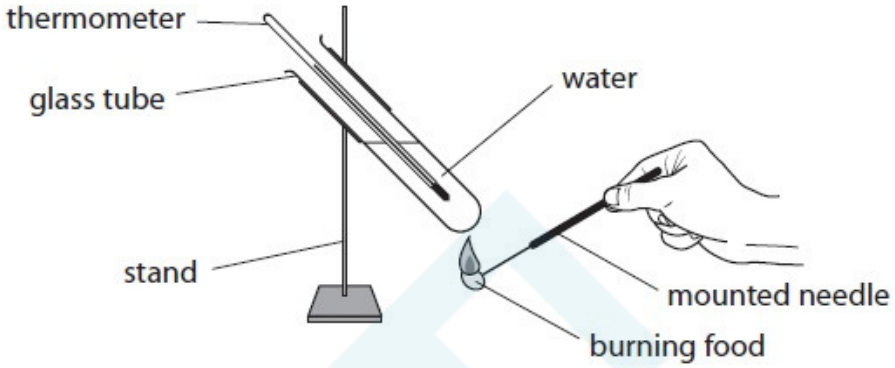
(Total for question = 13 marks)

Q16.

A student uses this apparatus to investigate the energy content of different foods.



(3)

This is the student's method.

- add water to the glass tube
- measure the temperature of the water
- place a piece of food onto the mounted needle
- set the food alight by placing it into a Bunsen flame
- place the burning food under the glass tube
- measure the temperature of the water when the food stops burning

Repeat the method using different foods.
(a) (i) State three safety precautions that the student should take.

(3)

1 .....

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2 .....

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3 .....

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(ii) State three factors that should be controlled during the investigation.

1.....
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(iii) Explain why the energy content of a sample of food is likely to be higher than the energy of the same sample measured by this method.

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..... **(5)**
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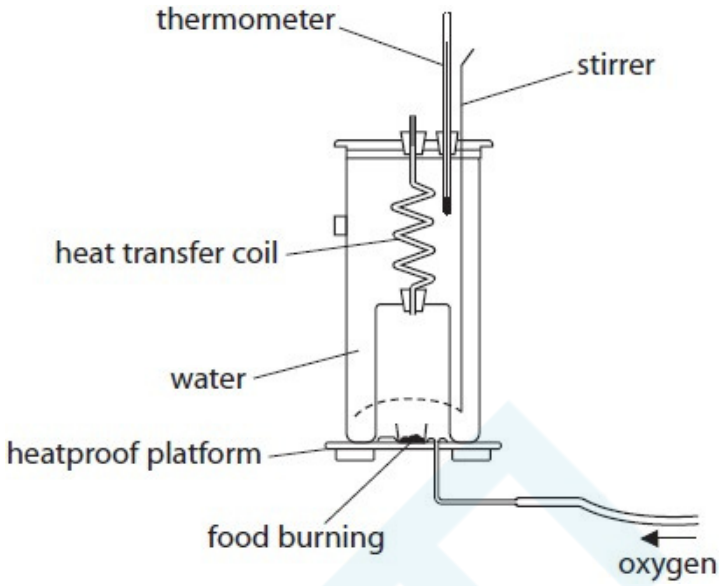
(b) The diagram shows a calorimeter. This is a piece of apparatus that is used to measure the energy content of a sample of food accurately.



Discuss the features of this calorimeter that will give a more accurate measurement of the energy in a sample of food than the method used by the student.

(4)

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(Total for question = 15 marks)