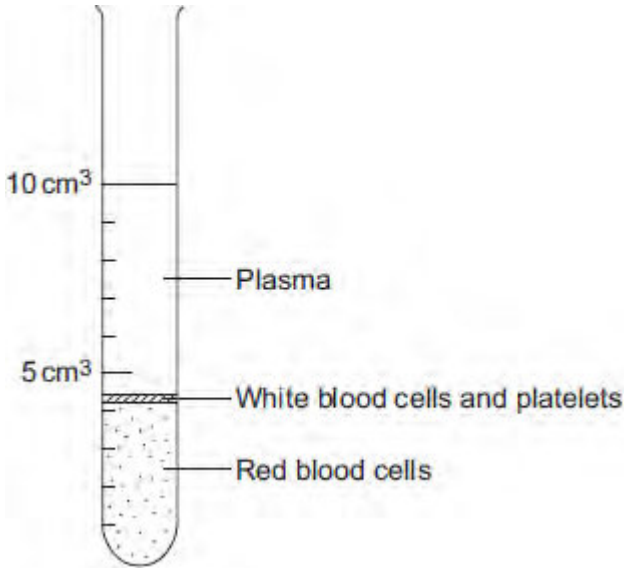
Q1. The parts of the blood can be separated from each other by spinning the blood in a centrifuge.

The image below below shows the separated parts of a 10 cm^3 blood sample.



(a) Calculate the percentage of the blood that is made up of plasma.

.....

.....

Answer = ... %

(2)

(b) Name **three** chemical substances transported by the plasma.

1.....

2.....

3.....

(3)

(c) **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

White blood cells are part of the immune system. White blood cells help the body to defend itself against pathogens.

Describe how pathogens cause infections **and** describe how the immune system defends the body against these pathogens.

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(6)
(Total 11 marks)

Q2. The photograph shows a fossil of a prehistoric bird called *Archaeopteryx*.



By Ghedoghedo (own work) [CC-BY-SA-3.0 (http://creativecommons.org/licenses/BY-SA-3.0) or GFDL (http://www.gnu.org/copyleft/fdl.html)], via W kimedia Commons; By Steenbergs from Ripon, United Kingdom (Small Fishing Boat In North Sea) [CC-BY-2.0 (http://creativecommons.org/licenses/by/2.0)], via Wikimedia Commons.

(a) Describe **three** ways fossils can be made.

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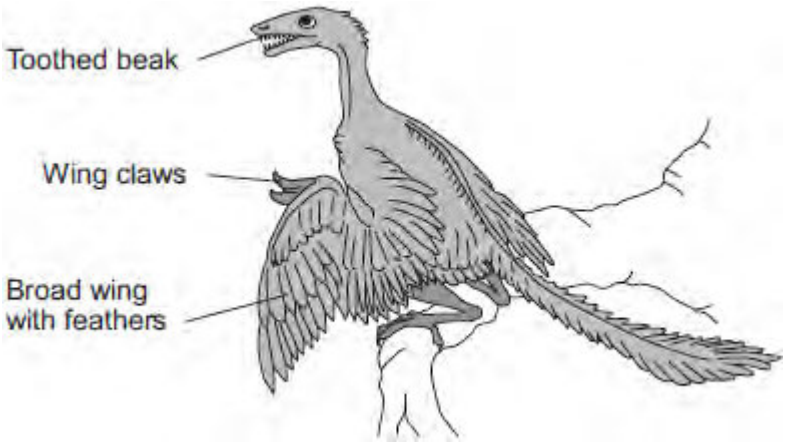
.....

.....

(3)

(b) The drawing shows what an *Archaeopteryx* might have looked like when it was alive.

Scientists think that *Archaeopteryx* was a predator.



(i) Look at the drawing.

Write down **three** adaptations that might have helped *Archaeopteryx* to catch prey.

How would **each** adaptation have helped *Archaeopteryx* to catch prey?

Adaptation 1 .....

How it helps .....

.....

Adaptation 2 .....

How it helps .....

.....

Adaptation 3 .....

How it helps .....

.....

(3)

(ii) *Archaeopteryx* is now extinct.

Give **two** reasons why animals may become extinct.

1 .....

.....

2 .....

.....

(2)
(Total 8 marks)

Q3.(a) High-fructose corn syrup (HFCS) is used instead of sucrose as a sweetener in many types of food.

Table 1 shows the relative sweetness of different types of sugar.

Table 1

Sugar	Relative sweetness
Fructose	173
Glucose	74
Lactose	16
Sucrose	100

(i) One of the sugars was used as a 'standard' measure of sweetness.

The sweetness of all the other sugars was compared with this.

Which sugar was used as the standard of sweetness?

.....

(1)

(ii) Fructose is used instead of sucrose in many types of food.

Suggest why.

Use information from **Table 1** in your answer.

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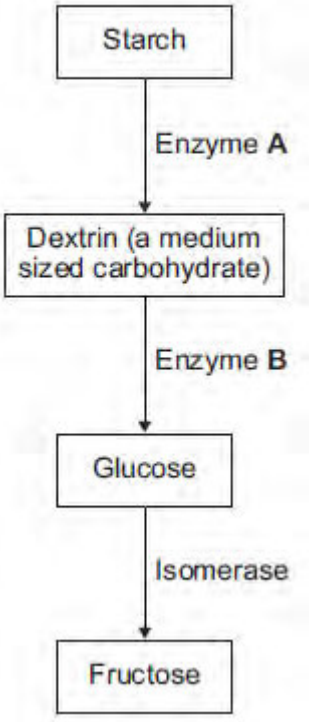
.....

(3)

(b) **Diagram 1** shows the main stages in the industrial production of fructose for use in

HFCS.

Diagram 1



(i) **A** and **B** are two enzymes that digest carbohydrates.

What general name do scientists give to enzymes like **A** and **B**?

Tick (✓) **one** box.

carbohydrases ☐

lipases ☐

proteases ☐

(1)

(ii) The enzymes in **Diagram 1** come from bacteria that live in hot springs.

The enzymes work best at a temperature of 60 °C.

What would happen to most enzymes at a temperature of 60 °C?

.....

.....

(1)

(iii) It is an advantage to carry out these reactions in the industrial production of HFCS at 60 °C.

Suggest why.

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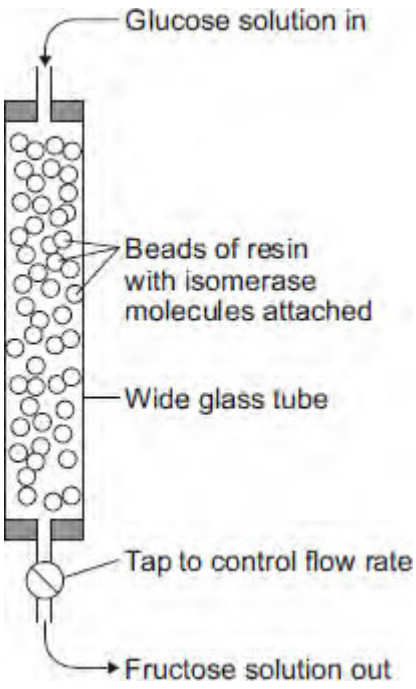
.....

(2)

Isomerase is used in an immobilised form in the production of HFCS. Isomerase molecules are immobilised by attaching them to beads made of resin in a glass tube.

Diagram 2 shows how immobilised isomerase is used.

Diagram 2



(c) An alternative to using immobilised isomerase is to mix isomerase solution with glucose solution in a large container.

Suggest **two** advantages of using immobilised isomerase, rather than isomerase solution, in the production of HFCS for use in human foods.

1 .....

.....

2 .....

.....

(2)

(d) **Table 2** shows some differences between the industrial production of HFCS from glucose using:

- isomerase solution
- immobilised isomerase.

Table 2

	Isomerase solution	**Immobilised isomerase**
Reaction container volume in m^3	1100	15
Time taken for reaction in hours	20	0.5
Temperature in °C	65	60
Number of product refining stages	4	1
Total production cost in £ per tonne	500	5

Explain how factors given in **Table 2** help to lower production costs when using the immobilised enzyme.

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(3)

(e) **Table 3** gives information about the half-life of isomerase in the two processes.

The **half-life** of the enzyme is the time it takes for the enzyme's activity to fall to half its starting value.

The **active life** of the enzyme is the time for which it can be used before it is thrown away.

Table 3

	Isomerase solution	**Immobilised isomerase**
Half-life of enzyme in hours	30	1500
Active life of enzyme in half-lives	0.7	3

(i) Using the information from **Table 3**, we can calculate that the active life, in hours, of isomerase solution is 21 hours.

Calculate the active life, in hours, of **immobilised isomerase**.

.....

.....

Active life of immobilised isomerase = ... hours

(2)

(ii) A high active life of isomerase is important in lowering the production costs of HFCS.

Explain why.

.....

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(2)
(Total 17 marks)

Q4. Lipase is an enzyme that digests fat.

(a) (i) Complete the equation to show the digestion of fat.

Use the correct answer from the box.

glucose	glycerol	glycogen

fat $\xrightarrow{\text{lipase}}$ fatty acids + ...

(1)

(ii) Name **one** organ that makes lipase.

.....

(1)

(b) Some students investigated the effect of bile on the digestion of fat by lipase.

The students:
1 mixed milk and bile in a beaker
2 put the pH sensor of a pH meter into the beaker
3 added lipase solution
4 recorded the pH at 2-minute intervals
5 repeated steps 1 to 4, but used water instead of bile.

Suggest **two** variables that the students should have controlled in this investigation.

1.....

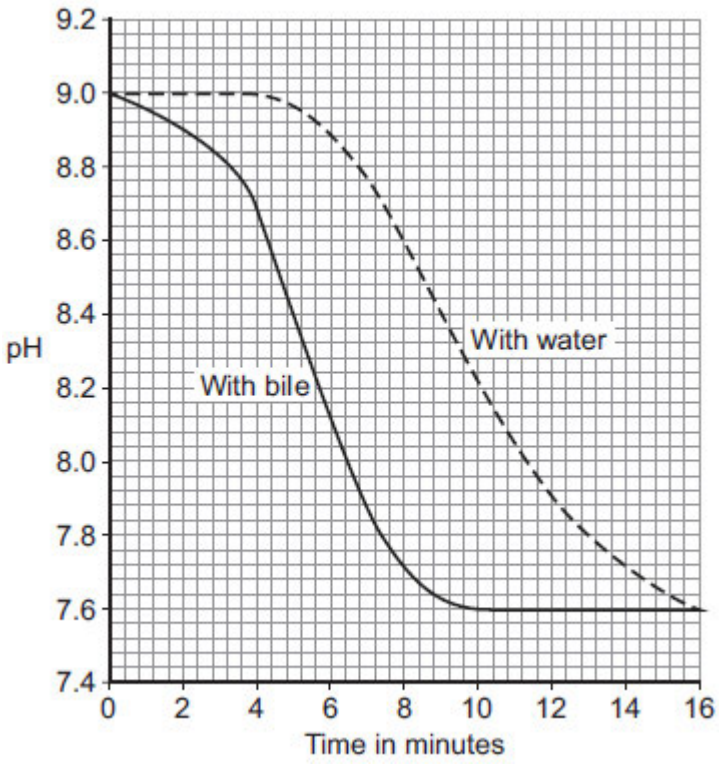
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2.....

.....

(2)

(c) The graph shows the students' results.



(i) Why did the pH decrease in both investigations?

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.....

(1)

(ii) Bile helps lipase to digest fat.

What evidence is there in the graph to support this conclusion?

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(1)

(iii) Suggest **one** reason why the contents of both beakers had the same pH at the end of the investigations.

.....

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(1)

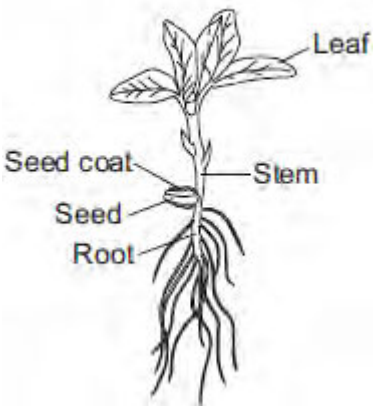
(Total 7 marks)

Q5. Catalase is an enzyme found in many different tissues in plants and animals. It speeds up the rate of the following reaction.

$$\text{hydrogen peroxide} \xrightarrow{\text{catalase}} \text{water + oxygen}$$

Figure 1 shows a 25-day-old broad bean seedling.

Figure 1



Some students investigated whether different parts of bean seedlings contained different amounts of catalase.

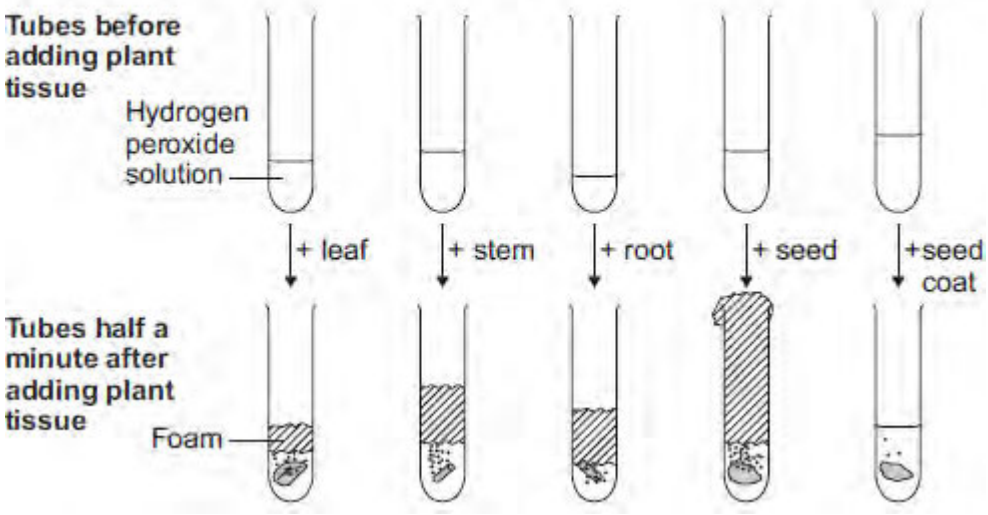
The students:

- put hydrogen peroxide into five test tubes
- added a different part of a bean seedling to each tube
- recorded the results after half a minute.

If there was catalase in part of the seedling, oxygen gas was given off.
When oxygen gas is given off, foam is produced in the tubes.

Figure 2 shows the results.

Figure 2



The students made the following conclusions:

- most parts of a bean seedling contain catalase
- the seed contains a lot of catalase
- stems and roots have quite a lot of catalase
- the leaves have a little bit of catalase
- the seed coat has hardly any catalase.

The students' teacher said that the students needed to improve their investigation in order to make valid conclusions.

(a) **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

Describe how you would carry out an investigation to compare the amounts of catalase in different parts of bean seedlings.

You should include details of how you would make sure your results give a valid comparison of the amounts of catalase.

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(6)

(b) Scientists investigated the effect of pH on the activity of the enzyme catalase in a fungus.

The table below shows the scientists' results.

pH	Enzyme activity in arbitrary units					
	Test 1	**Test 2**	**Test 3**	**Test 4**	**Test 5**	**Mean**
3.0	0	0	0	0	0	0
4.0	6	5	8	4	7	6
5.0	38	65	41	42	39	
5.5	80	86	82	84	88	84
6.0	100	99	96	103	102	100
6.5	94	92	90	93	91	92
7.0	61	63	61	62	63	62
8.0	22	22	21	24	21	22

(i) Calculate the mean enzyme activity at pH 5.0.

.....

.....

Mean = ... arbitrary units

(2)

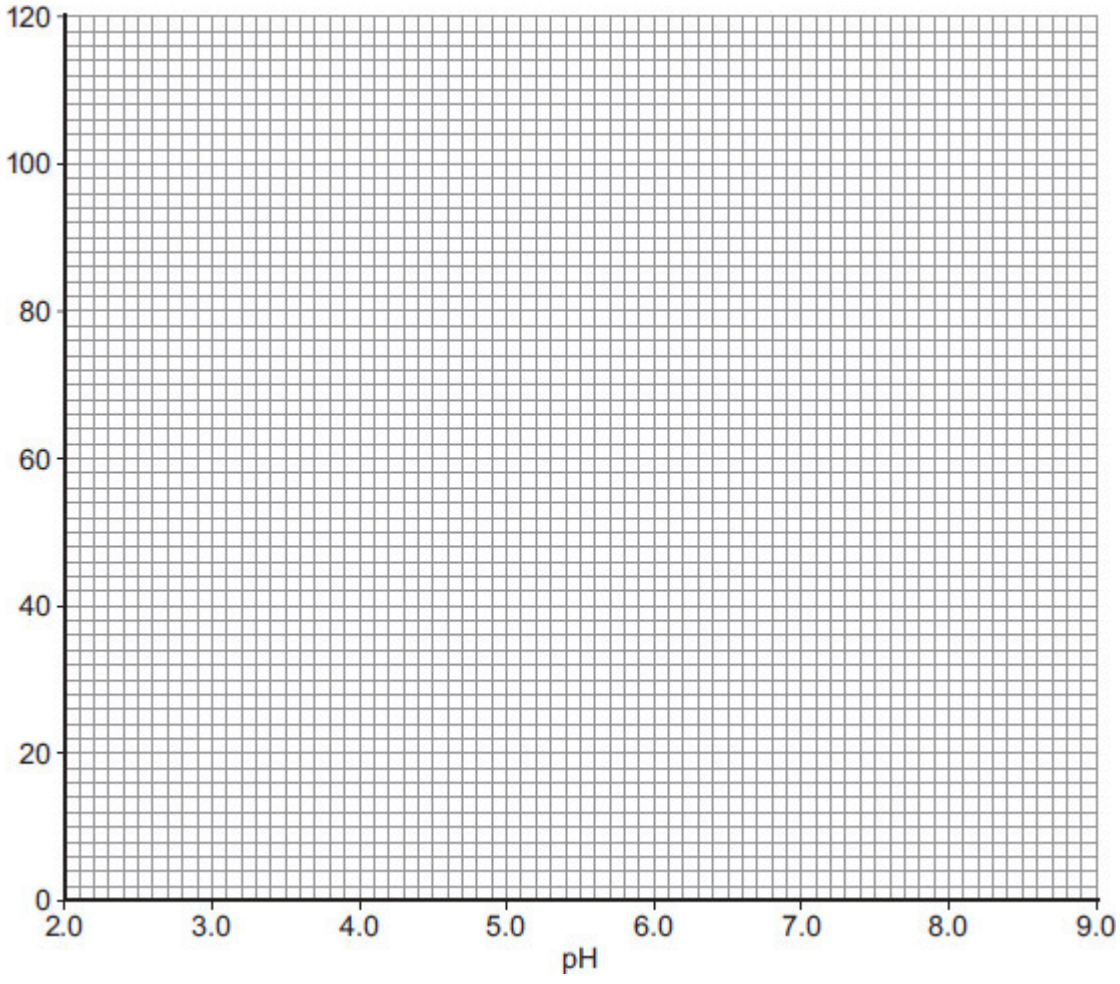
(ii) On the graph paper in **Figure 3**, draw a graph to show the scientists' results.

Remember to:

- add a label to the vertical axis

- plot the mean values of enzyme activity
- draw a line of best fit.

Figure 3



(4)

(iii) At what pH does the enzyme work best?

.....

(1)

(iv) Predict the activity of the enzyme at pH 9.0.

..... arbitrary units

(1)

(v) Suggest why the enzyme's activity at pH 3.0 is zero.

.....

.....

(1)
(Total 15 marks)