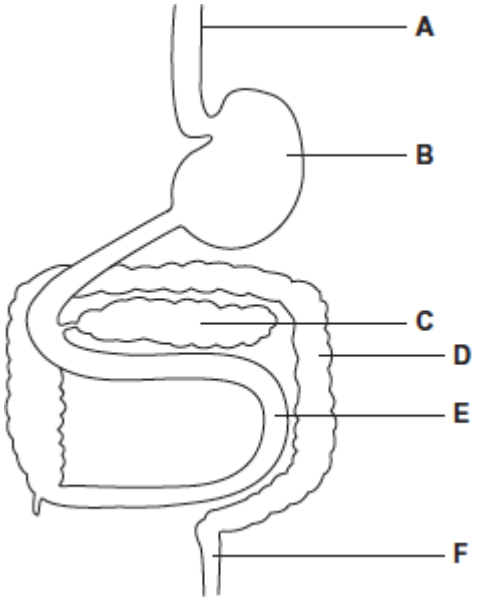
Q1. The diagram represents part of the human digestive system. The organs are labelled **A–F**.



(a) Give the letter of the organ that produces amylase.

(1)

(b) Give the letter of the organ that produces maltase.

(1)

(c) Maltose is hydrolysed by the enzyme maltase.

Explain why maltase catalyses only this reaction.

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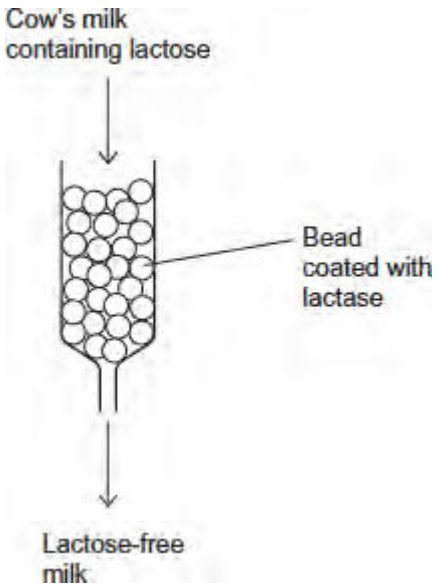
(3)
(Total 5 marks)

Q2. Cow's milk contains the sugar lactose. Many cats are unable to digest cow's milk because they are lactose intolerant.

Cow's milk can be made suitable for these cats by treating it with the enzyme lactase to hydrolyse lactose. This makes the cow's milk lactose-free. Beads are coated with lactase and placed in a tube, as shown in the diagram below. Cow's milk flows over the beads and the lactose is hydrolysed.



(a) Attaching lactase to the beads is a more efficient use of lactase than adding the lactase directly to cow's milk.

Suggest **three** reasons why it is more efficient to attach lactase to the beads.

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2 .....

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3 .....

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(3)

(b) Monosaccharides and disaccharides taste sweet.
The lactose-free milk made after hydrolysis with lactase tastes sweeter than the cow's milk containing lactose.
Suggest why.

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(2)
(Total 5 marks)

Q3. A stomach ulcer is caused by damage to the cells of the stomach lining. People with stomach ulcers often have the bacterium *Helicobacter pylori* in their stomachs.

A group of scientists was interested in trying to determine how infection by *H. pylori* results in the formation of stomach ulcers.

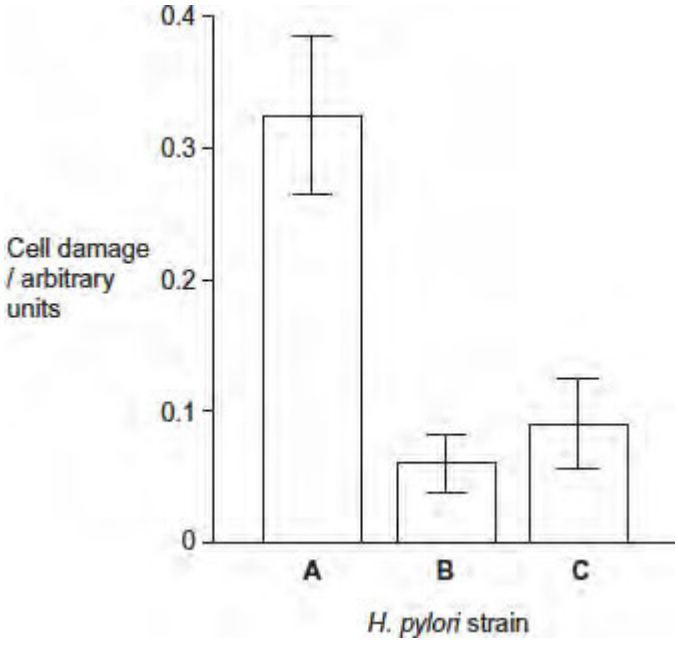
The scientists grew different strains of *H. pylori* in liquid culture.

The table below shows the substances released by each of these strains.

***H. pylori* strain**	**Substances released by the *H. pylori* cells**	
	Toxin	**Enzyme that neutralises acid**
A	✓	✓
B	×	✓
C	✓	×

The scientists centrifuged the cultures of each strain to obtain cell-free liquids. They added each liquid to a culture of human cells. They then recorded the amount of damage to the human cells.

Their results are shown below. The error bars show ± 1 standard deviation.



(a) Describe and explain how centrifuging the culture allowed the scientists to obtain a cell-free liquid.

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[Extra space] .....

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(3)

(b) The scientists measured cell damage by measuring the activity of lysosomes.
Give **one** function of lysosomes.

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(1)

(c) *H. pylori* cells produce an enzyme that neutralises acid.
Suggest **one** advantage to the *H. pylori* of producing this enzyme.

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(2)

(d) What do these data suggest about the damage caused to human cells by the toxin and by the enzyme that neutralises acid?
Explain your answer.

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(3)

(e) The scientists carried out a further investigation. They treated the liquid from **strain A** with a protein-digesting enzyme before adding it to a culture of human cells. No cell damage was recorded.
Suggest why there was no damage to the cells.

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(3)
(Total 12 marks)

Q4. A principle of homeostasis is the maintenance of a constant internal environment. An increase in the concentration of carbon dioxide would change the internal environment and blood pH.
Explain the importance of maintaining a constant blood pH.

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[Extra space] .....

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(Total 3 marks)

Q5. Cyanide is poisonous. Cyanide binds to cytochrome oxidase, which is an enzyme in the electron transport chain in mitochondria. This stops the movement of electrons to oxygen. As a result, ATP cannot be made via aerobic respiration. If a person or animal is exposed to cyanide, a substance that acts as an antidote can reduce or prevent poisoning. This substance binds to cyanide.

Scientists investigated the effect of cyanide on the rate of respiration of cells in different animal organs and in organs from different animals. They extracted organs from animals that had just been killed. For each animal organ they set up 3 dishes. Each dish contained:

- phosphate solution
- saline (sodium chloride) solution
- cyanide solution of known concentration.

They measured the mean amount of oxygen used by the slices of organs in one hour. Their results are shown in **Table 1**.

Table 1

Trial	Animal organ	Mean amount of oxygen used, in the absence or presence of cyanide, per hour / arbitrary units		
		No cyanide	10^{-4} mol dm^{-3} cyanide	10^{-2} mol dm^{-3} cyanide
A	Sheep liver	2.7	2.5	0.7
B	Sheep kidney	14.1	9.9	1.9
C	Ox liver	1.9	1.5	0.8
D	Rat kidney	20.7	18.8	2.3
E	Rat liver	10.5	10.0	1.9
F	Guinea pig kidney	16.8	14.4	1.9

(a) Suggest how binding of cyanide to cytochrome oxidase affects the enzyme.

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(3)

(b) Suggest how the antidote can reduce poisoning by cyanide.

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(1)

(c) **Table 1** shows the scientists' results for different trials. The trials could be put into groups to allow comparisons to be made within each group.

(i) As an example of how trials could be grouped, **Group 1** has been completed in **Table 2** below. Complete **Table 2** to show **three** other possible ways that the scientists' trials could be grouped.

Table 2

Group	Trials allowing comparisons to be made
1	**A** with **B**
2	
3	
4	

(2)

(ii) What is the effect of cyanide on **Group 1** trials in **Table 2**? Use evidence from **Table 1** to support your answer.

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(3)

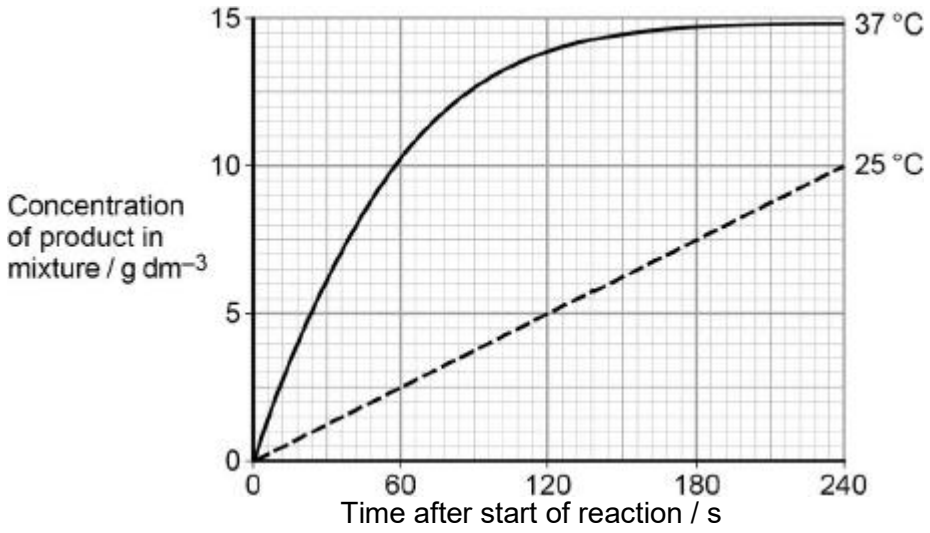
(iii) Calculate the percentage difference in oxygen use for 'rat liver' (**Trial E**) between a cyanide concentration of 10^{-4} and 10^{-2} mol dm^{-3}.

Percentage difference = ...

(2)
(Total 11 marks)

Q6. A technician investigated the effect of temperature on the rate of an enzyme-controlled reaction. At each temperature, he started the reaction using the same volume of substrate solution and the same volume of enzyme solution.

The figure below shows his results.



(a) Give **one** other factor the technician would have controlled.

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(1)

(b) Calculate the rate of reaction at 25 °C.

Answer .....

(2)

(c) Describe and explain the differences between the two curves.

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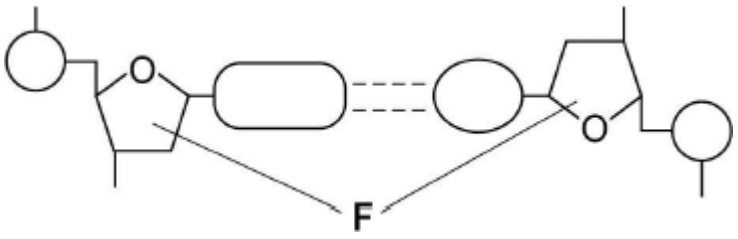
(5)
(Total 8 marks)

Q7.Figure 1 shows one base pair of a DNA molecule.

Figure 1



(a) Name part **F** of each nucleotide.

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(1)

(b) Scientists determined that a sample of DNA contained 18% adenine.

What were the percentages of thymine and guanine in this sample of DNA?

Percentage of thymine ☐

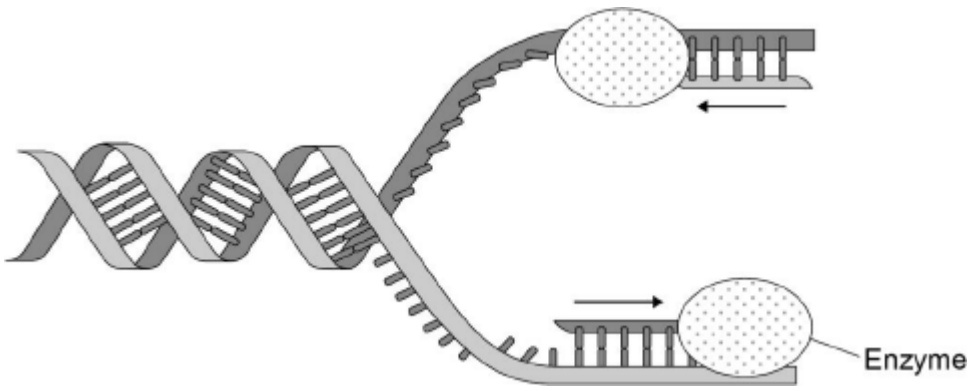
Percentage of guanine ☐

(2)

During replication, the two strands of a DNA molecule separate and each acts as a template for the production of a new strand.

Figure 2 represents DNA replication.

Figure 2



(c) Name the enzyme shown in **Figure 2**.

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(1)

The arrows in **Figure 2** show the directions in which each new DNA strand is being produced.

(d) Use **Figure 1, Figure 2** and your knowledge of enzyme action to explain why the arrows point in opposite directions.

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(4)
(Total 8 marks)