

AQA, OCR, Edexcel

A Level

A Level Biology

**Biological Molecules and
Enzyme Questions**

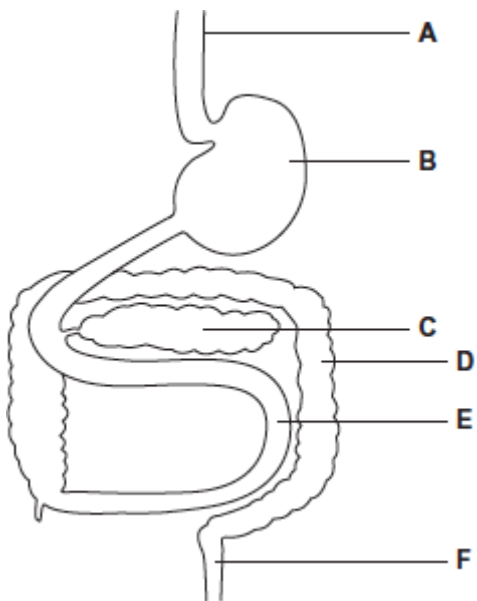
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Total Marks:

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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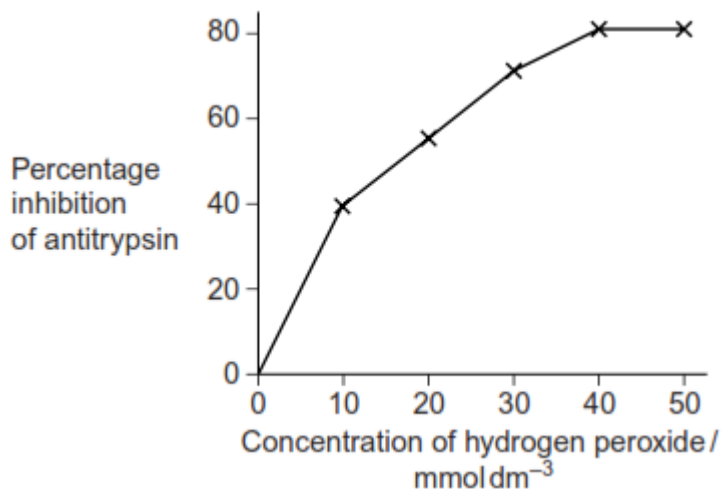
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(3)
(Total 5 marks)

Q2. Alpha-1-antitrypsin is a protein that reduces the activity of enzymes that can damage lung tissue. Cigarette smoke contains hydrogen peroxide. Hydrogen peroxide reduces the activity of alpha-1-antitrypsin. Scientists investigated the effect of different concentrations of hydrogen peroxide on the activity of alpha-1-antitrypsin. The graph shows their results.



(a) (i) Hydrogen peroxide reacts with two amino acids in alpha-1-antitrypsin. Explain how this reduces activity of the protein.

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.....(2)

(ii) Explain the results shown in the graph.

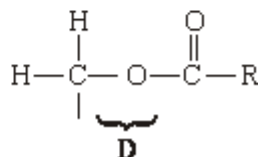
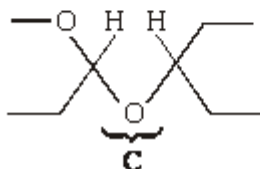
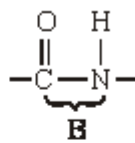
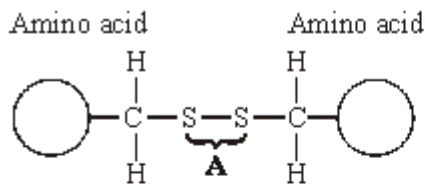
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.....(2)

(b) Long-term smokers are often short of breath. Use this information to explain why.

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(2)
(Total 6 marks)

Q3. The diagrams show four types of linkage, **A** to **D**, which occur in biological molecules.



(a) Name the chemical process involved in the formation of linkage **B**.

.....(1)

(b) Give the letter of the linkage which

(i) occurs in a triglyceride molecule;

..... (1)

(ii) might be broken down by the enzyme amylase;

..... (1)

(iii) may occur in the tertiary, but not the primary structure of protein.

..... (1)

(c) Describe how a saturated fatty acid differs in molecular structure from an unsaturated fatty acid.

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(2)

(Total 6 marks)

Q4.(a) (i) Describe the role of DNA polymerase in DNA replication.

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(1)

(ii) Other than being smaller, give **two** ways in which prokaryotic DNA is different from eukaryotic DNA.

1

2**(2)**

(b) The table shows the percentage of each base in the DNA from three different organisms.

Organism	Percentage of each base in DNA			
	Adenine	Guanine	Thymine	Cytosine
Human	30.9	19.9	29.4	19.8
Grasshopper	29.4	20.5	29.4	20.7
Virus	24.0	23.3	21.5	31.2

(i) Humans and grasshoppers have very similar percentages of each base in their DNA but they are very different organisms. Use your knowledge of DNA structure and function to explain how this is possible.

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(2)

- (ii) The DNA of the virus is different from that of other organisms. Use the table above and your knowledge of DNA to suggest what this difference is. Explain your answer.

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(2)
(Total 7 marks)

Q5.A student investigated the effect of chewing on the digestion of starch in cooked wheat. He devised a laboratory model of starch digestion in the human gut. This is the method he used.

1. Volunteers chewed cooked wheat for a set time. The wheat had been cooked in boiling water.
2. This chewed wheat was mixed with water, hydrochloric acid and a protein-digesting enzyme and left at 37 °C for 30 minutes.
3. A buffer was then added to bring the pH to 6.0 and pancreatic amylase was added. This mixture was then left at 37 °C for 120 minutes.
4. Samples of the mixture were removed at 0, 10, 20, 40, 60 and 120 minutes, and the concentration of reducing sugar in each sample was measured.
5. Control experiments were carried out using cooked wheat that had been chopped up in a blender, not chewed.

- (a) What reducing sugar, or sugars, would you expect to be produced during chewing? Give a reason for your answer.

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

- (b) In this model of digestion in the human gut, what other enzyme is required for the complete digestion of starch?

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

- (c) What was the purpose of step 2, in which samples were mixed with water, hydrochloric acid and pepsin?

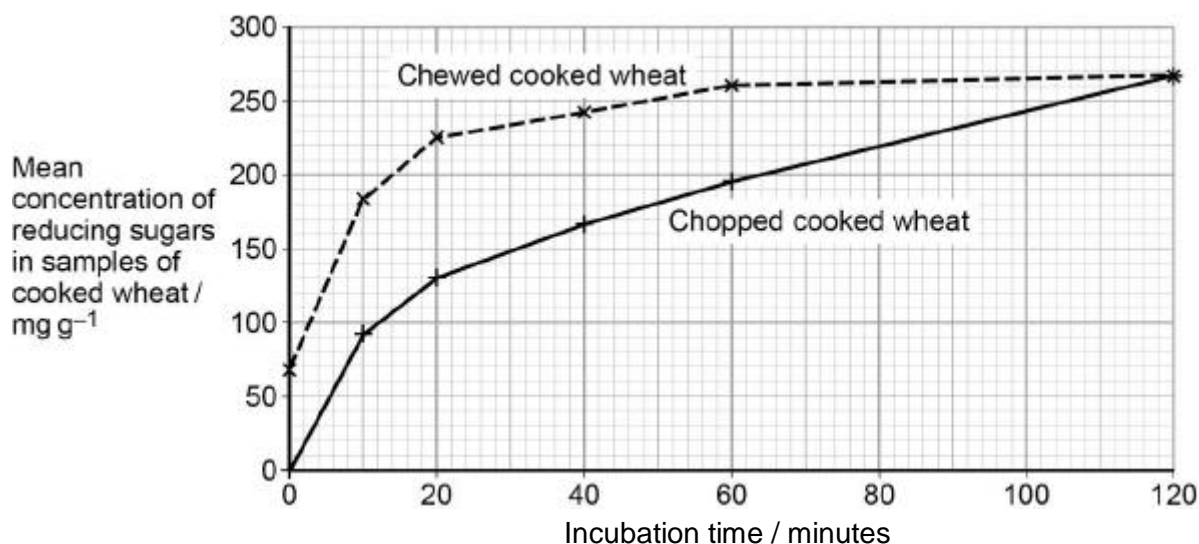
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..... **(1)**

(d) In the control experiments, cooked wheat was chopped up to copy the effect of chewing. Suggest a more appropriate control experiment. Explain your suggestion.

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.....(2)

(e) The figure below shows the student's results.



Explain what these results suggest about the effect of chewing on the digestion of starch in wheat.

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(3)
(Total 9 marks)

Q6.(a) Describe how you would test a sample of food for the presence of starch.

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.....(2)

(b) The concentration of glucose in the blood rises after eating a meal containing carbohydrates. The rise is slower if the carbohydrate is starch rather than sucrose. Explain why.

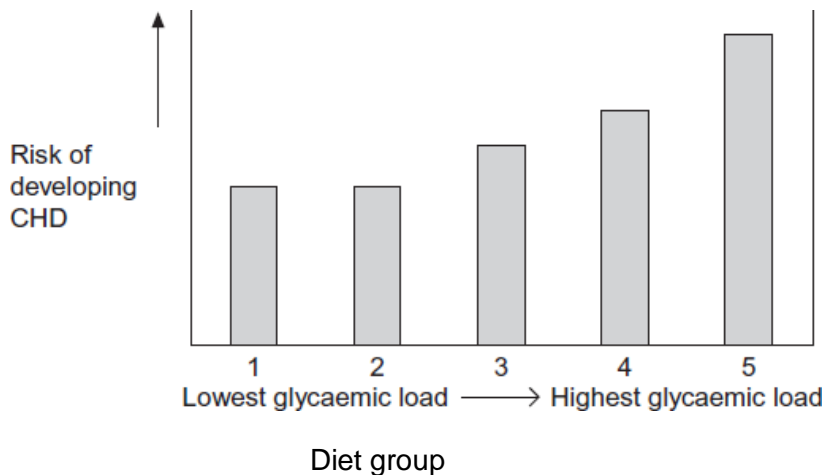
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The glycaemic load (GL) of a diet is a measure of how much digestible carbohydrate it contains. The higher the GL of a diet the more quickly it raises the blood glucose concentration after a meal. A diet with a high GL also increases the concentration of harmful lipids in the blood.

Scientists investigated the relationship between diets with different glycaemic loads and the risk of developing coronary heart disease (CHD) in women.

The scientists determined the glycaemic loads of the diets of a large number of women. They then divided the women into 5 groups. Group 1 had diets with the lowest glycaemic load and group 5 had diets with the highest glycaemic load. The scientists determined the risk of developing CHD in each group.

The graph shows their results.



(b) Describe how proteins are digested in the human gut.

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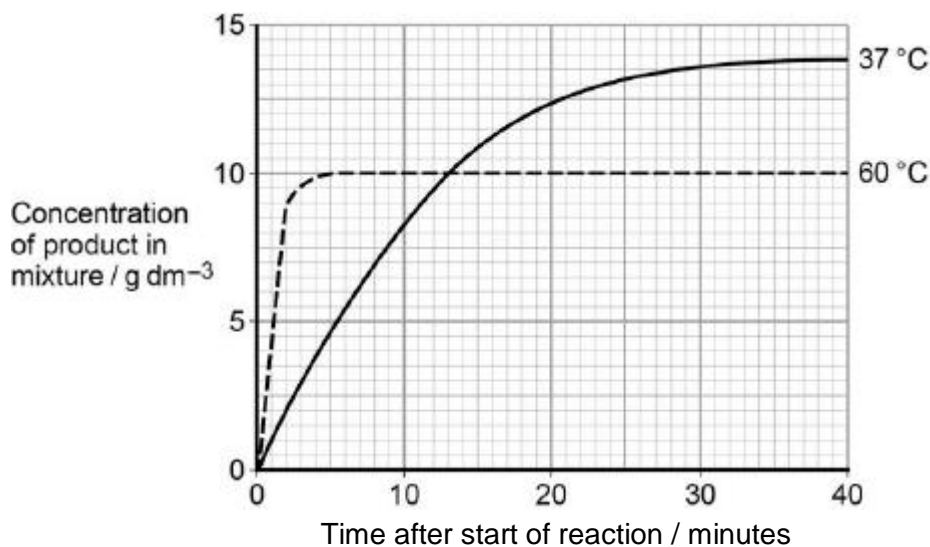
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(4)
(Total 15 marks)

Q8.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 concentration of substrate.

The following graph shows his results.



(a) Give **two** other factors the technician would have controlled.

1

2(1)

- (b) Draw a tangent on each curve to find the initial rates of reaction.
Use these values to calculate the ratio of the initial rates of reaction at 60 °C : 37 °C.
Show your working.

Ratio = :1

(2)

- (c) Explain the difference in the initial rate of reaction at 60 °C and 37 °C.

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(2)

- (d) Explain the difference in the rates of reaction at 60 °C and 37 °C between 20 and 40 minutes.

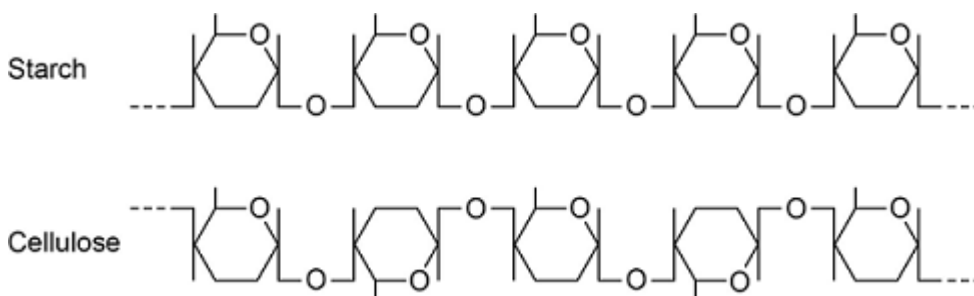
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(4)

(Total 9 marks)

Q9. Starch and cellulose are two important plant polysaccharides.

The following diagram shows part of a starch molecule and part of a cellulose molecule.



- (a) Explain the difference in the structure of the starch molecule and the cellulose molecule shown in the diagram above.

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(2)

- (b) Starch molecules and cellulose molecules have different functions in plant cells. Each molecule is adapted for its function.

Explain **one** way in which starch molecules are adapted for their function in plant cells.

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(2)

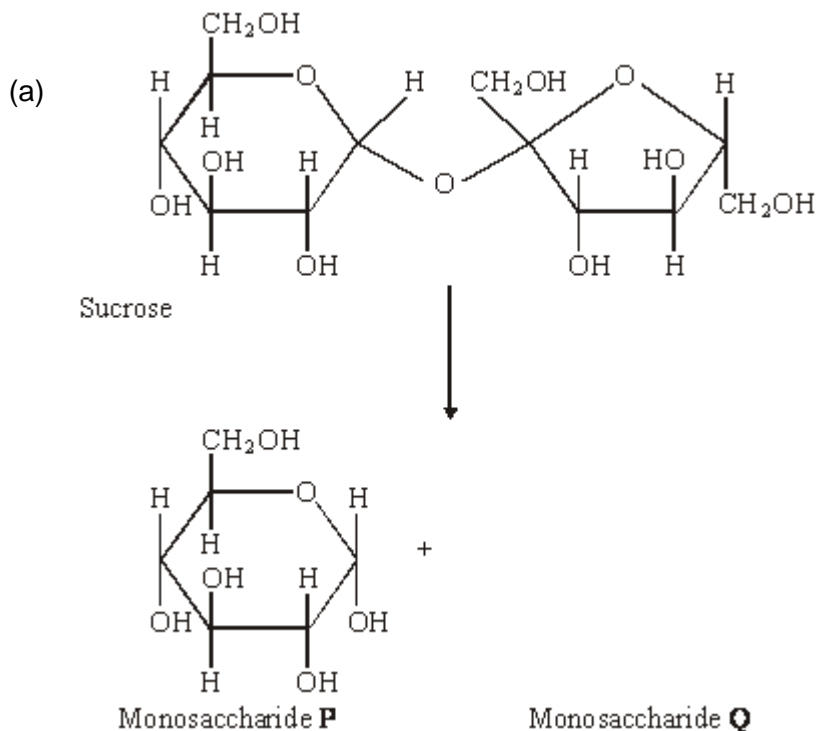
- (c) Explain how cellulose molecules are adapted for their function in plant cells.

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(3)

(Total 7 marks)

Q10. Sucrose is a disaccharide. It is formed from two monosaccharides **P** and **Q**. The diagram shows the structure of molecules of sucrose and monosaccharide **P**.



(i) Name monosaccharide **Q**.

.....(1)

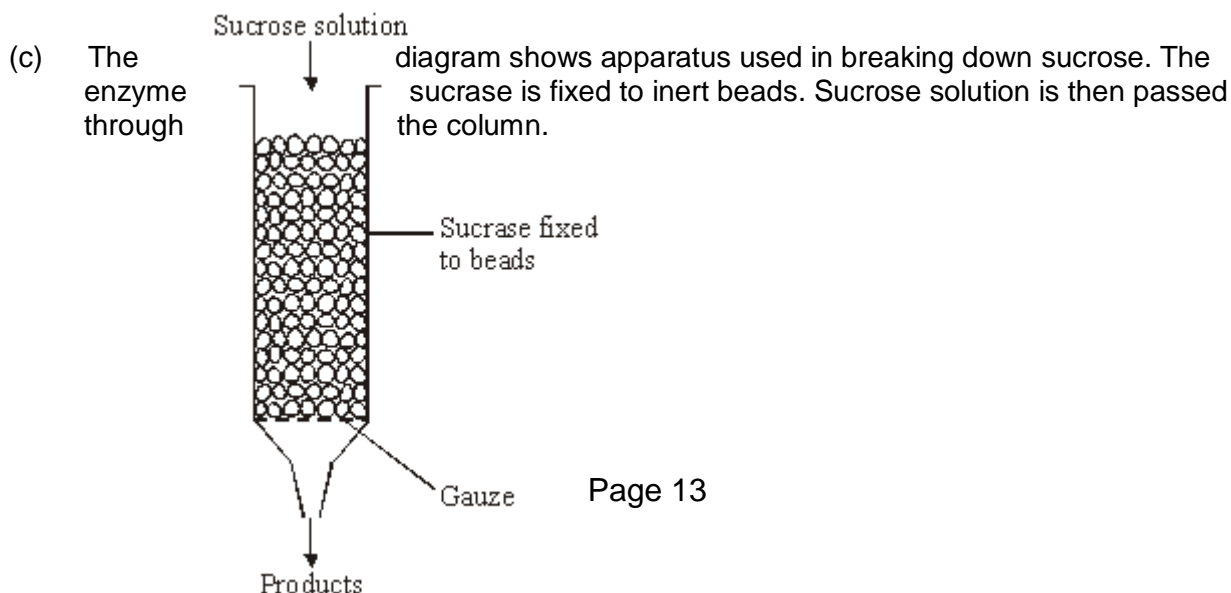
(ii) Draw the structure of a molecule of monosaccharide **Q** in the space above.

(1)

(b) The enzyme sucrase catalyses the breakdown of sucrose into monosaccharides. What type of reaction is this breakdown?

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(1)



Describe a biochemical test to find out if the solution collected from the apparatus contains

(i) the products;

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.....(2)

(ii) the enzyme.

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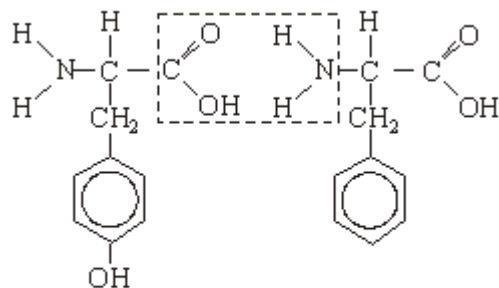
(2)
(Total 7 marks)

Q11. (a) Describe how you would use a biochemical test to show that a solution contained protein.

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(2)

The diagram shows the structure of two amino acid molecules, tyrosine and phenylalanine.



Tyrosine

Phenylalanine

(b) Copy from the diagram the R group in the phenylalanine molecule.

(1)

- (c) (i) In the space below, draw the chemical bond formed when these two amino acids are joined by condensation. You need only draw the parts of the molecules shown in the box.

(2)

- (ii) Name this bond.

.....(1)

- (d) Tyrosine can be made in the body by hydroxylating phenylalanine. Use the diagram to explain the meaning of *hydroxylating*.

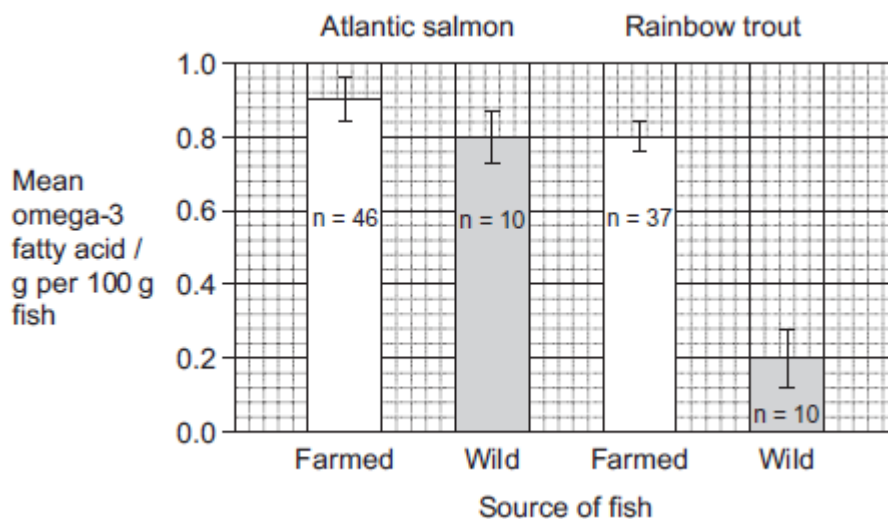
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(1)

(Total 7 marks)

Q12. Omega-3 fatty acids are also found in fish. Scientists investigated the concentration of omega-3 fatty acids from wild-caught and farmed fish. Their results are shown in the figure below.



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The bars show standard deviation; n is the sample size.

It is **not** possible to conclude from the data that the concentration of omega-3 fatty acids in the farmed salmon is higher than that of the wild salmon. Use the data to explain why.

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(Total 2 marks)

Q13.(a) Some seeds contain lipids. Describe how you could use the emulsion test to show that a seed contains lipids.

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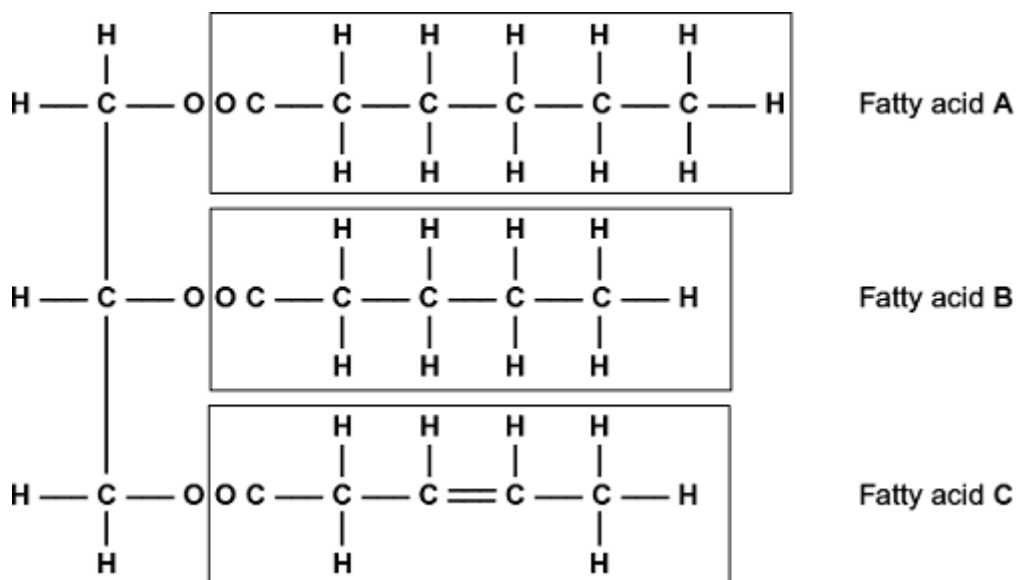
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(3)

(b) A triglyceride is one type of lipid. The diagram shows the structure of a triglyceride molecule.



- (i) A triglyceride molecule is formed by condensation. From how many molecules is this triglyceride formed?

(1)

- (ii) The structure of a phospholipid molecule is different from that of a triglyceride. Describe how a phospholipid is different.

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(2)

- (iii) Use the diagram to explain what is meant by an unsaturated fatty acid.

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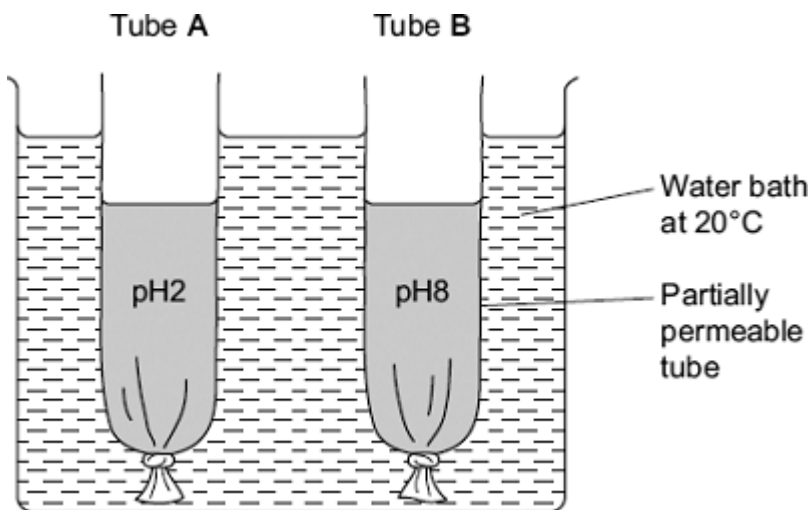
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(2)

(Total 8 marks)

amylase.
She set up the apparatus shown in the diagram.



The tubes were made from Visking tubing. Visking tubing is partially permeable. She added an equal volume of amylase solution and starch to each tube.

- She added a buffer solution at pH2 to tube **A**.
- She added an equal volume of buffer solution at pH8 to tube **B**.

After 30 minutes, she measured the height of the solutions in both tubes. She then tested the solutions in tubes **A** and **B** for the presence of reducing sugars.

Describe how the student would show that reducing sugars were present in a solution.

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..... (3)

(b) After 30 minutes, the solution in tube **B** was higher than the solution in tube **A**.

(i) Explain why the solution in tube **B** was higher.

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- (ii) The student concluded from her investigation that the optimum pH of amylase was pH8. Is this conclusion valid? Explain your answer

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(1)
(Total 7 marks)

Q15. Doctors compared two tests for lactase deficiency.

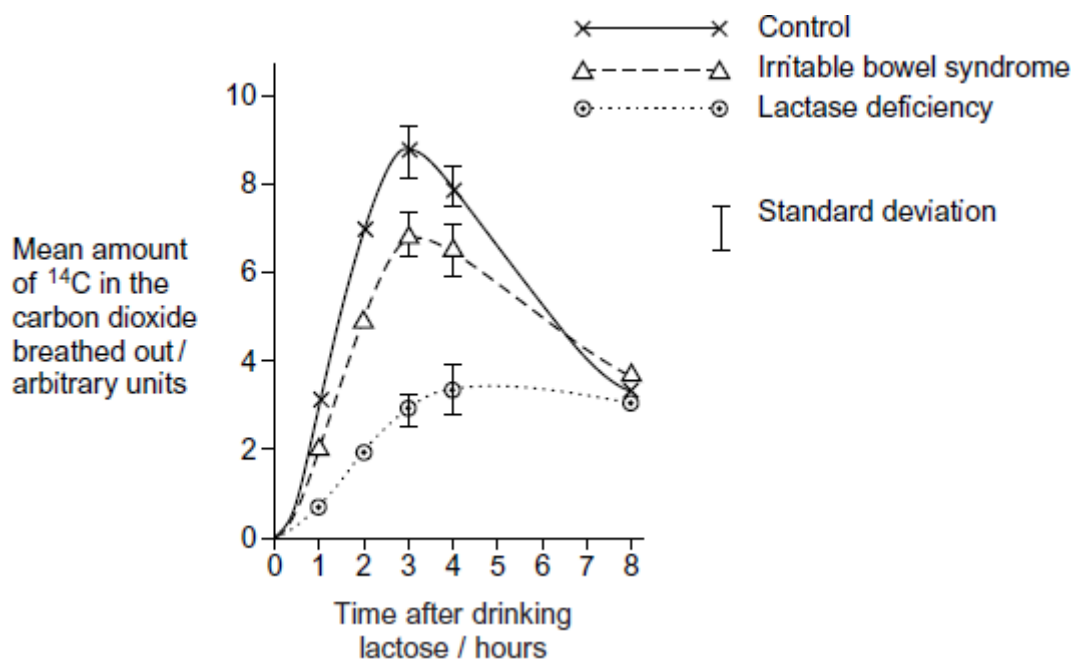
Doctors investigated three groups of people. The people in all three groups were not allowed to eat or drink for 8 hours before the test. They each then drank a solution containing 50 g of lactose made with a radioactive form of carbon called ^{14}C .

- Group **A** were the control group
- Group **B** were lactase deficient
- Group **C** had irritable bowel syndrome (IBS)

Both lactase deficiency and irritable bowel syndrome have similar symptoms.

The carbon dioxide breath test

In this test the doctors measured the amount of ^{14}C in the carbon dioxide breathed out. The doctors took measurements at intervals for 8 hours after each volunteer had drunk the lactose solution. The following figure shows the mean results for each group.



- (a) Describe the common trend shown by **all** the curves in the figure.

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(1)

- (b) Explain why the doctors stopped measuring the amounts of ^{14}C in the carbon dioxide breathed out after 8 hours.

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(2)

- (c) Carbon dioxide in the breath contained the radioactive form of carbon, ^{14}C . Explain how ^{14}C in carbon dioxide came from ^{14}C in glucose in the blood.

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(2)

- (d) The doctors concluded that measuring the amount of ^{14}C in the carbon dioxide in the breath after 3 hours was a better way of diagnosing lactase deficiency than the lactose tolerance test. Do you agree with the doctors' conclusion? Give the reasons for your answer.

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(2)

(Total 7 marks)

Q16. Read the following passage.

Aspirin is a very useful drug. One of its uses is to reduce fever and inflammation. Aspirin does this by preventing cells from producing substances called prostaglandins. Prostaglandins are produced by an enzyme-controlled pathway. Aspirin works by inhibiting one of the enzymes in this pathway. Aspirin attaches permanently to a chemical group on one of the monomers that make up the active site of this enzyme.

5

The enzyme that is involved in the pathway leading to the production of prostaglandins is also involved in the pathway leading to the production of thromboxane. This is a substance that promotes blood clotting. A small daily dose of aspirin may reduce the risk of myocardial infarction (heart attack).

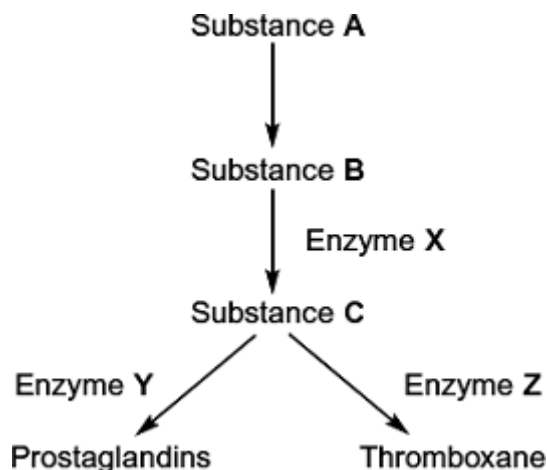
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Use information from the passage and your own knowledge to answer the following questions.

- (a) Name the monomers that make up the active site of the enzyme (lines 6 – 7).

.....(1)

- (b) The diagram shows the pathways by which prostaglandins and thromboxane are formed.



- (i) Aspirin only affects one of the enzymes in this pathway. Use information in lines 5 - 7 to explain why aspirin does **not** affect the other enzymes.

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.....(2)

- (ii) Which enzyme, **X**, **Y** or **Z**, is inhibited by aspirin? Explain the evidence from the passage that supports your answer.

Enzyme

Explanation

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.....(2)

- (c) Aspirin is an enzyme inhibitor. Explain how aspirin prevents substrate molecules being converted to product molecules.

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.....(2)

Q17. 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	
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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)

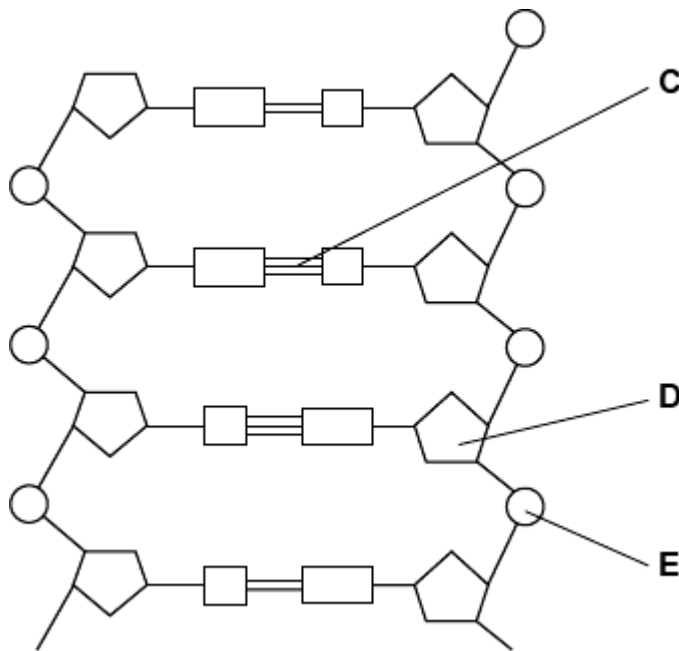
- (iii) Calculate the percentage difference in oxygen use for 'rat liver' (**Trial E**) between a cyanide concentration of 10^{-4} and 10^{-2} mol dm⁻³.

Percentage difference =

(2)

(Total 11 marks)

Q18.The diagram shows part of a DNA molecule.



(a) (i) DNA is a polymer. What is the evidence from the diagram that DNA is a polymer?

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(1)

(ii) Name the parts of the diagram labelled **C**, **D** and **E**.

Part **C**
 Part **D**
 Part **E**

(3)

(iii) In a piece of DNA, 34% of the bases were thymine.

Complete the table to show the names and percentages of the other bases.

Name of base	Percentage
Thymine	34
	34

(2)

- (b) A polypeptide has 51 amino acids in its primary structure.
- (i) What is the minimum number of DNA bases required to code for the amino acids in this polypeptide?

(1)

- (ii) The gene for this polypeptide contains more than this number of bases.

Explain why

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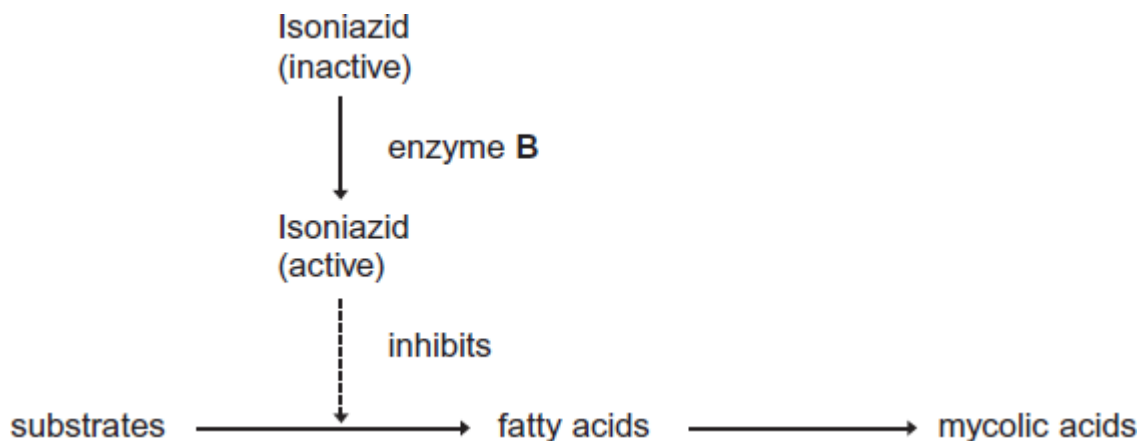
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(1)

(Total 8 marks)

Q19. Mycolic acids are substances that form part of the cell wall of the bacterium that causes tuberculosis. Mycolic acids are made from fatty acids. Isoniazid is an antibiotic that is used to treat tuberculosis. The diagram shows how this antibiotic inhibits the production of mycolic acids in this bacterium.



- (a) Treatment with isoniazid leads to the osmotic lysis of this bacterium. Use information in the diagram to suggest how.

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(2)

- (b) Human cells also produce fatty acids. Isoniazid does not affect the production of these fatty acids.

Use information in the diagram to suggest **one** reason why isoniazid does **not** affect the production of fatty acids in human cells.

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(1)

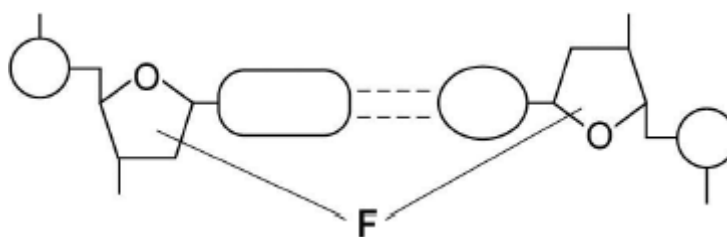
- (c) A mutation in the gene coding for enzyme **B** could lead to the production of a non-functional enzyme. Explain how.

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(3)
 (Total 6 marks)

Q20.Figure 1 shows one base pair of a DNA molecule.

Figure 1



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

.....(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?

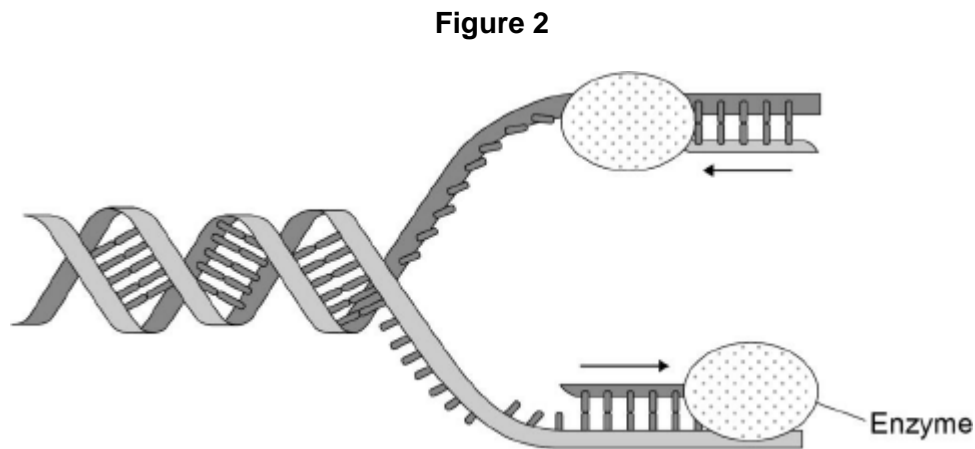
Percentage of thymine

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.



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

.....(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)

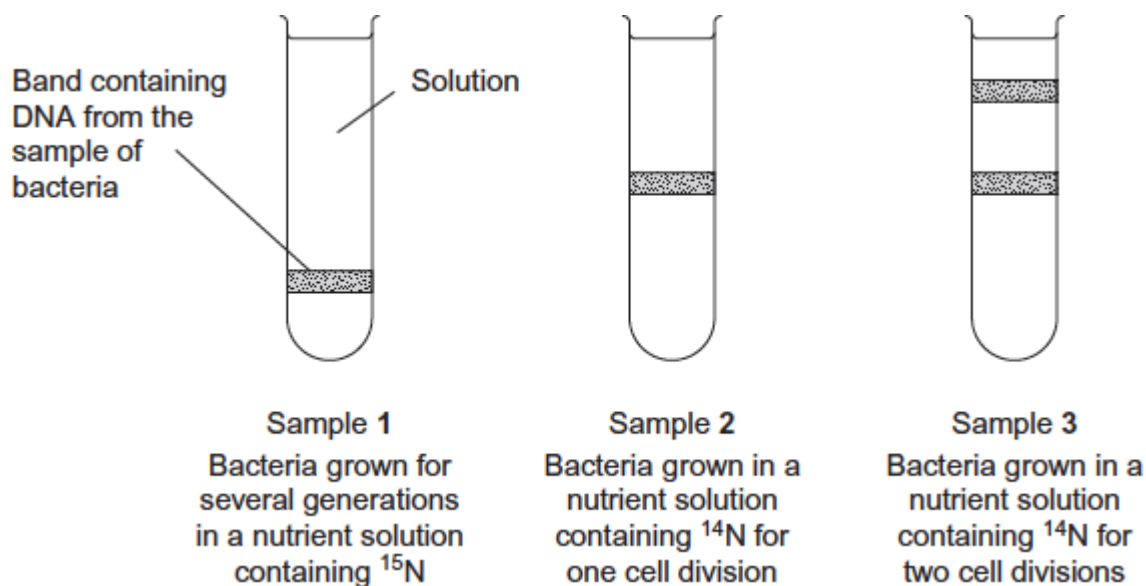
Q21.(a) DNA helicase is important in DNA replication. Explain why.

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.....(2)




Scientists investigating DNA replication grew bacteria for several generations in a nutrient solution containing a heavy form of nitrogen (^{15}N). They obtained DNA from a sample of these bacteria.

The scientists then transferred the bacteria to a nutrient solution containing a light form of nitrogen (^{14}N). The bacteria were allowed to grow and divide twice. After each division, DNA was obtained from a sample of bacteria.

The DNA from each sample of bacteria was suspended in a solution in separate tubes. These were spun in a centrifuge at the same speed and for the same time. The diagram shows the scientists' results.

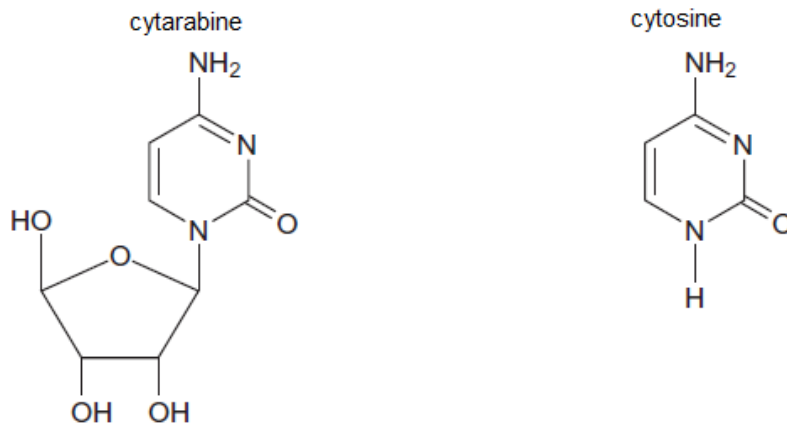


- (b) The table shows the types of DNA molecule that could be present in samples 1 to 3. Use your knowledge of semi-conservative replication to complete the table with a tick if the DNA molecule is present in the sample.

Sample	Type(s) of DNA molecule present in each sample		
	$^{15}\text{N} \ ^{15}\text{N}$ 	$^{15}\text{N} \ ^{14}\text{N}$ 	$^{14}\text{N} \ ^{14}\text{N}$ 
1			
2			
3			

(3)

- (c) Cytarabine is a drug used to treat certain cancers. It prevents DNA replication. The diagram shows the structures of cytarabine and the DNA base cytosine.



- (i) Use information in the diagram to suggest how cytarabine prevents DNA replication.

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.....(2)

- (ii) Cytarabine has a greater effect on cancer cells than on healthy cells. Explain why.

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.....(1)