3(a) **Define catalyst as a substance that speeds up a chemical reaction and is not changed by the reaction**

Properties Enzyme

- Proteins that act as Biological catalyst/ speeds up reaction.
- Enzymes are specific to their substrate
- Work best in a narrow range of pH and Temperature called Optimum
- They are not altered at the end of a chemical reactions
- Catalyses reversible reactions

Question 1

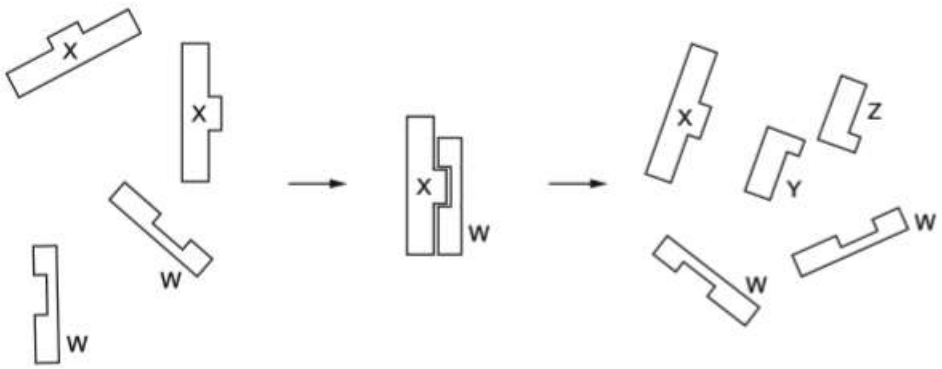
Which are properties of enzymes?

	reusable many times	specific in their action	unaffected by temperature
A	✓	✓	✗
B	✗	✗	✗
C	✓	✗	✓
D	✗	✓	✓

key
✓ = yes
✗ = no

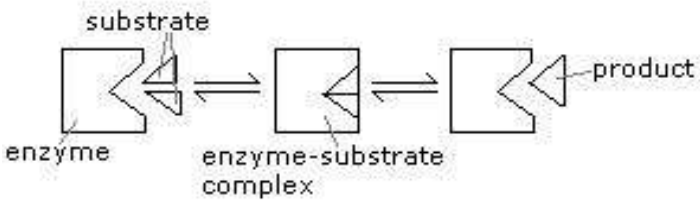
Question 2

The diagram illustrates the 'lock and key' hypothesis of enzyme action.



What are the enzyme, product and substrate in this reaction?

	enzyme	product	substrate
A	W	X	Y and Z
B	W	Y and Z	X
C	X	W	Y and Z
D	X	Y and Z	W

3(b)	**Define enzymes as proteins that function as biological catalysts**
	Question 21 Which chemical test shows the presence of an enzyme in a biological washing powder? **A** Benedict's **B** biuret **C** ethanol emulsion **D** iodine solution
3(c)	Explain enzyme action in terms of the 'lock and key' hypothesis
	Enzyme Action explained by Lock and Key model Enzyme has an active site of specific shape. Only a substrate of complementary shape to the active site can bind into the active site to make a temporary ES-Complexes (enzyme substrate complex). The substrate is a key and enzyme is a lock according to the lock and key hypothesis. The enzyme changes the substrate to a product. **Why does a product readily come out of the active site?** The product does not have the shape complementary to the active site so it can not remain bound in the active site. 

ZAFAR SULEHRI phone; 03218800091 eMail; zafar@solehri.com web; solehri.com

2 Fig. 2.1 shows, in order, four stages in which an enzyme-controlled chemical reaction may occur.

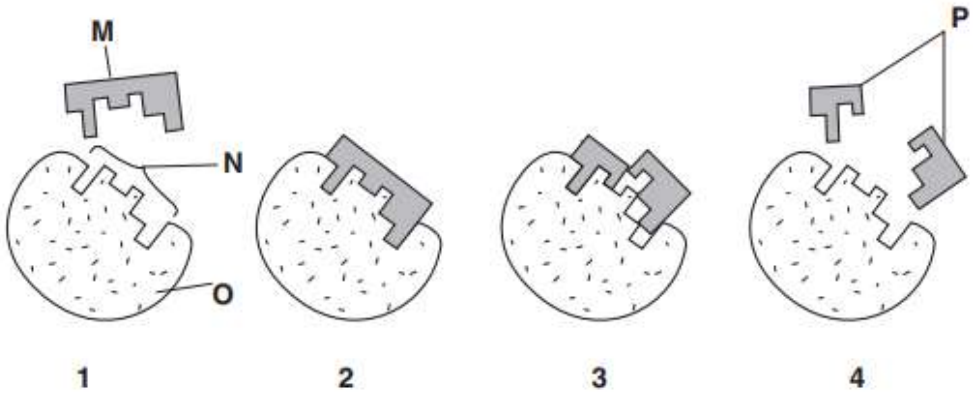


Fig. 2.1

(a) Identify **M**, **N**, **O** and **P**.

M .....

N .....

O .....

P ..... [4]

(b) By referring to Fig. 2.1, explain why only a small amount of enzyme is needed to catalyse a reaction involving many molecules.

.....

..... [1]

(c) **(i)** Explain how a rise in temperature may increase the rate of an enzyme-controlled reaction.

.....

.....

(ii) At high temperatures, enzymes are denatured and can no longer act as catalysts.

By using the letters **M** and **N** from Fig. 2.1, suggest what happens when an enzyme is denatured.

.....

.....

.....

[4]

[Total : 9]

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Question

Which property of enzymes is explained by the lock and key hypothesis?

A All enzymes are proteins.

B Enzymes are inactive at very low temperatures.

C Human enzymes are most active just below 40 °C.

D Most enzymes can only catalyse one reaction.

Question 22

Enzyme action can be explained by the lock and key hypothesis.

Where is the active site and which acts as the lock or key?

	active site	lock/key
A	on the enzyme	substrate acts as a key
B	on the enzyme	substrate acts as a lock
C	on the substrate	enzyme acts as a key
D	on the substrate	enzyme acts as a lock

3(d) **Investigate and describe the effects of temperature and pH on enzyme activity**

Enzyme Activity

Effect of temperature on the rate of an enzyme action

Investigate

- Take three test tubes
- Label them A,B and C
- Add same volume of Hydrogen peroxide in each
- Maintain the pH same
- Place them at different temperatures
  - Tube A at room temperature
  - Tube B in an Ice cold water
  - Tube C in boiling water
- Add same volume of catalase into each test tube
- Record the volume of oxygen released
- Repeat the experiment

Describe the effect of temperature on the enzyme activity

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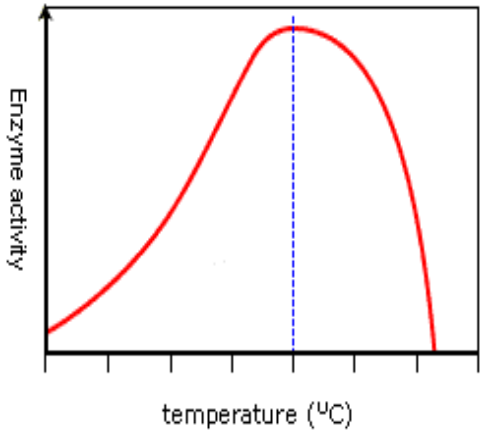

- Increase of temperature increases rate of enzyme action.
- At optimum temperature the rate is maximum
- Further increase of temperature decrease the rate of an enzyme action.

Explain

- Increasing temperature increase kinetic energy
- More enzyme substrate collisions.
- More ES complexes formed
- More products formed
- At higher temperature above optimum
- Enzyme denature
- Shape of active site changes
- Substrate does not fit into the active site
- So it is forming less product

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(a) Fig. 5.1 shows the effect of temperature on the activity of enzyme **E**.

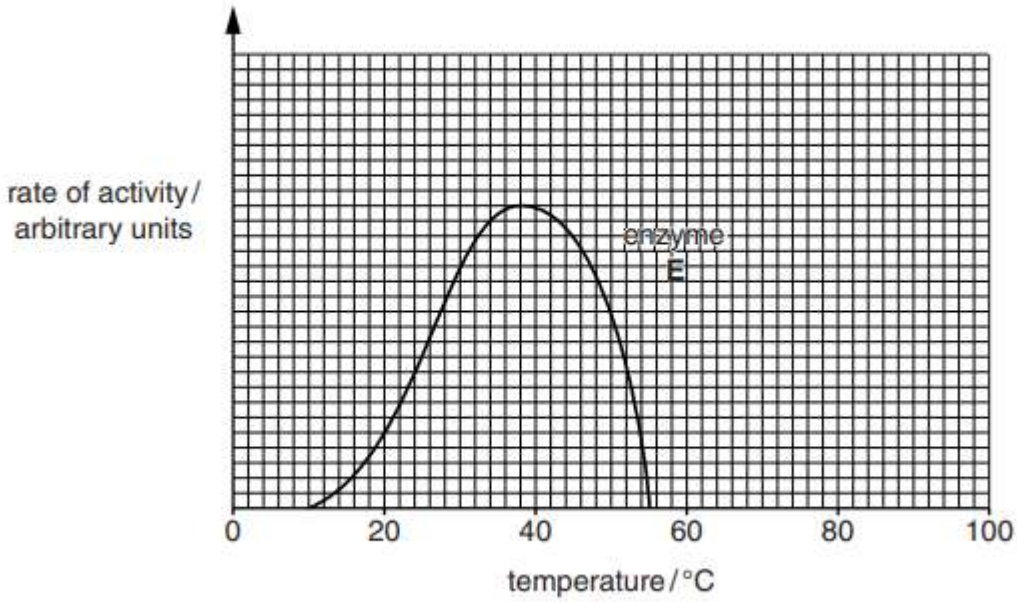

Fig. 5.1

(i) State the optimum temperature for enzyme **E**. ..... [1]

(ii) Suggest a possible identity for enzyme **E**, where it is found, and its function.

identity of enzyme **E** .....

where it is found .....

function .....

[3]

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(b) Fig. 5.2 shows the effect of temperature on the activity of another enzyme, **F**.

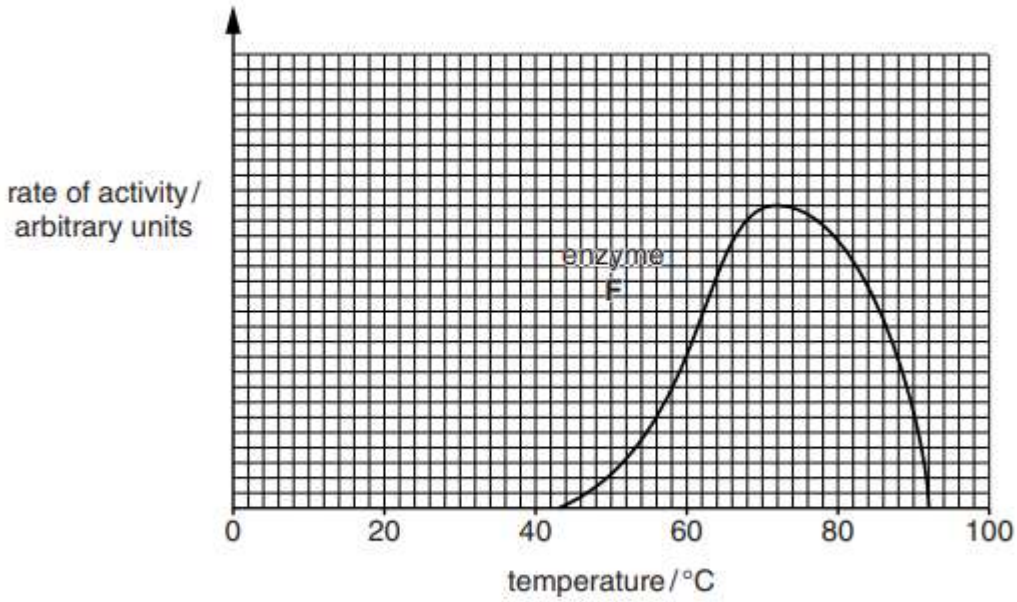

Fig. 5.2

State and explain what would happen to the activity of enzyme **E** at the optimum temperature for enzyme **F**.

.....

.....

.....

.....

.....

.....

..... [5]

[Total: 9]

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2 Fig. 2.1 shows details of an experiment in which a washing powder was used to wash three similar shirts, **H**, **I** and **J**, that had identical fat stains. The shirts were washed at three different temperatures, 15 °C, 35 °C and 65 °C. The washing powder contained enzymes similar to those found in the human duodenum.

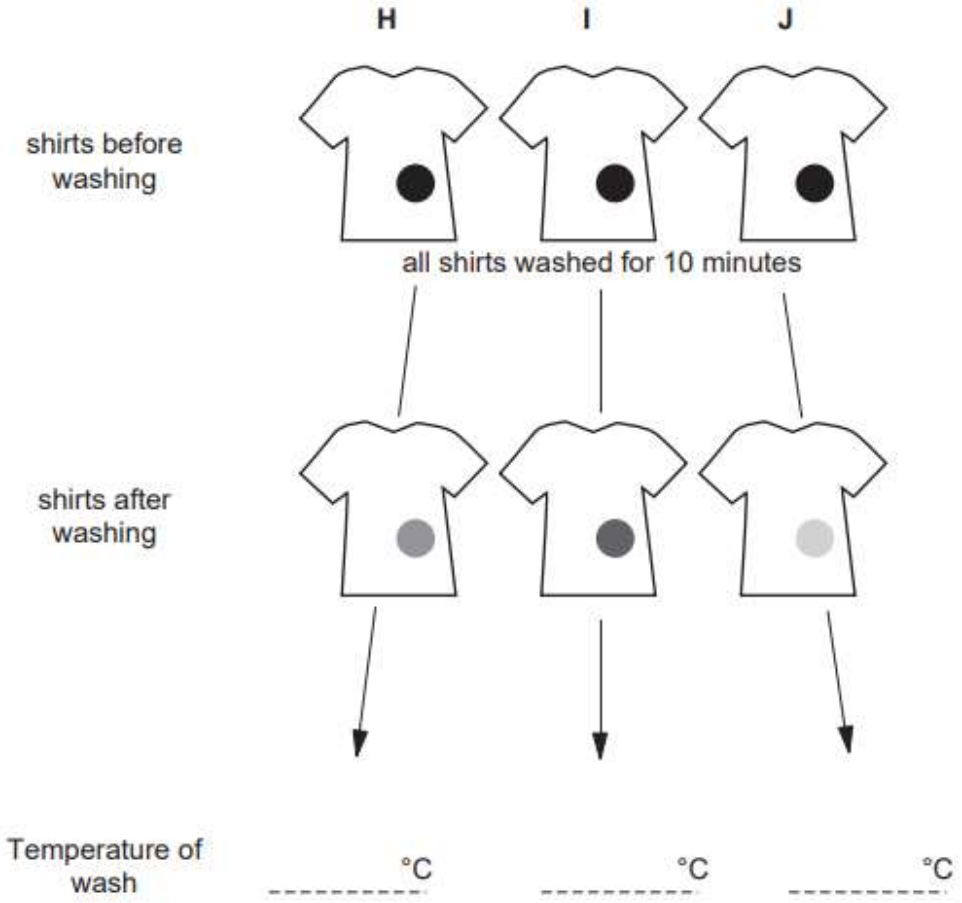

Fig. 2.1

(a) (i) Complete Fig. 2.1 to show the temperature at which each shirt was washed. [2]

(ii) Explain your answer for each of the shirts **I** and **J**.

shirt **I**

.....

.....

.....

shirt **J**

.....

.....

..... [2]

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(b) Suggest a change to the procedure that might have resulted in the complete removal of the stain from shirt **J**.

..... [1]

[Total: 5]

Effect of pH on the rate of an enzyme action
Investigate

- Take three test tubes
- Label them A,B and C
- Add same volume of Hydrogen peroxide in each
- Maintain the temperature same
- Place an acid or alkali to vary the pH
  Tube A - low pH
  Tube B - neutral
  Tube C - high pH
- Add same volume of catalase into each test tube
- Record the volume of oxygen released
- Repeat the experiment

Describe the effect of change of pH on the rate of an enzyme action
Enzymes work best in a narrow range of pH only.

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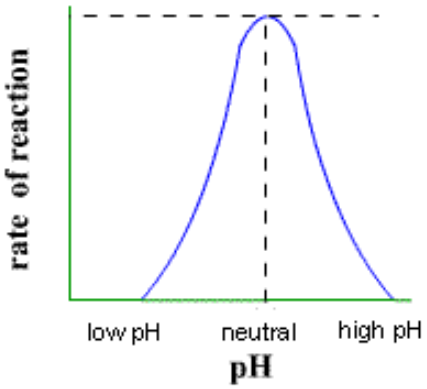


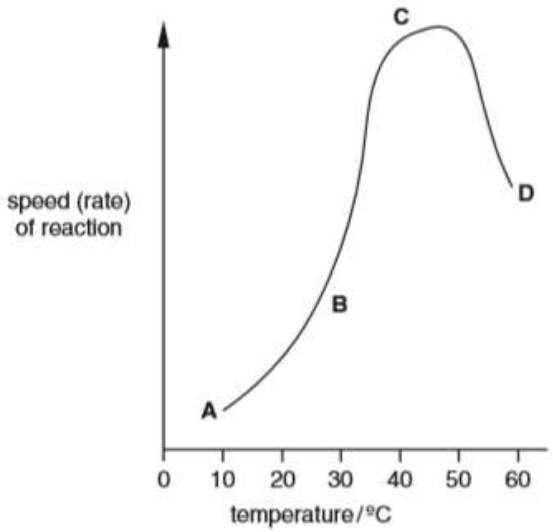
Explain the effect of pH on the rate of an enzyme action

Change of pH changes the shape of enzyme molecule as they are made of proteins. As pH changes the shape of an active site so a substrate can no longer bind into it and converted into products, it slows the rate of an enzyme action.

Question 23

The graph shows the effect of temperature on a chemical reaction which is controlled by enzymes.

At which point are most product molecules being released?



Question 24

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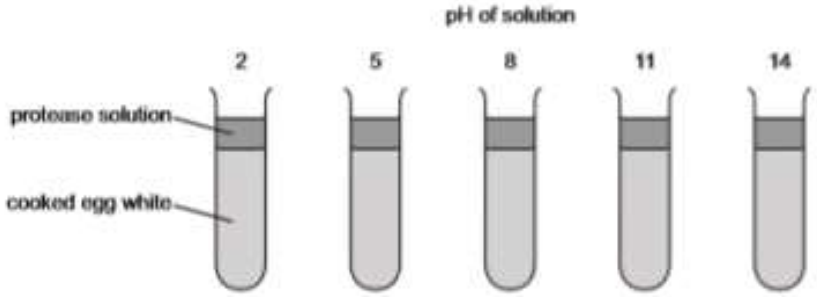
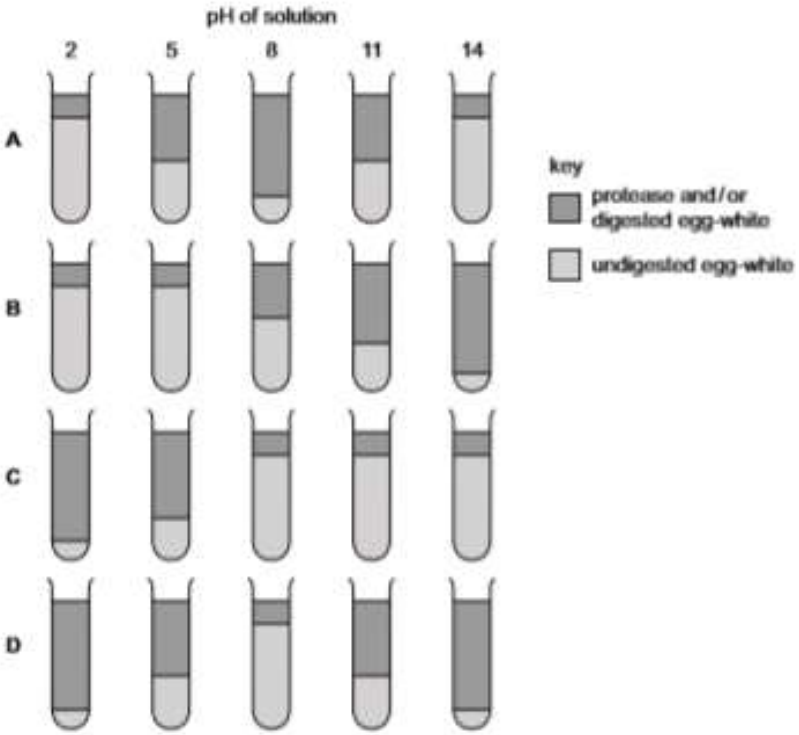
) Five tubes containing cooked egg-white are set up as shown. Protease solutions of different pH are added to each tube.



Which diagram shows the results of this experiment for a protease from the stomach?



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