CH5 - ENZYMES

1. 2017 Summer Zone 3 Paper 4 Question 2

Quinoa, *Chenopodium quinoa*, is a dicotyledonous plant that produces seeds that resemble those of cereals, such as rice.

(a) State one feature shown by **all** dicotyledonous plants.

.....

.....[1]

(b) During seed development, amino acids are converted into storage proteins and proteases.

Protease molecules become active when the seed absorbs water at the start of germination.

Fig. 2.1 shows the formation of a storage protein and a protease in developing quinoa seeds and the action of protease on the storage protein during germination.

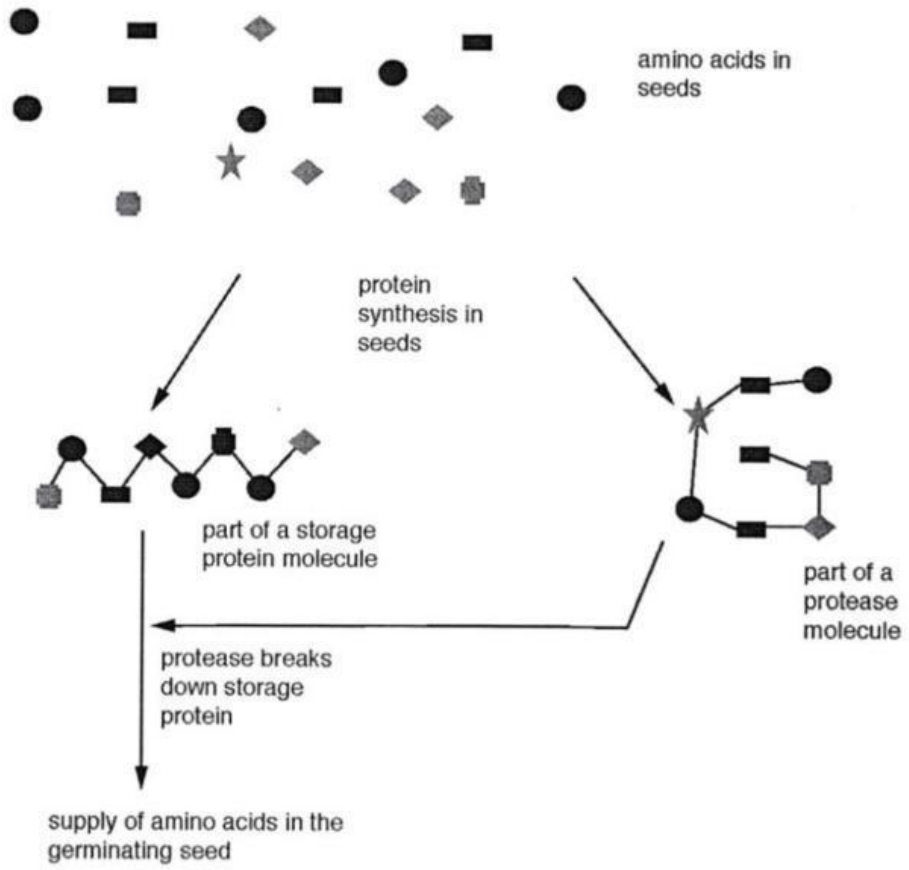

Fig. 2.1

(i) During seed development in quinoa some genes are 'switched on'.

Define the term *gene*.

Code for a protein, length of DNA

- A gene is a _____, that _____

[2]

(ii) Describe the differences in structure between the storage protein and the protease shown in Fig. 2.1.

- They have _____.
- The two molecules are _____ and have _____

Keyword: different sequences of amino acids, different shapes, folded differently

[2]

(c) State the roles of mRNA and ribosomes in protein synthesis.

mRNA It **carries a** _____ from the _____ to the _____

ribosome This is the _____ where _____ **are** _____ into proteins.

[2]

Keyword: ribosome, nucleus， copy of the gene
site of protein synthesis, assembled, amino acids,

(d) Researchers investigated the effect of pH on the activity of the protease in quinoa seeds.

The results are shown in Fig. 2.2.

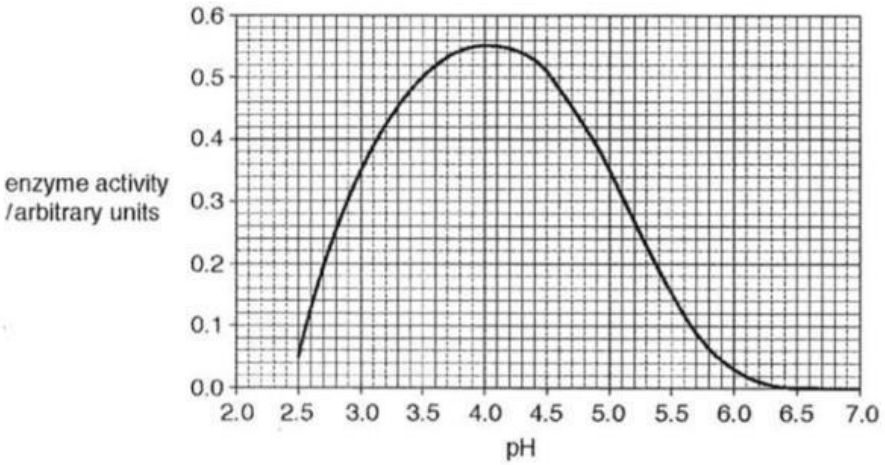

Fig. 2.2

(i) State **two** factors other than pH that would affect enzyme activity.

1 .....

2 .....

[2]

(ii) Describe the effect of increasing pH on the activity of the protease in quinoa seeds.

.....

As the pH level changes, the rate of enzyme activity initially **(1)**_____ and then **(2)**_____. The enzyme reaches its **(3)**_____ peak at pH **(4)**_____, where the activity level is **(5)**_____ arbitrary units (au). The shape of the activity curve is **(6)**_____, showing a consistent rate of change on either side of the peak. There is no detectable enzyme activity beyond pH **(7)**_____, indicating that the enzyme has likely **(8)**_____.

.....

Keyword:
0.55
4.0
6.5
Denatured
Decreases
Increases
Optimum
Symmetrical

.....

.....

.....

.....[3]

(iii) Explain the activity of protease at pH 4.0 **and** at pH 7.0.

- pH 4.0 is the **(1)** _____ pH for this enzyme.
- At this pH, the shape of the **(2)** _____ is **(3)** _____ to the substrate, allowing **(4)** _____ to form.
- At pH 7.0, the enzyme is **(5)** _____.
- The **(6)** _____ has changed shape, so the substrate no longer **(7)** _____.

Answer Key

1. Optimum
2. Active site
3. Complementary
4. Enzyme-substrate complexes
5. Denatured
6. Active site
7. Fits

2. 2018 Summer Zone 1 Paper 4 Question 1

(a) The reactions of chemical digestion are catalysed by enzymes.

Fig. 1.1 shows the stages of an enzyme-catalysed reaction.

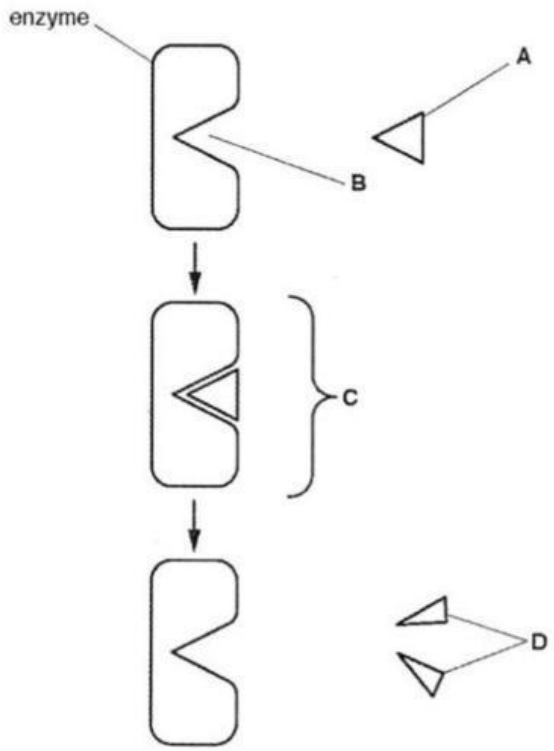

Fig. 1.1

State the names of **A** to **D** in Fig. 1.1.

A .....

B .....

C .....

D .....

[4]

Answer Key

1. **Denature**
2. **Active site**
3. **Kinetic**
4. **Fewer**
5. **Slower**
6. **Optimum**

(b) The digestive systems of young mammals are not fully developed.

Enzymes such as amylase, maltase and protease are often added to baby food to aid chemical digestion.

(i) Complete Table 6.1 by stating the substrate and product(s) for each enzyme reaction.

Table 6.1

enzyme	substrate	product(s)
amylase		
maltase		
protease		

[3]

(ii) Suggest why the temperature of baby food must be controlled when the enzymes are added.

- High temperatures **(1)** _____ enzymes, which changes the shape of the **(2)** _____.
- At low temperatures, molecules have low **(3)** _____ energy. This leads to **(4)** _____ collisions and **(5)** _____ reactions.
- Enzymes work most efficiently at their **(6)** _____temperature.

.....

.....

..[2]

(iii) State **one** other condition that must also be controlled to optimise enzyme activity.

.....[1]

4. 2019 Summer Zone 3 Paper 4 Question 6

Fig. 6.1 is a photomicrograph of part of a cell from the pancreas that produces enzymes that are released into the small intestine.

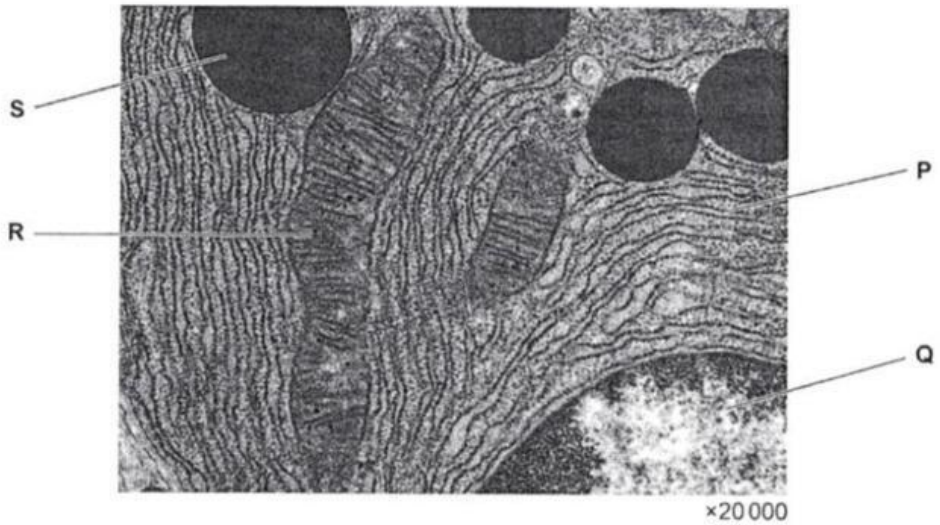

Fig. 6.1

(a) (i) Structure **Q** is part of the nucleus of the cell.

State **one** function of a nucleus.

.....

.....

..... [1]

(ii) State the names of the structures labelled **P** and **R** in Fig. 6.1.

P .....

R .....

[2]

(b) The structure labelled **S** transports enzymes to the cell membrane **for** release into the pancreatic duct. These structures contain molecules of amylase, trypsin **and** lipase.

Complete the sentences with the most appropriate words.

Enzymes are made of protein and act as ..... **because** they increase the rate of chemical reactions, but are not changed in those reactions. **Amylase** speeds up the digestion of ..... to ..... Trypsin continues the chemical digestion of protein begun by the enzyme ..... in the stomach.

The optimum pH for pancreatic enzymes is greater than pH **7**. Bile is produced by the ..... and enters the small **intestine**, where it ..... stomach acid to provide the appropriate **pH**. Bile also breaks down fat by ..... to increase the surface area **for** the action of lipase.

[7]

5. 2020 Summer Zone 1 Paper 4 Question 2

Biological washing powders contain enzymes that break down food stains.

(a) Complete Table 2.1 by naming the enzymes that break down three substances in food stains and by stating the product or products.

Table 2.1

substance	enzyme	product(s)
starch		
fat		
protein		

[3]

Some students compared how effective biological and non-biological washing powders are at removing stains at temperatures between 10 °C and 60 °C.

- Pieces of stained cloth were washed using two different washing powders.
- The degree of stain removal was measured by using a light meter to record the percentage of light reflected from the cloth.
- A light meter gave a value of 100% when the cloth was completely clean.
- Any stain left on the cloth reduced the percentage of light reflected.

The results of the students' investigation are shown in Fig. 2.1.

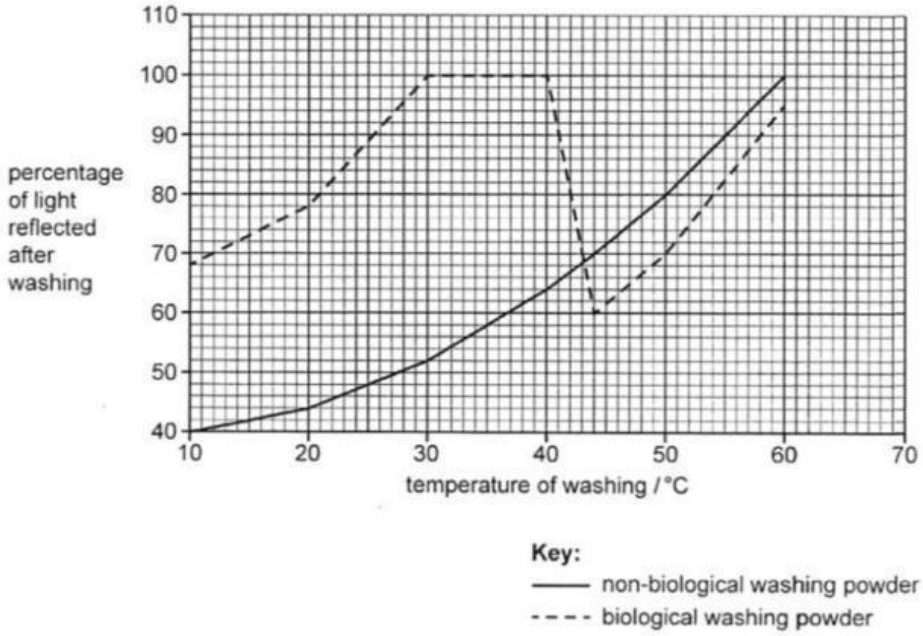

Fig. 2.1

(b) Compare the effectiveness of the two washing powders at removing stains.

Use the information in Fig. 2.1 in your answer.

Biological washing powder is generally more effective at **(1)** _____ temperatures, within the range of **(2)** _____ to **(3)** _____. While biological powder is capable of removing all stains when the temperature is between **(4)** _____ and **(5)** _____, non-biological powder only removes all stains once the temperature reaches **(6)** _____.

The effectiveness of both types of powder is **(7)** _____ at high temperatures, particularly between 50°C and 60°C. In fact, both powders follow the same performance **(8)** _____ at temperatures below 30°C and from 50°C upwards.

One key difference is that the effectiveness of **(9)** _____ washing powder actually **(10)** _____ between 40°C and 44°C, a trend that is not observed in non-biological washing powder.

- **60°C**
- **Similar**
- **Trend**
- **Biological**
- **Decreases**
- **Lower**
- **10°C**
- **43°C**
- **30°C**
- **40°C**

(c) The students suggested that the enzymes in the biological washing powder were denatured at high temperatures.

Explain why enzyme molecules do not function when they are denatured.

. This occurs because the **(1)** _____ of the enzyme changes its shape. Because the shape has changed, the **(2)** _____ can no longer fit into it. This prevents the formation of an **(3)** _____ and results in a lack of **(4)** _____.

..... [2]

(d) Forensic scientists often try to find DNA on items of stained clothing. The DNA can be used to identify individual people.

Suggest why DNA can be used to identify individual people.

Forensic scientists use DNA to identify individuals because each person possesses **(5)** _____ DNA. DNA contains **(6)** _____, which are composed of **(7)** _____.

.....

..... [2]

Answer Key

1. **Active site**
2. **Substrate**
3. **Enzyme-substrate complex**
4. **Successful collisions**
5. **Unique and different**
6. **Genes or alleles**
7. **Specific sequences of bases**

6. 2021 Winter Zone 2 Paper 4 Question 6

Enzymes are catalysts.

(a) Define the term catalyst.

.....

.....

..... [2]

(b) Fig. 6.1 shows diagrams of three enzymes and eight different substrates.

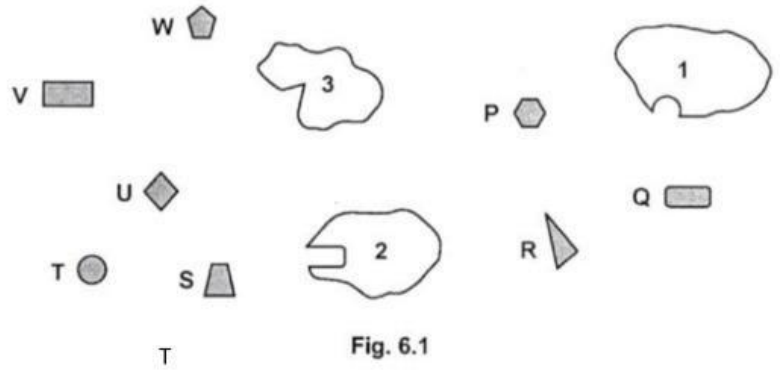

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Fig. 6.1

(i) State the letter of the substrate that will be broken down by enzyme 1.

..... [1]

(ii) Explain, in terms of enzyme structure, the reason for your choice in **6(b)(i)**.

.....

.....

.....

.....

..... [2]

(c) Table 6.1 lists some enzymes and the reactions that they catalyse.

Complete Table 6.1.

Table 6.1

enzyme	reaction
maltase	breakdown of maltose to ..glucose.....
.....	breakdown of proteins to amino acids
lipase	breakdown of fats to ..... and .....
.....	breakdown of lactose to simpler sugars
.....	insertion of a short length of DNA into a plasmid
restriction enzyme	.....

[6]

[Total: 11]

(iii) Describe the effect of enzyme 1 on the DNA molecule in step 3.

This enzyme cuts the DNA strands to form **sticky ends**, which are **complementary to other DNA sequences.**

[2]

(iv) Explain how enzyme 1 in Fig. 1.1 is specific to the exact sequence of DNA bases.

The enzyme's action is _____ because the _____ (the substrate) is _____ to the shape of the enzyme's _____.

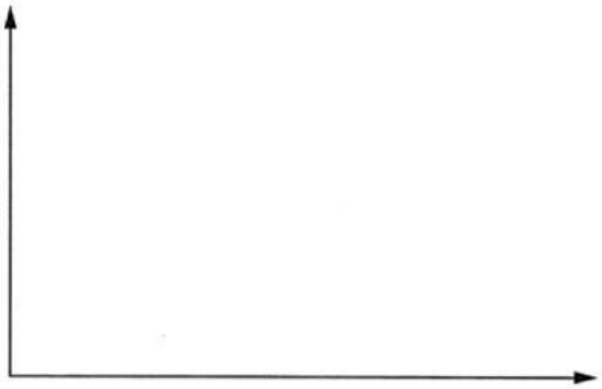
[2]

Keyword: complementary, active site, sequence of DNA bases, specific

(d) Sketch a graph to describe how the activity of the enzymes used in genetic engineering would change if the reaction occurred at a range of temperatures from very cold to very hot.

Label the axes with appropriate titles.

Do **not** use units or a numbered scale.



[3]

[Total: 14]