# Past-paper walk-through

## Enzymes ▪ 5.1

eXercise

# Questions in this set

- 0610/21 N25 Q7 ▪ 1 mark
- 0610/22 N25 Q6 ▪ 1 mark
- 0610/42 N25 Q3 ▪ 11 marks
- 0610/21 J25 Q7 ▪ 1 mark
- 0610/22 J25 Q8 ▪ 1 mark
- 0610/23 J25 Q5 ▪ 1 mark
- 0610/42 J25 Q6 ▪ 10 marks
- 0610/62 J25 Q2 ▪ 14 marks
- 0610/22 M25 Q9 ▪ 1 mark

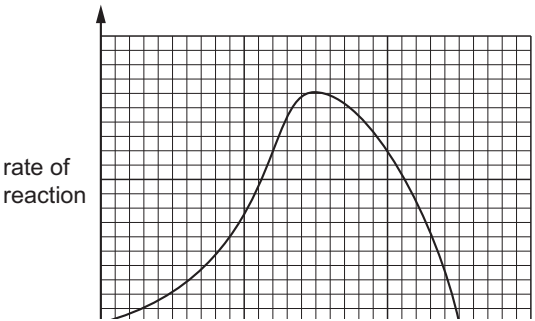
# Reading the mark scheme

- **B1** a mark that stands on its own – the point is either made or not.
- **M1** a *method* mark: the right approach, even if the number is wrong.
- **A1** an *answer* mark, and it usually needs its M mark first.
- **C1** a working mark on the way to the answer.
- // separates answers the examiner accepts equally.
- **ecf** = error carried forward: a later part is marked on your own earlier answer.
- **owtte** = "or words to that effect" – the wording need not match.

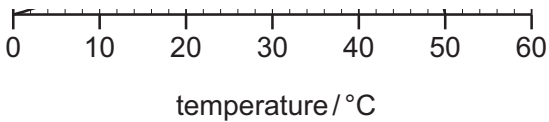
# Question 7

0610/21 N25 ▪ Q7 ▪ 1 mark

**7** The graph shows the effect of temperature on an enzyme-controlled reaction.



# Question 7




Which statement describes the effect of temperature on this reaction?

**A** As the temperature increases to 25 °C, the reaction speeds up.

**B** Between 10 °C and 20 °C, the enzyme denatures.

**C** Between 35 °C and 45 °C, frequency of effective collisions increases.

**D** The optimum temperature for this reaction is 40 °C.

# Solution 7

Answer: **A**

**Why**

- Below the optimum, raising the temperature gives the molecules more kinetic energy, so the rate rises.
- At the optimum the rate is highest.
- Above it the enzyme denatures – its active site loses shape – so the rate falls sharply.

# Question 6

0610/22 N25 ▪ Q6 ▪ 1 mark

**6** Which substance is an enzyme?

**A** fibrinogen

**B** mRNA

**C** pepsin

**D** saliva

# Solution 6

Answer: **C**

**Why**

- An enzyme is a protein that catalyses a reaction.
- Pepsin is the protease of the stomach.
- Fibrinogen is a clotting protein, mRNA is nucleic acid, and saliva is a mixture that *contains* an enzyme.

# Question 3

0610/42 N25 ▪ Q3 ▪ 11 marks

**3** Enzymes are biological catalysts.

**(a)** Describe what is meant by the term catalyst.

# Question 3

**(b)** A student investigated the effect of temperature on enzyme activity.

A starch suspension was kept at 0 °C.

Amylase solution was added to the starch suspension.

Samples of the starch and amylase mixture were tested with iodine solution at 1-minute intervals for 15 minutes.

The student recorded the time at which the starch and amylase mixture stopped turning a blue-black colour.

The student repeated this investigation at different temperatures.

Table 3.1 shows the results.

**Table 3.1**

# Question 3

# Question 3

| temperature / °C | time at which the starch and amylase mixture stopped turning a blue-black colour / minutes |
|---|---|
| 0 | stayed blue-black |
| 10 | 12 |
| 20 | 8 |
| 30 | 5 |
| 40 | 3 |
| 50 | 10 |
| 60 | stayed blue-black |

**(i)** Explain the results between 0 °C and **40 °C** in Table 3.1.

# Question 3

**(ii)** This investigation was repeated with protease instead of amylase.

Explain why the samples from the mixture produced a blue-black colour at every temperature.

# Question 3

**(c)** State **one** factor, other than temperature, that affects enzyme action.

# Question 3

[Total: 11]

# Solution 3

**(a)**

**Mark scheme**

- increases the rate of a (chemical) reaction ;
- (and is) not changed (during the reaction) / AW ;
- 2
- 0610/42
- October/November 2025
- Guidance

# Solution 3

## (b)(i) Mark scheme

- any six from:
- 1
- amylase breaks down starch ;
- 2
- iodine (solution) turns blue-black in the presence of starch ;
- idea that at 0 °C / at the start
- 3
- least, starch break down / enzyme activity / amylase activity ;

# Solution 3

- 4
- fewest, successful collisions / enzyme substrate-complexes formed ;
- 5
- idea that particles do not have sufficient (kinetic)
- energy ;
- idea as temperature increases
- 6
- the kinetic energy (of particles) increases ;
- 7
- (starch and amylase) collide more, frequently / successfully or more

# Solution 3

- enzyme-substrate complexes form ;
- 8
- faster break down of starch ;
- 9
- 40 °C is the optimum temperature ;
- 6

# Solution 3

**(b)(ii)**

**Mark scheme**

- any two from:
- ref to specificity ;
- idea that protease has a different shaped active site (to amylase) / starch and
- the active site (of protease) are not complementary ;
- unable to bind / unable to form an enzyme-substrate complex ;
- 2

# Solution 3

**(c)**

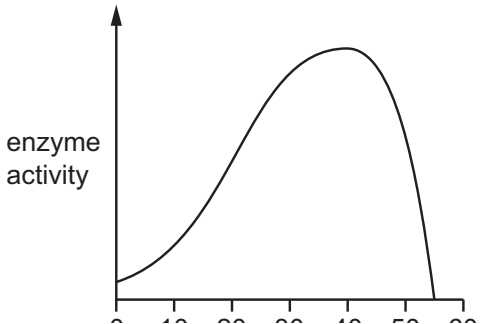
**Mark scheme**

- pH / AVP ;
- 1
- Guidance

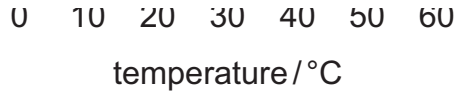
# Question 7

0610/21 J25 ▪ Q7 ▪ 1 mark

**7** The graph shows how enzyme activity is affected by temperature.



# Question 7




Why is enzyme activity lower at 55 °C than it is at 40 °C?

**A** Heat has killed the enzyme.

**B** The enzyme has been used up.

**C** The reactants are moving faster.

**D** The substrate is less likely to fit into the active site.

# Solution 7

Answer: **D**

**Why**

- Enzymes work fastest at their optimum temperature and slow down above it.
- Above the optimum the heat breaks the bonds holding the enzyme's shape.
- The active site changes shape – the enzyme is denatured – so the substrate no longer fits.

# Question 8

0610/22 J25 ▪ Q8 ▪ 1 mark

**8** What is the correct definition of enzymes?

**A** carbohydrates that act as biological catalysts

**B** carbohydrates that act as substrates

**C** proteins that act as biological catalysts

**D** proteins that act as substrates

# Solution 8

Answer: **C**

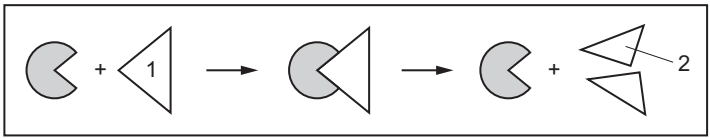
**Why**

- Enzymes are proteins, not carbohydrates.
- They speed up reactions without being used up, which makes them catalysts.
- They act *on* substrates – they are not substrates themselves.

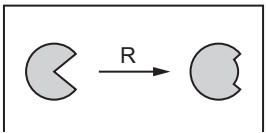
# Question 5

0610/23 J25 ▪ Q5 ▪ 1 mark

**5** The diagram shows a process involving an enzyme in the human stomach.




The diagram shows another process, R, that affects this enzyme.



# Question 5

Which row identifies the substrate and the cause of process R?

| | substrate | cause of process R |
|---|---|---|
| **A** | 1 | acidic conditions |
| **B** | 1 | alkaline conditions |
| **C** | 2 | acidic conditions |
| **D** | 2 | alkaline conditions |

# Solution 5

Answer: **B**

**Why**

- The stomach enzyme is a protease, so its substrate is protein.
- It works best in the acid conditions the stomach provides.
- A process that destroys the enzyme's shape is denaturation, which is what a high temperature or the wrong pH causes.

# Question 6

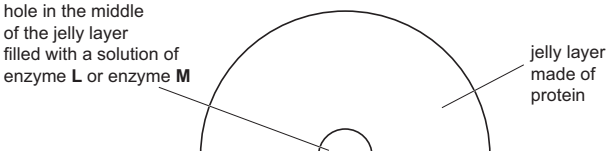
0610/42 J25 ▪ Q6 ▪ 10 marks

**6** A scientist investigated the effect of changes in pH on the activity of two different protease enzymes.

Each enzyme was placed in a hole in the centre of a jelly layer in a Petri dish. The jelly layer was made of protein. The investigation was carried out at a range of different pH values.

After 60 minutes, the area of the jelly layer that had been broken down by enzyme **L** or enzyme **M** was recorded at each pH value tested.

Fig. 6.1 is a diagram of the apparatus.



# Question 6

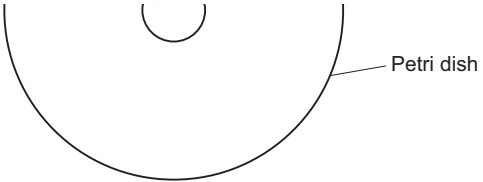
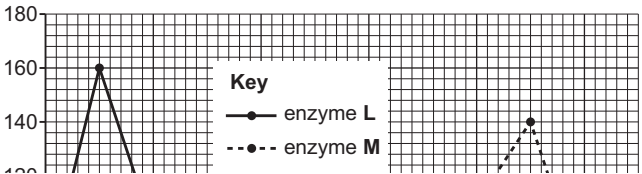



**Fig. 6.1**

Fig. 6.2 shows the results of the investigation.



# Question 6

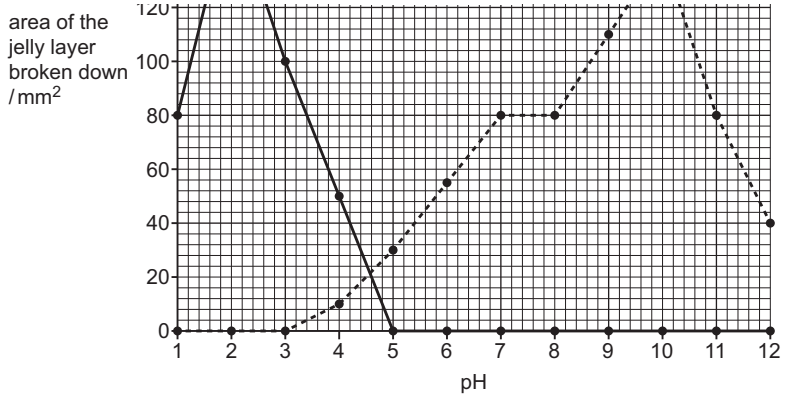



**Fig. 6.2**

# Question 6

**(a)** Using the information in Fig. 6.2, describe the results of this investigation.

# Question 6

**(b)** Explain the result for enzyme **M** at pH 2 shown in Fig. 6.2.

# Question 6

**(c)** Suggest the name of enzyme **L and** state its location in the human digestive system.

# Question 6

[2]

[Total: 10]

# Solution 6

## (a) Mark scheme

- any five from:
- 1
- enzyme activity reaches, peaks / increases and decreases (for
- L / M) ;
- 2
- maximum (area digested) / peaks, is pH 2 for L and pH 10 for M ;
- 3
- L has steepest increase in activity between pH 1 and 2 / M has

# Solution 6

- most gradual increase from pH 3 to pH 10 / as pH increases / AW ;
- 4
- L has higher activity than M at their optimum pHs / AW ; ora
- 5
- L and M are active, between pH 3 and pH 5 ;
- 6
- L has no activity, from / at pH 5 (and onwards) OR M has no
- activity, before / at, pH 3 ;
- 7
- M is active for a wider pH range (in this investigation than L) ; ora

# Solution 6

- 8
- no change in activity between pH 7 and 8 for M ;
- 9
- data quote with correct units that includes ref to pH and area
- where the enzyme is active ;
- 5
- MP6 A denatured for no enzyme activity
- MP9 examples:
- ▪
- at pH 2 L digests 160 mm2 of jelly

# Solution 6

- ▪
- at pH 10 M digests 140 mm2 of jelly
- ▪
- at pH, 7 / 8 M digests 80 mm2 of jelly

# Solution 6

**(b) Mark scheme**

- any three from:
- no jelly is broken down / enzyme has no activity ;
- enzyme / M / active site, is denatured ;
- enzyme / M / active site, has changed shape ;
- active site, does not fit / does not bind / is not complementary to, the
- substrate / protein in jelly ;
- 3

# Solution 6

**(c)**

**Mark scheme**

- enzyme L: pepsin ;
- location: stomach ;
- 2

# Question 2

0610/62 J25 ▪ Q2 ▪ 14 marks

**2** **(a)** The enzyme pectinase is used in the production of apple juice.

In an experiment, a student investigated the production of apple juice using five different concentrations of pectinase solution.

For each concentration, the student:

- put 100 g of crushed apple into a beaker
- added 10 $cm^3$ of the pectinase solution to the crushed apple
- left the crushed apple and enzyme mixture for 30 minutes at 40 °C
- filtered the apple juice from the mixture
- measured the volume of apple juice produced.

**(i)** The temperature was maintained at 40 °C.

# Question 2

Describe how the student could maintain the crushed apple and enzyme mixture at a constant temperature.

# Question 2

**(ii)** State **two other** variables that were kept constant in this investigation.

# Question 2

[2]

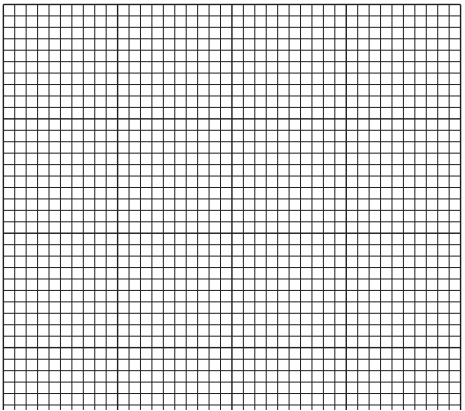
**(b)** The results of this investigation are shown in Table 2.1.

**Table 2.1**

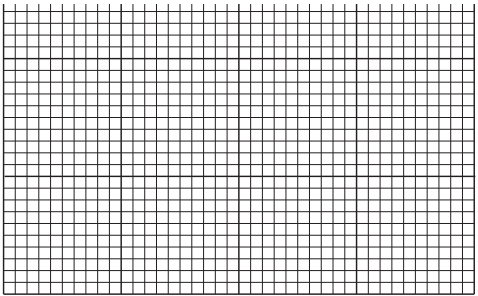
| percentage concentration of the pectinase solution | volume of apple juice produced / $cm^3$ |
|---|---|
| 0.1 | 4 |
| 0.2 | 6 |
| 0.4 | 12 |
| 0.8 | 22 |
| 1.6 | 22 |

# Question 2

**(i)** Plot a line graph on the grid of the data in Table 2.1.



# Question 2



[4]

# Question 2

**(ii)** Use your graph to estimate the volume of apple juice produced with a 0.5% pectinase solution.

Show on your graph how you obtained your answer.

# Question 2

[2]

**(iii)** Describe the effect of pectinase solution concentration on apple juice production.

# Question 2

**(iv)** Pectinase is used to produce apple juice commercially.

Suggest what extra data would be required to determine if a 0.8% pectinase solution is the optimum concentration for the production of apple juice.

# Question 2

**(v)** Draw and label the apparatus the student could use to filter **and** measure the volume of apple juice produced.

# Question 2

[3]

[Total: 14]

# Solution 2

**(a)(i)**

**Mark scheme**

- thermostatically controlled water-bath / AVP ;
- 1

# Solution 2

**(a)(ii)**

**Mark scheme**

- any two from:
- mass of apple ;
- volume of, pectinase / enzyme (solution) ;
- time / left for 30 minutes ;
- 2

# Solution 2

**(b)(i)**

**Mark scheme**

- axes labelled with units ;
- suitable linear scale and data occupies at least half the grid in both
- directions ;
- all points plotted accurately $\pm$ half a small square ;
- suitable line drawn ;
- 4

# Solution 2

**(b)(ii)**

**Mark scheme**

- any indication on graph at 0.5% pectinase concentration / indication of
- correct value on the volume axis ;
- correct value recorded from candidates graph ;
- 2

# Solution 2

**(b)(iii)**

**Mark scheme**

- increasing, concentration / pectinase , increases juice production
- and then stops increasing / AW ;
- 1

# Solution 2

**(b)(iv)**

**Mark scheme**

- more concentrations measured between 0.4% and 1.6% ;
- 1 A smaller intervals above and below, 0.8%
- e.g. 0.7% and 0.9%
- A smaller intervals around 0.8%

# Solution 2

## (b)(v) Mark scheme

- drawings of:
- funnel with filter paper ;
- measuring cylinder ;
- labelling:
- at least one item correctly labelled ;
- 3
- 0610/62
- May/June 2025

# Solution 2

- Guidance
- 3
- independent variable
- 1
- at least three different light intensities ;
- dependent variable
- 2
- the colour of the indicator ;
- 3 and 4 details of the method ;;
- ▪

# Solution 2

- method of changing light intensity e.g. different lamp
- distances / dimmer switch altered / different bulbs / different
- lamps / different power lamps / detail of how to make one in the dark
- and one in the light
- ▪
- method to avoid heating effect of light e.g. heat shield / beaker of
- water between lamp and plant / use LED bulbs to prevent heating
- ▪
- keeping the plant under the water / weighting the plant down
- ▪

# Solution 2

- sample the water around the plant and test with indicator
- 5 and 6 and 7 variables kept constant ;;;
- ▪
- colour / wavelength, of light
- ▪
- temperature
- ▪
- type / species / age, of plant
- ▪
- size / mass / length / height / surface area / number of leaves, of plant

# Solution 2

- ▪
- volume of water (covering plant)
- ▪
- volume / number of drops, of (hydrogencarbonate) indicator
- ▪
- concentration of (hydrogencarbonate) indicator
- ▪
- set (stated) time for equilibration (to the new light intensity)
- ▪
- set (stated) time before noting colour

# Solution 2

- 8
- two or more repeats ;
- 9
- relevant safety ;
- 6

# Question 9

0610/22 M25 ▪ Q9 ▪ 1 mark

**9** Which statement describes enzymes?

**A** Enzymes are carbohydrates.

**B** Enzymes are involved in metabolic reactions.

**C** Enzymes decrease the rate of reaction.

**D** Enzymes have the same shape of active site as their substrate.

# Solution 9

Answer: **B**

**Why**

- Enzymes are *proteins*, not carbohydrates.
- They speed reactions up, so they cannot decrease the rate.
- Each has an active site of its own specific shape, and they catalyse the reactions of metabolism.