

1 Amylase is an enzyme that digests starch.

A student investigated the effect of pH on the activity of amylase.

This is the method used.

1. Mix amylase solution and starch suspension in a boiling tube.
2. Put the boiling tube into a water bath at 25 °C.
3. Remove a drop of the mixture every 30 seconds and test it for the presence of starch.
4. Repeat the investigation at different pH values.

The table below shows the students' results.

pH	Time when no starch was detected in minutes
5.0	7.0
5.5	4.5
6.0	3.0
6.5	2.0
7.0	1.5
7.5	1.5
8.0	2.0

(a) The student concluded pH 7.25 was the optimum pH for the amylase enzyme.

This is **not** a valid conclusion.

Suggest **two** reasons why.

1. \_\_\_\_\_

\_\_\_\_\_

2. \_\_\_\_\_

\_\_\_\_\_

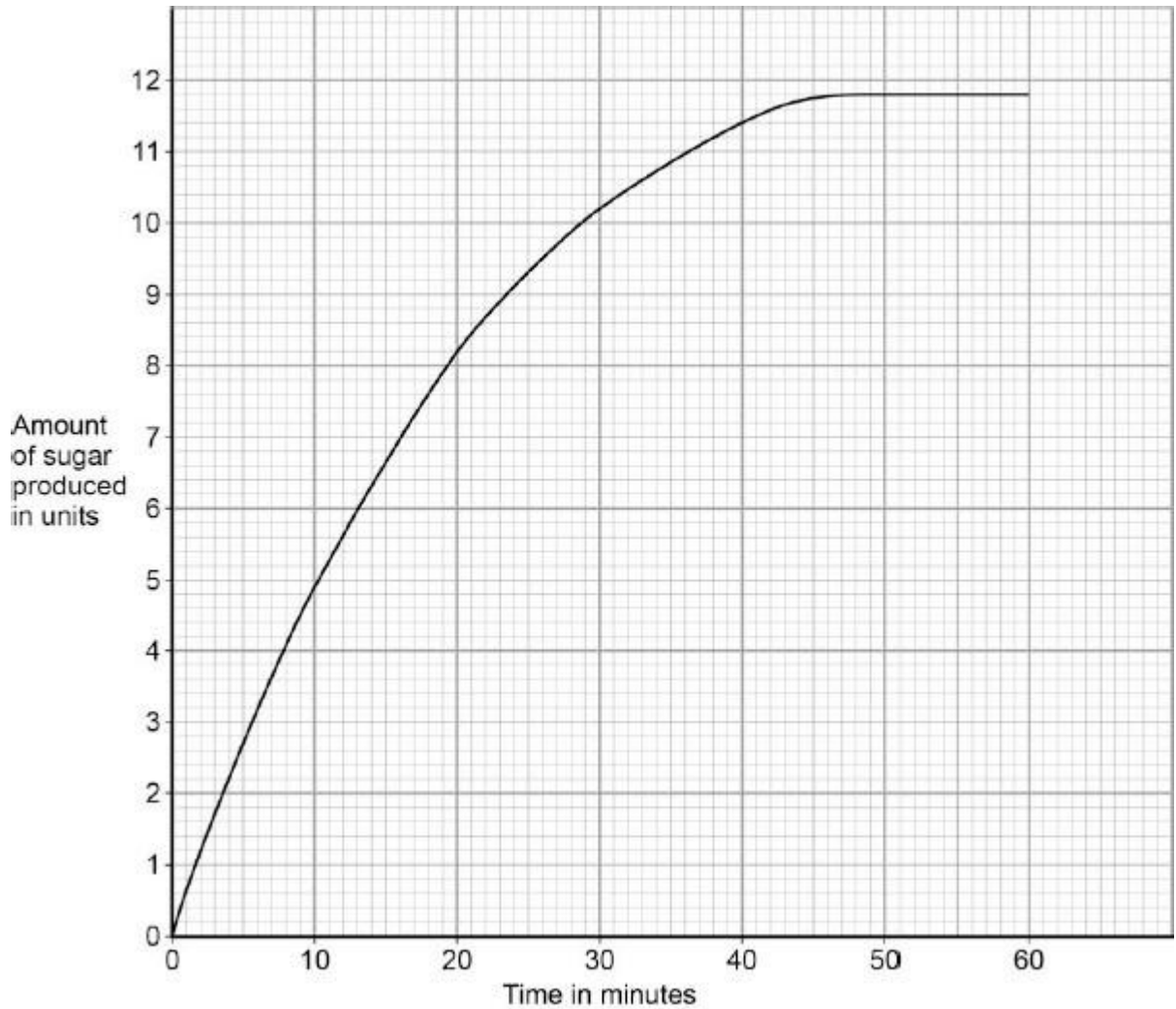
(2)

(b) The student did another investigation.

This is the method used.

1. Put amylase solution and starch suspension into a boiling tube.
2. Make the pH 7.25.
3. Put the boiling tube into a water bath at 25 °C.
4. Measure the amount of sugar produced every 30 seconds.

The results are shown in the figure below.



Calculate the mean rate of sugar produced per minute during the first 5 minutes.

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Mean rate = \_\_\_\_\_ units per minute

(2)

- (c) Iodine solution is added to a sample taken from the boiling tube after 10 minutes and 60 minutes.

Suggest what you would see in these samples.

After 10 minutes \_\_\_\_\_

\_\_\_\_\_

After 60 minutes \_\_\_\_\_

\_\_\_\_\_

**(2)**

- (d) The scientist repeated the investigation at 37 °C.

Draw a line on the figure above to show the results the scientist would get.

**(2)**

- (e) The same investigation was done at 65 °C.

How would this affect the results?

Explain why.

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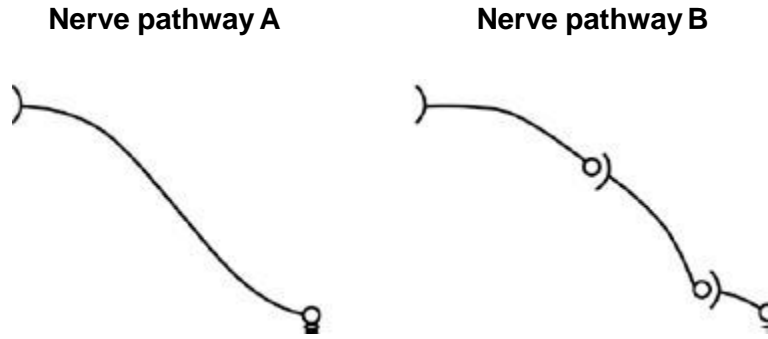
**(3)**

**(Total 11 marks)**

2

The nervous system allows humans to respond to their surroundings.

The figure below shows two nerve pathways.



(a) Nerve pathway **A** is 92 cm long.

A nerve impulse travels along pathway **A** at 76.2 m / s.

Calculate how long it takes for the nerve impulse to travel the length of the pathway.

Use the equation:

$$\text{distance} = \text{speed} \times \text{time}$$

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Time = \_\_\_\_\_ s

(3)

(b) Nerve pathways **A** and **B** are the same length.

The nerve impulse takes longer to travel along pathway **A** than along pathway **B**.

Use the figure above to explain why.

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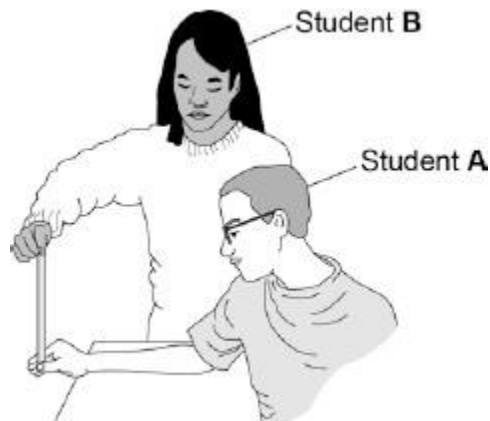
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(3)

(c) Two students compare their reactions using a ruler.

This is the method used.

1. Student **A** sits with his elbow on a table top.
2. Student **B** holds the ruler so the bottom of the ruler is level with the top of student **A**'s thumb.
3. Student **B** drops the ruler.
4. Student **A** catches the ruler.
5. Record the drop distance.
6. Repeat steps 1 to 5 four more times.
7. Repeat the whole experiment with student **A** dropping the ruler and student **B** catching it.



Both students are right-handed.

Student **A** uses his right hand to catch the ruler.

Student **B** uses her left hand to catch the ruler.

The table below shows the students' results.

Student	Drop distance in mm				
	Test 1	Test 2	Test 3	Test 4	Test 5
Student <b>A</b> – right hand	203	167	140	156	163
Student <b>B</b> – left hand	230	211	279	215	264

What is the range of student **A**'s results?

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(d) The students are testing the hypothesis:

**The drop distance of the ruler is smaller when a right-handed person uses their right hand to catch the ruler.**

The students' results in the table above are not a good test of the hypothesis.

Suggest what the students should have done to test the hypothesis.

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**(3)**

(e) Student **A**'s mean reaction time was 0.19 s.

Mean reaction time can be calculated using the equation:

$$\text{Mean reaction time} = \sqrt{\frac{2 \times \text{mean drop distance in m}}{9.8 \text{ m/s}^2}}$$

Calculate the mean reaction time for Student **B**.

Give your answer to two significant figures.

Student **B**'s results are repeated here to help you answer the question.

	Drop distance in mm				
	Test 1	Test 2	Test 3	Test 4	Test 5
Student <b>B</b> – left hand	230	211	279	215	264

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Mean reaction time = \_\_\_\_\_ s

(4)

(Total 14 marks)

**3** Neurones pass information around the body.

(a) Why are reflex reactions important?

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(1)

(b) Caffeine is a drug found in coffee.

After a person drinks coffee information passes through neurones in the nervous system more quickly.

Suggest a hypothesis for the effect of caffeine concentration on reaction time.

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(1)

(c) Two students investigated the effect of caffeine concentration on reaction time.

This is the method used.

1. Student **A** drinks a cup of coffee.
2. Student **B** holds a ruler above Student **A**'s hand.
3. Student **B** drops the ruler.
4. Student **A** catches the ruler as quickly as she can.
5. The distance the ruler falls is recorded.

Suggest how this method could be improved to produce valid results.

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(6)  
(Total 8 marks)



**4** This question is about the human nervous system.

(a) A ball is thrown towards a boy.

As the ball is thrown, information passes along a pathway to allow the boy to catch the ball.

Draw **one** line from each action to the correct part of the pathway.

Action	Part of the pathway
Retina cells in the eye detect the light from the ball	Coordinator
The impulse reaches the brain which 'sees' the ball and sends an impulse to the arm muscle	Effector
The muscle in the arm contracts	Response
The arm stretches to catch the ball	Receptor
	Stimulus

**(3)**

Students in a college made this hypothesis:

'reaction time will increase as the time you have been awake increases.'

The students set up an investigation to test their hypothesis.

This is the method used.

1. Find 5 volunteers willing to stay awake for 24 hours.
  2. Keep the volunteers in a room where they can study, use an exercise bike or watch TV as they wish.
  3. Provide food, water, coffee and tea as requested.
  4. Measure the volunteers' reaction time every 4 hours using a computer program.
- (b) What was the independent variable in this investigation?

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**(1)**

The students used a computer program to test reaction time.

(c) Describe one **other** method that can be used to measure reaction time.

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(3)

(d) Which method would you choose to use at your school?

Tick **one** box.

Computer program	<input type="checkbox"/>
Method described in part (c)	<input type="checkbox"/>

Give **one** reason for your choice.

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(1)

The table shows the students' results.

Time awake in hours	Reaction time in seconds					
	Volunteer					Mean
	A	B	C	D	E	
0	0.25	0.33	0.35	0.21	0.27	0.28
4	0.20	0.30	0.31	0.19	0.26	0.25
8	0.21	0.28	0.33	0.20	0.27	0.26
12	0.26	0.40	0.58	0.22	0.30	0.35
16	0.44	0.49	0.83	0.27	0.75	<b>X</b>
20	0.64	0.55	1.11	0.39	1.40	0.82
24	0.92	0.61	1.15	0.45	1.35	0.90

(e) Calculate value **X** in the table.

Give your answer to 2 significant figures.

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**X** = \_\_\_\_\_ seconds

(2)

(f) Describe the pattern of results for mean reaction time as the time awake increases.

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(2)

(g) Do these results support the students' hypothesis: 'reaction time will increase as the time you have been awake increases'?

Give **one** reason for your answer.

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(1)

(g) Give **two** ways the students could improve their investigation to make it more valid.

1. \_\_\_\_\_  
\_\_\_\_\_  
2. \_\_\_\_\_  
\_\_\_\_\_

(2)

(Total 15 marks)

**5**

This question is about reproduction.

(a) Describe the difference between the way hormonal and non-hormonal methods of contraception work.

Give **one** example of each method of contraception.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

(3)

The urine of women using hormonal methods of contraception contains high levels of progesterone.

Concentrations of 1–3 ng/dm<sup>3</sup> of progesterone are found in the water of rivers near sewage outflow points.

Scientists investigated the effect of different concentrations of progesterone in water on fish reproduction.

This is the method used.

1. Prepare tanks of water containing different concentrations of progesterone.
2. Put a breeding pair of fish into each tank.
3. Record the number of eggs produced per day by the female in each tank for 14 days.

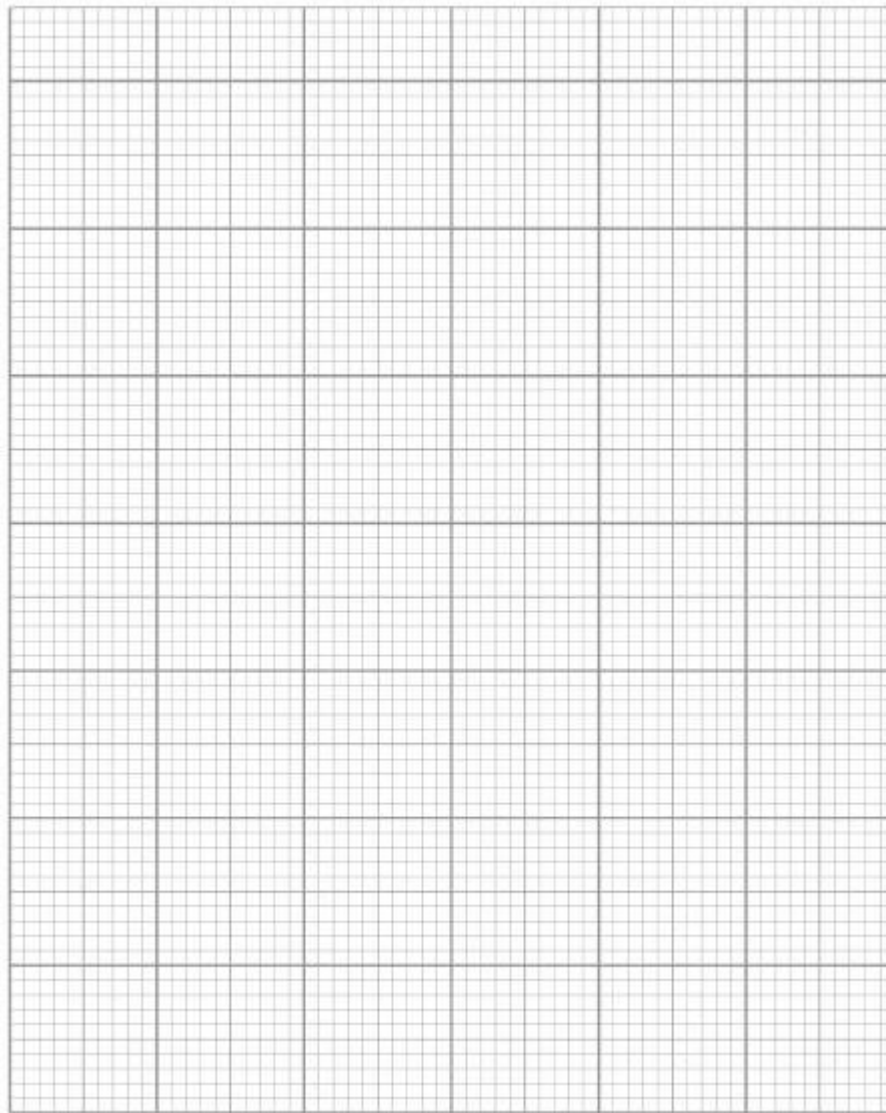
The table shows the results.

<b>Concentration of progesterone in water in ng/dm<sup>3</sup></b>	<b>Mean number of eggs produced per day</b>
0.0	28.6
0.8	4.5
1.5	3.2
3.0	2.8
10.0	1.1
20.0	0.2

(b) Plot the data from the table on the grid.

You should:

- label each axis
- use a suitable scale
- draw a line of best fit.



(4)

- (c) Describe the effect on fish reproduction of the concentrations of progesterone found in rivers near sewage outflows.

Use data from your graph.

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**(2)**  
**(Total 9 marks)**

## Mark schemes

- 1** (a) any **two** from:
- same result at pH 7 and 7.5  
**or**  
could be any pH between 7 and 7.5  
**or**  
not tested at pH 7.25  
**or**  
need to test at smaller pH intervals (between 7 and 7.5)
  - accuracy of result only to nearest 0.5 minutes
  - no repeats
  - difficult to determine end point (colour)
- 2
- (b) 2.7 / 5
- 1
- 0.54 (units per minute)
- 1
- allow 0.52 with no working shown for 2 marks*
- 1
- allow 1 mark for 0.52 **or** 0.56*
- (c) (after 10 minutes) solution goes black
- 1
- (after 60 minutes) solution stays the same
- or**  
does not go black  
**or**  
goes slightly orange
- 1
- (d) steeper curve
- 1
- levels off at 11.8 units **and** before 45 minutes
- 1
- (e) no / little sugar produced
- 1
- allow a correct description of what the graph would look like*
- (because at 65 °C) the enzyme will be denatured
- allow (because) the enzyme's shape will be changed*
- or**  
*(because) the active site is damaged*
- 1



(so) will no longer fit the starch  
**or**  
(so) will not be able to catalyse the reaction

1  
[11]

2

(a)  $0.92 = 76.2 \times \text{time}$

1

$\text{time} = 0.92 \div 76.2$

1

$= 0.012$

*allow 0.012 with no working shown for 3 marks*

1

(b) pathway **B** has two synapses

*allow converse for pathway A*

1

chemicals diffuse across each synapse

1

which slows down the impulse

1

(c) 140–203

1

(d) use the same person for each test

1

use left hand **and** right hand

1

use a bigger sample size **or** more people

*allow take more readings with each person*

1

(e) mean drop distance =  $(230 + 211 + 279 + 215 + 264) \div 5 = 239.8$

1

$239.8 \text{ mm} = 0.2398 \text{ m}$

1

mean reaction time =  $\sqrt{\frac{2 \times 0.2398}{9.8}}$

1

$= 0.221$

*incorrect sig. figs max. 3 marks*

1

*allow 0.221 with no working shown for 4 marks*

[14]

3

- (a) fast reaction to reduce / protect from harm

*allow named examples*

1

- (b) higher caffeine concentration causes shorter reaction time.

*allow converse*

*ignore 'faster / slower reaction time'*

1

- (c) **Level 3 (5–6 marks):**

A coherent method is described with relevant detail, which demonstrates a broad understanding of the relevant scientific techniques and procedures. The steps in the method are logically ordered. The method would lead to the collection of valid results.

**Level 2 (3–4 marks):**

The bulk of a method is described with mostly relevant detail, which demonstrates a reasonable understanding of the relevant techniques and procedures. The method may not be in a completely logical sequence and may be missing some detail.

**Level 1 (1–2 marks):**

Discrete relevant points are made which demonstrate some understanding of the relevant scientific techniques and procedures. They may lack a logical structure and would not lead to the production of valid results.

**0 marks:**

No relevant content.

**Indicative content**

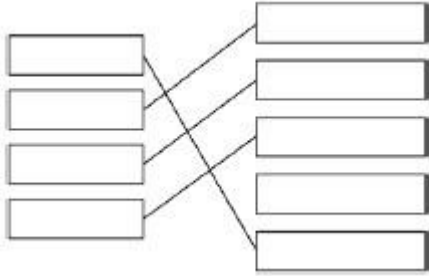
- use decaffeinated coffee as control
- control volume of coffee
- blind trial or do not tell students which coffee they are drinking
- left for standard time between drink and test
- at least 10 minutes
- control start position of ruler
- control other factors such as light in the room
- same person for different concentrations
- repeat for each caffeine concentration
- use a range of caffeine concentrations
- start with lowest concentration of caffeine
- use caffeine solution instead of coffee to control for other ingredients
- repeat investigation with more people and calculate means

6

[8]

4

(a)



4 correct = 3 marks

3 correct = 2 marks

2 correct = 1 mark

(4-5)

3

(b) time awake

1

(c) description of how to do a 'ruler drop'

1

how to measure length in cm

1

a control measure taken

**or**

how to use a conversion chart to get reaction time

1

(d) any **one** sensible reason:

for ruler drop test:

- have lots of equipment
- inexpensive equipment
- many students can do it at same time

for computer test:

- more accurate
- more repeatable
- students can cheat on ruler drop test

1

(e) 0.556..... or

$(0.44+0.49+0.83+0.27+0.75)/5$

1

0.56

*an answer of 0.56 scores 2 marks*

1

(f) at first stays same / has slight dip (until 12 hours)  
*12 hours only needed once* 1

increases from 12 hours awake  
*ignore 'increases' alone* 1

(g) **either:**  
does support, because overall goes up  
**or**  
does not support, because it goes down / stays the same at first and only goes up after 12 hours 1

(h) any **two** from:  
• use more volunteers  
• make sure they all do the same activities at the same time  
• give them the same food and coffee/tea at the same time  
• control the age / gender of volunteers  
• make sure they all had a good night's sleep the night before the investigation began 2

[15]

5 (a) (hormonal uses chemicals / synthetic) hormones to prevent an egg being released  
*allow 'to prevent maturation of eggs'* 1

(non-hormonal has a barrier which) prevents the sperm reaching an egg **or** prevents implantation 1

a correct example of each type 1

(b) suitable scales and axes labels correct 1

all points plotted accurately  
*allow 1 mark for 5 accurate points* 2

line of best fit  
*allow a bar chart for max 3 marks* 1

(c) decrease egg production 1

by between 6–10 times  
*allow ecf from their graph* 1

[9]