

Please check the examination details below before entering your candidate information

Candidate surname

Other names

Pearson BTEC Level 3  
Nationals Extended  
Certificate, Foundation  
Diploma, Diploma,  
Extended Diploma

Centre Number

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Learner Registration Number

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**Monday 18 January 2021**

Morning (Time: 45 minutes)

Paper Reference **31619H**

**Applied Science/Forensic and  
Criminal Investigation**

**Unit 3: Science Investigation Skills**

**Part A**

**You must have:**

a calculator and a ruler

### Instructions

- **Part A** contains material for the completion of the preparatory work for the set task.
- **Part A** must be issued to learners 45 minutes before the start of **Part B**.
- **Part A** is specific to each series and this material must only be issued to learners who have been entered to undertake the task in the relevant series.
- **Part A** materials for the set task will be issued prior to the start of the supervised assessment period according to the guidance in the specification.
- **Part A** should not be returned to Pearson.

Turn over ►

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## Instructions for Teachers/Tutors or Invigilators

This taskbook:

- contains the instructions for learners and the set task brief
- must be issued to learners 45 minutes before the start of **Part B**
- must not be taken out of the supervised assessment area.

Teachers/tutors or invigilators must not give any support to learners.

Learner notes will be retained securely by the centre after **Part B** has been undertaken and may be requested by Pearson if there is suspected malpractice.

Refer carefully to the instructions in this taskbook and the BTEC Nationals *Instructions for Conducting External Assessments (ICEA)* document to ensure that the preparatory period is conducted correctly and that learners have the opportunity to carry out the required activities independently.

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### Instructions for Learners

You will be given 45 minutes to read Part A and make notes.

**Part A** contains the set task brief you need to prepare for **Part B, Section 1**.

Read the set task brief carefully.

You should use the space provided at the end of **Part A** to make notes.

You will use the set task brief in **Part A** and your notes to complete the set task in **Part B, Section 1**.

You must return **Part A** and **Part B** at the end of the examination.

The teacher/tutor or invigilator must not give you feedback during the time given to read and make notes for **Part A**.

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## Set Task Brief for Part B, Section 1

A trainee technician is working in the quality control laboratory of a company. The company makes many different electrical components.

The trainee technician's supervisor has asked the trainee technician to test the electrical characteristics of a random 12 V lamp taken from the production line.

The trainee technician must check that the lamp meets production standards.

The trainee technician produces this draft report of the investigation.

### Draft Report

#### Title

An investigation into the relationship between the potential difference and the current for a lamp.

#### Aim

To measure the current through a lamp when the potential difference across the lamp is increased.

#### Introduction

A power supply provides energy. The energy is transferred to a lamp to produce light.

The potential difference across the lamp increases as the voltage output of the power supply increases.

#### Equipment

- One 0 to 16 V d.c. power supply, shown in Figure 1
- One 12 V lamp and lamp holder
- One ammeter, giving readings to 2 decimal places
- One switch
- Four leads to connect the circuit



Figure 1

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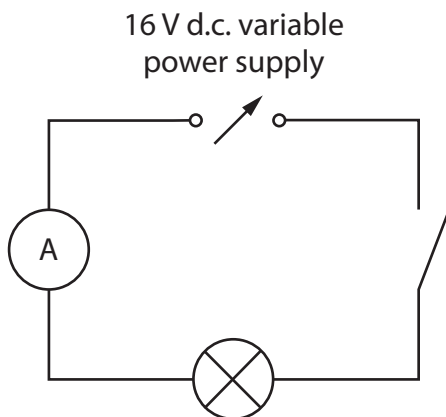


**Method**

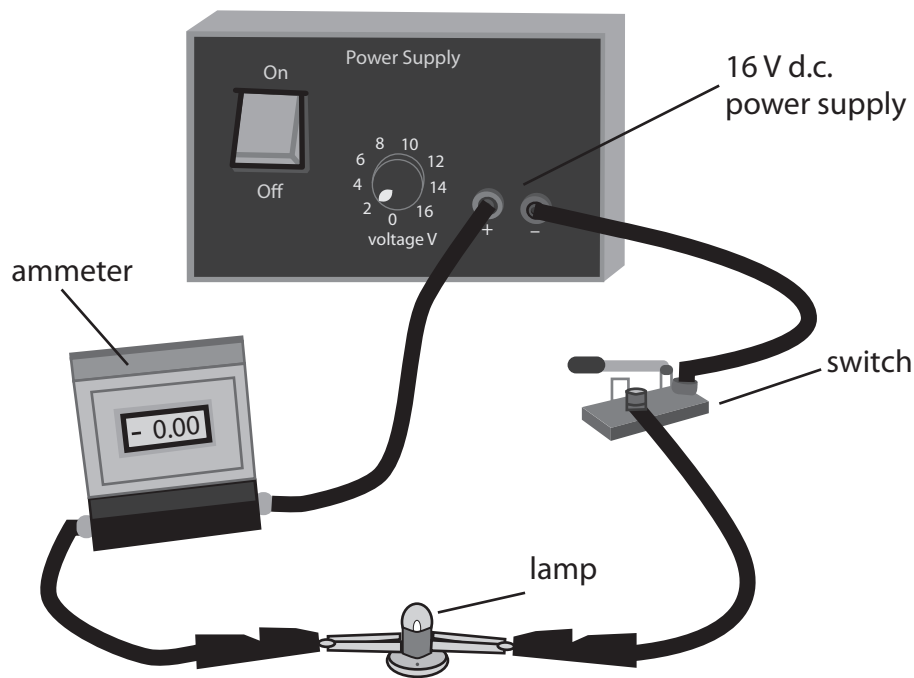
The power supply produces a range of different voltage outputs.

The current in the lamp was measured and the brightness recorded at a range of voltage outputs.

Figure 2a and Figure 2b show the equipment used to take the measurements.



**Figure 2a**



**Figure 2b**



These were the steps taken to obtain the data.

1. Set the power supply to the 2 V setting.
2. Close the switch.
3. Record the voltage output of the power supply.
4. Record the ammeter reading.
5. Open the switch.
6. Repeat steps 2, 3, 4 and 5 to get two more ammeter readings.
7. Increase the voltage output by 2 V on the power supply.
8. Repeat steps 2, 3, 4, 5, 6 and 7 for five more voltage settings.

**Raw data**

Voltage setting on power supply: 2V, Current: 0.02, 0.03, 0.03, lamp: just on

Voltage setting: 4V, Current A: 0.07, 0.04, 0.08, lamp: very dim

Voltage setting: 6V, Current: 0.12, 0.11, 0.12, quite dim

Voltage: 8 V, Current: 0.14, 0.14, 0.14, bright

Voltage: 10 V, brighter, Current : 0.16 A, 0.15, 0.16

Voltage: 12V, very bright, Current : 0.18, 0.17, 0.17

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**Notes**

Use this space to make notes about the trainee technician's draft report.

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**Notes**

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**Monday 18 January 2021**

Morning (Time: 1 hour 30 minutes)

Paper Reference **31619H**

**Applied Science/Forensic and  
Criminal Investigation**

**Unit 3: Science Investigation Skills**

**Part B**

**You must have:**

A calculator and a ruler.

Total Marks

### Instructions

- You will need **Part A** to complete **Part B Section 1**.
- **Part A** and **Part B** contain material for the completion of the set task under supervised conditions.
- **Part A** and **Part B** must be undertaken in a single session of 2 hours and 15 minutes on the date timetabled by Pearson.
- **Part A** should be given to learners at the start of the examination.
- **Part B** should be given to learners after 45 minutes has passed.
- **Part A** and **Part B** are specific to each series and this material must only be issued to learners who have been entered to undertake the task in the relevant series.
- **Part B** should be kept securely until the start of the 1 hour and 30 minute supervised assessment period.
- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and learner registration number.
- Answer **all** questions.
- Answer the questions in the spaces provided  
– *there may be more space than you need.*

### Information

- The total mark for this paper is 60.
- The marks for **each** question are shown in brackets  
– *use this as a guide as to how much time to spend on each question.*

### Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

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**Answer ALL questions in Section 1 and Section 2.**

**Write your answers in the spaces provided.**

**SECTION 1**

**You should use the trainee technician's draft report and your notes from Part A to complete Section 1.**

- 1 (a) Record the trainee technician's raw data in a suitable table, using the space provided.

Your table must include an average current for each voltage output.

Circle any anomalous results.

(3)

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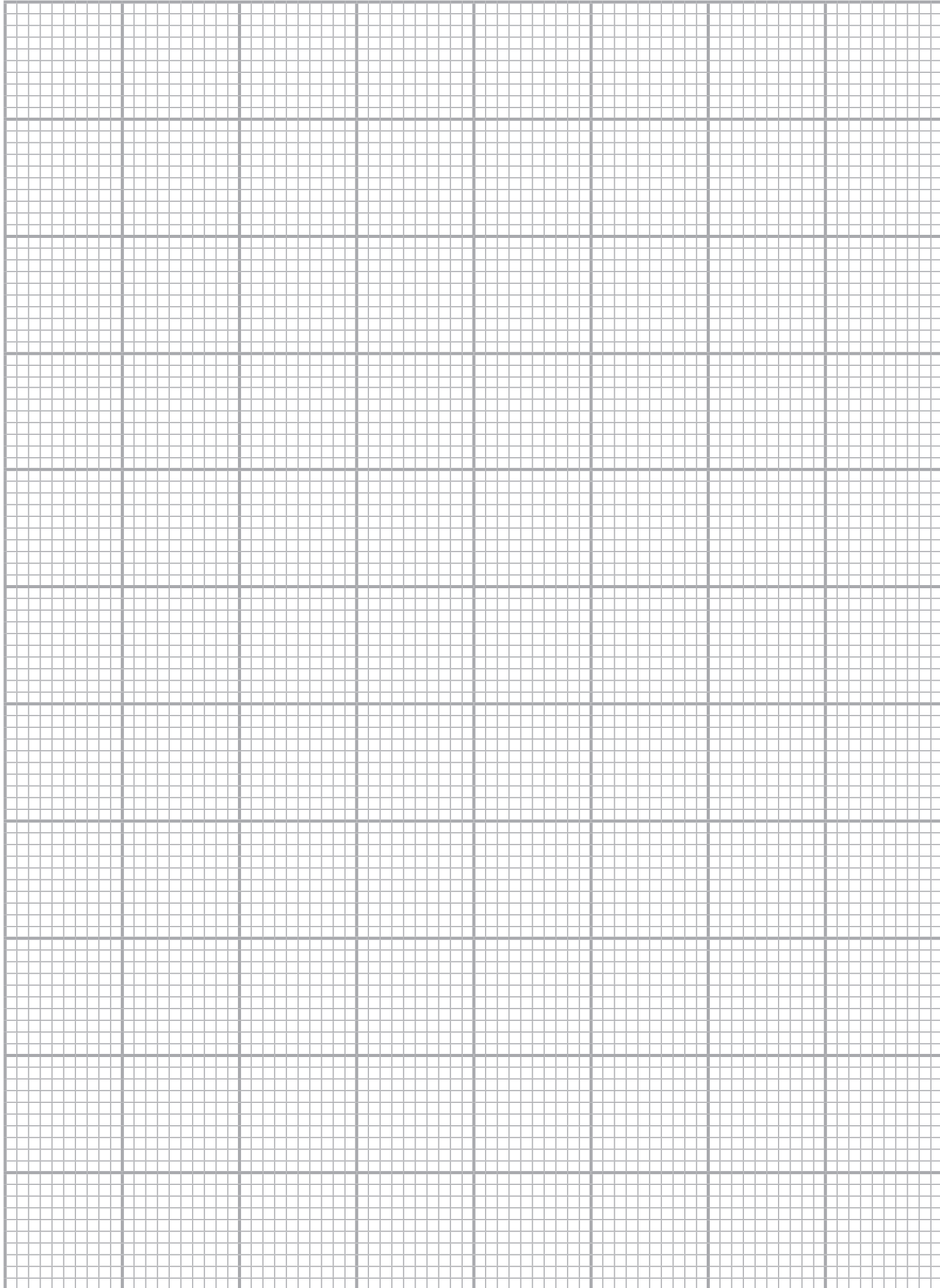
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(b) Plot a graph of the average current in the lamp against the voltage output.

You should include a curve of best fit.

(3)



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P 6 7 5 0 1 A 0 3 2 0

(c) Describe the pattern of results shown in your graph.

(2)

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(d) State **one** observation about the lamp when the voltage output was increased.

(1)

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(e) Give **two** variables that were controlled in the investigation.

(2)

1 .....

2 .....

(f) Give the independent variable and the dependent variable in the investigation.

(2)

independent variable

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dependent variable

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(g) Explain why the switch in the circuit should be opened between taking readings.

(2)

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**(Total for Question 1 = 15 marks)**

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2 (a) The trainee technician's supervisor did a similar investigation.

The supervisor replaced the lamp used in the investigation with a fixed resistor.

Figure 1 shows the supervisor's circuit diagram.

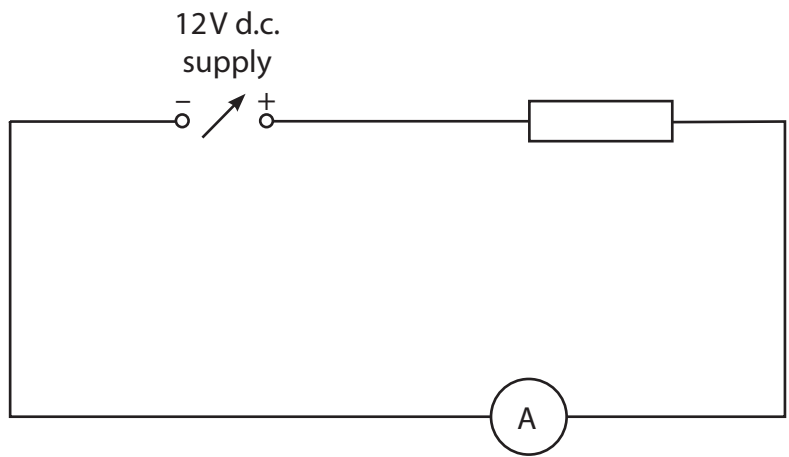



Figure 1

A voltmeter must be added to the circuit to measure the potential difference (p.d.) across the fixed resistor.

A voltmeter has the symbol 

(i) Add a voltmeter to Figure 1 to measure the potential difference (p.d.) across the fixed resistor.

(1)



- (ii) The supervisor recorded the potential difference across the fixed resistor as the current increased.

Table 1 shows their results.

current (A)	potential difference (V)
0.00	0.00
0.20	0.44
0.40	0.88
0.60	1.32
0.80	1.76
1.00	2.20
1.20	2.64
1.40	

**Table 1**

Predict the value of the potential difference when the current is 1.40 A.

(1)

..... V

- (iii) Describe the relationship between the current and the potential difference shown in Table 1.

(2)

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(iv) Calculate the resistance (R) when the current is 0.60 A as shown in Table 1.

(2)

Use the equation:  $R = \frac{V}{I}$

where V is potential difference and I is current.

Show your working.

resistance = ..... ohms

(b) (i) The supervisor checked the ammeter after the investigation was completed.

The ammeter gave readings with a systematic error of 0.01 A.

Give **one** reason for the systematic error in the ammeter readings.

(1)

(ii) Calculate the percentage error in the 1.20 A reading that this error of 0.01 A causes.

(2)

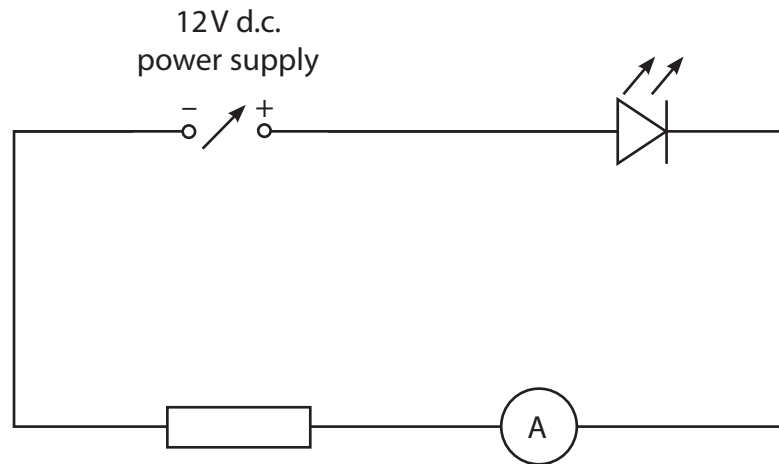
Show your working.

percentage error = ..... %



- (c) The supervisor puts a light emitting diode (LED) and a fixed resistor in another circuit.

Figure 2 shows the circuit.



**Figure 2**

The power transferred in the LED is 0.075 W.

The current in the circuit is 25 mA.

- (i) Calculate the voltage (p.d.) across the LED.

(4)

Use the equation:

$$\text{power} = \text{voltage} \times \text{current}$$

Show your working.

voltage (p.d.) = ..... V

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(ii) The supervisor kept the LED in the circuit switched on for 300 seconds.

Calculate the work done by the LED.

(3)

Use the equation:

$$\text{power} = \frac{\text{work done}}{\text{time}}$$

Show your working.

work done = ..... J

**(Total for Question 2 = 16 marks)**

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3 (a) The trainee technician used a method to collect data.

Identify **two** strengths of the trainee technician's method.

(2)

strength 1

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strength 2

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(b) Explain how **two** limitations in the trainee technician's investigation could be improved.

(4)

limitation 1

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limitation 2

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(c) Reproducibility and repeatability are measures of precision.

Describe how the reproducibility of the trainee technician's data could be tested.

(3)

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**(Total for Question 3 = 9 marks)**

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**TOTAL FOR SECTION 1 = 40 MARKS**

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## SECTION 2

### 4 Enzymes are biological catalysts in chemical reactions.

The rate of enzyme-catalysed reactions is affected by many factors, including temperature.

During digestion starch is broken down, to maltose, by the enzyme amylase.

Starch solution can be mixed with amylase solution in a test tube.

Starch reacts with iodine solution and turns the solution from brown to a blue/black colour. Maltose does not react with iodine solution.

You have been asked to write a plan to investigate the effect of temperature on the rate of digestion of starch by the enzyme amylase.

Your plan should include the following details:

- a hypothesis
- selection, and justification, of equipment, techniques or standard procedures
- health and safety associated with the investigation
- a step-by-step method for data collection and analysis to test the hypothesis including:
  - quantities to be measured
  - number and range of measurements to be taken
  - how equipment may be used
  - control variables
  - brief method for data collection analysis.

(12)

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(Total for Question 4 = 12 marks)



5 The pH of the environment affects the rate of an enzyme-catalysed reaction.

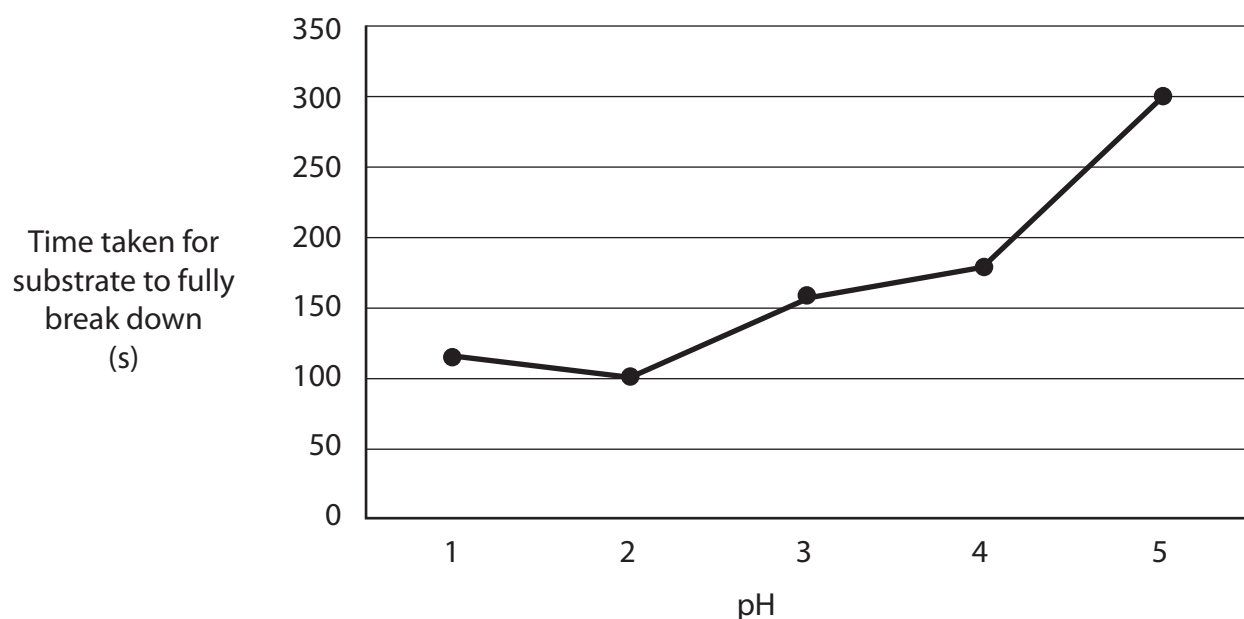
The pH of the environment can be changed by adding a buffer solution to the enzyme-substrate mixture.

A learner investigated the effect of pH on the rate of an enzyme-catalysed reaction.

Here is the learner's method:

- Label five beakers with pH values 1, 2, 3, 4 and 5.
- Add a pH buffer solution at the pH for the label on the beaker.
- Add the substrate into each beaker.
- Add the enzyme into each beaker.
- Check every minute until all of the substrate has been broken down.

The results of the learner's investigation are shown on Graph 1.



Graph 1

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The learner concludes that:

“The enzyme works best at pH 2.”

Evaluate the learner’s investigation.

Your answer should make reference to the:

- method of the experiment and equipment used
- results collected
- conclusion made.

(8)

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**(Total for Question 5 = 8 marks)**

**TOTAL FOR SECTION 2 = 20 MARKS**

**TOTAL FOR PAPER = 60 MARKS**



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