Pearson BTEC Level 3 Nationals Extended Certificate

Applied Science

Unit 3: Science Investigation Skills Teacher/ Technician notes and guidance – Confidential

Part P

June series 2018

Paper Reference
31619H

Practical investigation preparation materials.

Instructions

- This document contains confidential information for centres on the preparation and administration of the **Part A** practical investigation.
- This document should be opened once it is received to allow centres to prepare for the **Part A** practical investigation.
- This document is confidential. It must be stored securely and must not be disclosed to learners.
- This document should not be returned to Pearson.

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Guidance for Teachers/Tutors

Set task

The set task requires learners to carry out a practical investigation in **Part A** and then complete a taskbook in **Part B**.

Both **Parts A** and **B** of the task must be completed in the assessment period timetabled by Pearson.

The teacher/technicians notes provided in this document give information on the method for the practical investigation. It is the responsibility of centres to resource and trial the practical investigation prior to it being undertaken by learners in the assessment period.

Any assessment material not required by learners for submission must be collected and held securely by the Exams Office until the EAR deadline at which point they may be recycled or destroyed.

Part A Practical Investigation

Learners must not see the teacher/technician notes. A separate **Part A** will be available for learners at the beginning of the assessment period.

The **Part A** task brief provides all the necessary information for learners to conduct the practical investigation and includes a notes page for the learner to record their results/ observations.

Centres will be required to supervise learners when they carry out the investigation.

Teachers cannot provide guidance during the practical investigation. The practical investigation may take up to three hours depending on the nature of the investigation and it should be completed in the first section of the assessment period.

Centres must refer to the Pearson BTEC exam timetable for the **Part A** window to allow the centres to schedule sessions for all learners. Each learner must have a single session of three hours. Centres are encouraged to schedule the practical session (**Part A**) as close to the **Part B** as possible.

Learners may work in pairs to conduct the practical investigation, however they must record their set of results/observations independently.

Once learners have completed the practical investigation, teachers must keep the **Part A** taskbook containing learner results/observations secure.

This must be returned to learners when they start **Part B** in the second part of the assessment period.

Learners will need to refer to their results/observations obtained from **Part A** when they complete **Part B**.

Teachers/Technician Notes for the Practical Investigation

Learners must observe safe practice when carrying out practical scientific investigations.

It is the responsibility of centres to carry out risk assessments for all practical investigations.

Technician's list of equipment needed

- Approximately 1 kg of apples per learner/pair of learners
- Knife
- Peeler
- Chopping board
- Liquidiser
- Large beaker, labelled 'apple puree', per learner/pair of learners
- Pectinase solution or powder to make 5 different concentrations per learner/pair of learners
  - 50 cm^3 0% pectinase solution (distilled water)
  - 50 cm^3 0.25% pectinase solution
  - 50 cm^3 0.5% pectinase solution
  - 50 cm^3 1% pectinase solution
  - 50 cm^3 2% pectinase solution
- Measuring cylinders
- Conical flasks
- 5 medium beakers, labelled with the pectinase concentration that it contains, per learner/pair of learners
- Weighing boat
- Syringes
- Balance, reading to at least 2 decimal places
- Water bath(s)/incubator(s)
- Bottles of distilled water

Method for technicians for one learner/pair of learners

1. Peel and core approximately 1 kg of apples.
2. Puree, using a liquidiser, the peeled and cored apples.
3. Weigh out 800 g of the pureed apple into the large labelled beaker.
4. Prepare and measure 50 cm^3 of 0%, 0.25%, 0.5%, 1% and 2% pectinase solutions into five medium labelled beakers.
5. Store pureed apple and pectinase solutions at room temperature.
6. Set the water bath/incubator at 45°C.

Please note it is normal for the pureed apple to discolour and turn brown. This should not affect the results. However, the pureed apple and pectinase solutions should be prepared as close to the time of the practical as possible.

Learner's list of equipment needed

Each learner/pair of learners will need:

- 800 g pureed apple
- Set of 5 medium labelled beakers, each containing one of the 5 pectinase solutions
- 5 small beakers
- Cling film
- 15 filter papers
- 5 filter funnels
- 5 x 10 cm^3 measuring cylinders
- 5 conical flasks
- 5 stirring rods
- Permanent marker pen
- Stop clock
- Thermometer
- Access to a water bath/incubator set at 45°C
- Access to a balance, reading to at least 2 decimal places
- Bottles of distilled water

Learners will measure and record

1. The mass of apple juice extracted by different concentrations of pectinase solutions.
2. Any relevant observations.

Method for learners

1. Label five beakers and five 10 cm^3 measuring cylinders with the pectinase concentrations: 0%, 0.25%, 0.5%, 1% and 2%.
2. Weigh out 50 g of apple puree into each of the five labelled beakers.
3. Measure 10 cm^3 of each of the five pectinase solutions into the matching labelled 10 cm^3 measuring cylinders.
4. Pour the 10 cm^3 of pectinase solution from each measuring cylinder into the matching labelled beaker of apple puree.
5. Stir each beaker of apple puree and pectinase solution with a clean stirring rod.
6. Cover each labelled beaker with cling film.
7. Place all five labelled beakers in the water bath/ incubator, set at 45°C.
8. Leave the labelled beakers for 15 minutes.
9. During the 15 minutes, label five conical flasks with the five pectinase concentrations.
10. Weigh and record the mass of each of the five empty labelled conical flasks.
11. Place five funnels with filter paper into the five labelled conical flasks.
12. After the 15 minutes have elapsed, remove all five labelled beakers from the water bath/incubator.
13. Filter each apple puree and pectinase mixture through the funnel and filter paper into the matching labelled conical flask.
14. After five minutes, remove the funnel from each conical flask.
15. Weigh and record the mass of each conical flask containing the extracted juice.
16. Calculate and record the mass of extracted juice for each of the five pectinase concentrations.
17. Record any other observations.
18. Rinse with distilled water the beakers, conical flasks, stirring rods, funnels and measuring cylinders.
19. Repeat steps 1 to 18 two more times.

Write your name here

Surname	Other names

Pearson BTEC Level 3 Nationals Extended Certificate

Applied Science

Unit 3: Science Investigation Skills

Part A

23 April 2018 – 3 May 2018	Paper Reference **31619H**

Instructions

- **Part A** contains material for the completion of the preparatory work for the set task.
- **Part A** should be undertaken over approximately 3 hours across the assessment period as timetabled by Pearson.
- **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 B** materials for the set task will be issued prior to the start of the supervised assessment period according to the guidance in the specification.
- This taskbook should not be returned to Pearson.

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Instructions for Teachers/Tutors

This paper must be read in conjunction with the teacher/technician notes and guidance, the unit information in the specification and the BTEC Nationals Instructions for Conducting External Assessments (ICEA) document. See the Pearson website for details.

This taskbook contains the instructions for learners and the set task brief and should be issued to learners at the start of the practical investigation. This taskbook must not be taken out of the classroom/laboratory.

The practical investigation outlined in the set task brief must be undertaken by learners over approximately three hours during the first section of the assessment period. The practical investigation must be undertaken in supervised conditions.

Centres are free to arrange the supervised assessment period how they wish provided the three hours for completing the practical investigation are under the level of supervision specified, and in accordance with the conduct procedures.

Learners will be expected to conduct a practical investigation and record their results/observations in this taskbook.

Teachers/tutors cannot give any support to learners during the practical investigation and recording of results/observations.

Learners may work in pairs for the practical investigation, however they must record their own results and observations independently.

Once the practical investigation is completed and learners have recorded their results/observations in the spaces provided, teacher/tutors must keep the taskbooks secure until the start of **Part B**.

Any assessment materials not required by learners for submission must be collected and held securely by the Exams Office until the EAR deadline at which point they may be recycled or destroyed.

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.

Instructions for Learners

Read the set task information carefully.

This contains **Part A** of the information you need to prepare for the set task.

You will carry out a practical investigation over a period of up to three hours.

You may work in pairs, however you must record your set of results/observations independently in the spaces provided.

Your teacher/tutor may give guidance on when you can complete the practical investigation.

Your teacher/tutor cannot give you feedback during the practical investigation.

You must not take this taskbook out of the classroom/laboratory at any time and you must hand it in to your teacher/tutor on completion of the practical investigation and write up of any results/observations.

You will use your results/observations recorded in this taskbook, and they will be given back to you when you begin the set task in **Part B**.

Set Task Brief

Please read the following brief carefully before completing the practical investigation.

You must observe safe practice when carrying out the practical investigation.

You are an assistant research scientist who works for an apple juice company.

You have been asked to find the optimum concentration of the enzyme pectinase to extract the maximum mass of juice from apples.

The pectinase enzyme breaks down the apple cell walls to release the juice.

Safety information

Do not consume the apple juice extracted.

Avoid direct skin and eye contact and wear eye protection.

Wipe up spillages immediately and rinse the cloth thoroughly with water.

Method

1. Label five beakers and five 10 cm^3 measuring cylinders with the pectinase concentrations: 0%, 0.25%, 0.5%, 1% and 2%.
2. Weigh out 50 g of apple puree into each of the five labelled beakers.
3. Measure 10 cm^3 of each of the five pectinase solutions into the matching labelled 10 cm^3 measuring cylinders.
4. Pour the 10 cm^3 of pectinase solution from each measuring cylinder into the matching labelled beaker of apple puree.
5. Stir each beaker of apple puree and pectinase solution with a clean stirring rod.
6. Cover each labelled beaker with cling film.
7. Place all five labelled beakers in the water bath/incubator, set at 45 °C.
8. Leave the labelled beakers for 15 minutes.
9. During the 15 minutes, label five conical flasks with the five pectinase concentrations.
10. Weigh and record the mass of each of the five empty labelled conical flasks.
11. Place five funnels with filter paper into the five labelled conical flasks.
12. After the 15 minutes have elapsed, remove all five labelled beakers from the water bath/incubator.
13. Filter each apple puree and pectinase mixture through the funnel and filter paper into the matching labelled conical flask.
14. After five minutes, remove the funnel from each conical flask.
15. Weigh and record the mass of each conical flask containing the extracted juice.
16. Calculate and record the mass of extracted juice for each of the five pectinase concentrations.
17. Record any other observations.
18. Rinse with distilled water the beakers, conical flasks, stirring rods, funnels and measuring cylinders.
19. Repeat steps 1 to 18 two more times.

Record your results/observations in the space provided.

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Write your name here

Surname	Other names

Pearson BTEC Level 3 Extended Certificate

Centre Number

Learner Registration Number

Applied Science

Unit 3: Science Investigation Skills

Part B

Friday 4 May 2018
Time: 1 hour 30 minutes

Paper Reference
31619H

You must have:
a calculator and a ruler.

Total Marks

Instructions

- You will need your results/observations from the practical investigation in **Part A**.
- **Part B** contains material for the completion of the set task under supervised conditions.
- **Part B** must be undertaken in a single session of 1 hour and 30 minutes on the date timetabled by Pearson.
- **Part B** 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 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.

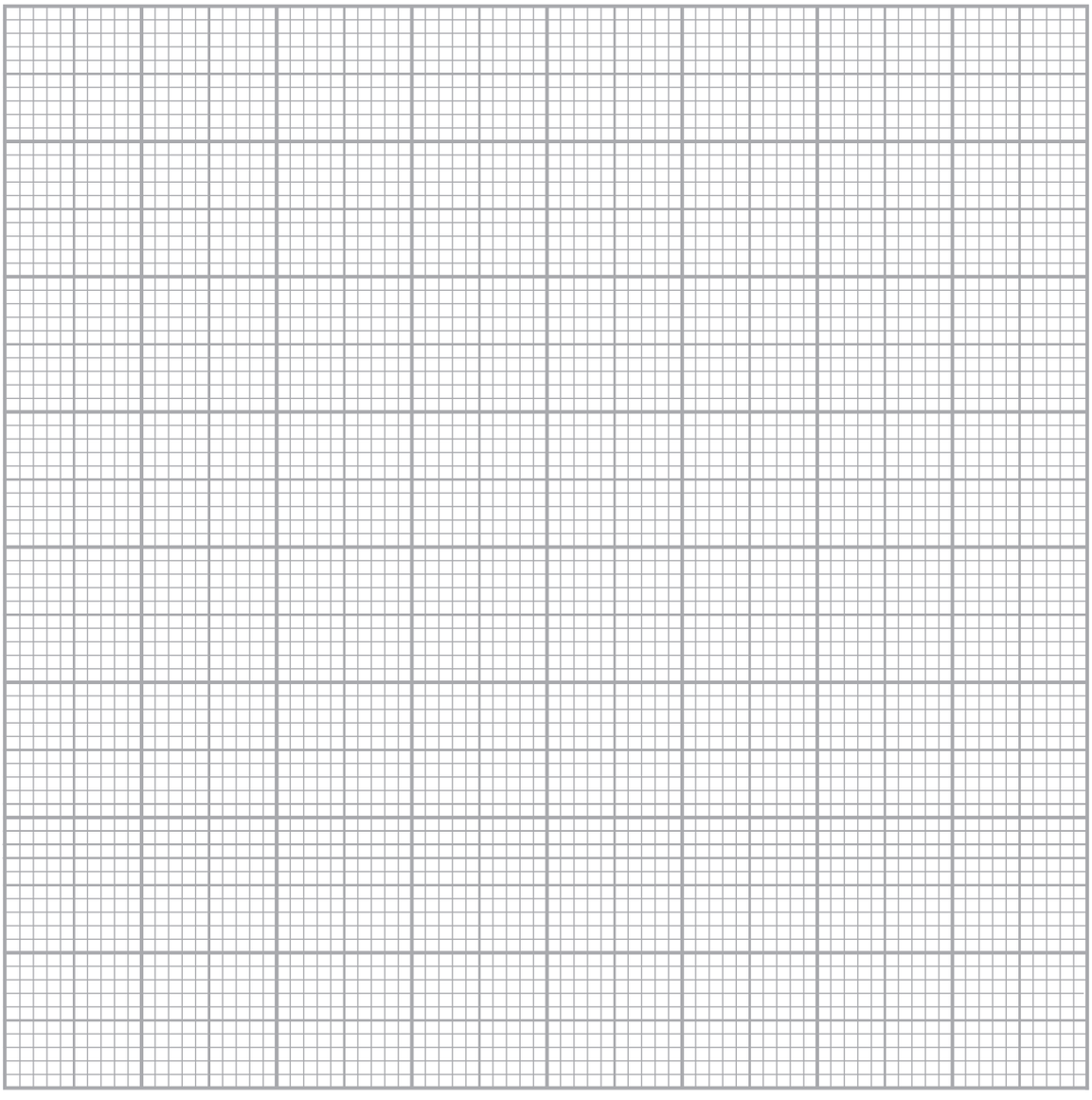
SECTION 1

1 (a) Record all your experimental results, including average mass of extracted apple juice, in a suitable table, using the space provided. Circle any anomalous results.

(3)

(b) Plot a line graph of average mass of extracted apple juice against pectinase concentration.

(3)



(c) (i) Describe, using information from your graph, how the change in the concentration of pectinase affected the mass of extracted apple juice.

(2)

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(ii) Identify, using information from your graph, the optimum concentration of pectinase for extracting apple juice.

(1)

..... %

(iii) Give **one** reason why the pectinase concentration you identified in (c)(ii) is the optimum.

(1)

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(d) Give **one** reason why it was important to stir the pureed apple and pectinase solution.

(1)

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(e) Describe how you made sure that the mass of extracted apple juice was measured accurately.

(3)

(f) Temperature was one of the variables controlled in your investigation.

The rate of enzyme activity is affected by temperature. Pectinase has an optimum temperature at which it works best.

(i) Explain how a temperature **below** the optimum would affect the rate of pectinase activity.

(2)

(ii) Explain how a temperature **above** the optimum would affect the rate of pectinase activity.

(2)

(Total for Question 1 = 18 marks)

2 (a) Your colleague carried out a similar investigation.
They extracted juice from two different types of apple: Jazz and Gala.

(i) State a null hypothesis for your colleague's investigation.

(2)

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(ii) The table shows the mass of apple juice extracted from the Jazz and Gala apples.

Experimental repeats	Mass of juice extracted (g)	
	Jazz apples	Gala apples
1	102.0	141.0
2	95.0	160.0
3	134.0	155.0
4	115.0	130.0
5	97.0	120.0
6	132.0	191.0
7	119.0	154.0
8	107.0	203.0
9	126.0	170.0
10	111.0	176.0
Mean mass of juice extracted (g)	113.8	160.0
Standard deviation (s)	13.93	26.00

Calculate, using the unpaired *t*- test, the value of *t* for your colleague's investigation.

(6)

Use the equation.

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

Show your working.

t = ...

(iii) Calculate the degrees of freedom for your colleague's investigation.

(2)

Use the equation $(n_1 + n_2) - 2$

Show your working.

degrees of freedom = ...

(iv) Give the critical value of *t* at the p = 0.05 level.

(1)

Use the *t* table shown.

		p = 0.05
degrees of freedom	16	2.120
	17	2.110
	18	2.101
	19	2.093
	20	2.086
	21	2.080
	22	2.074

***t* table**

critical value of *t* = ...

(v) Explain whether the null hypothesis should be accepted or rejected.

(3)

(Total for Question 2 = 14 marks)

3 (a) (i) The ripeness of the apples used in your investigation was a variable that could not be controlled.

Explain why the differences in ripeness did not affect your results.

(2)

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(ii) Identify **two** other variables in your investigation that could not be controlled.

(2)

1 .....

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2 .....

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(b) Explain **two** ways you could extend your investigation to provide a more accurate value for the optimum concentration of pectinase.

(4)

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(Total for Question 3 = 8 marks)

TOTAL FOR SECTION 1 = 40 MARKS

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SECTION 2

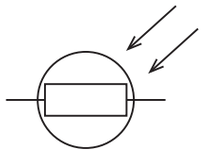
4 Variation in resistance with light brightness

The brightness of a lamp can be altered by changing the power supplied to it.

The resistance of a light-dependent resistor (LDR) changes with the brightness of the light falling on the LDR.

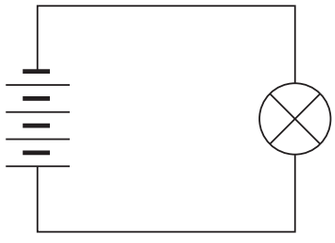
The images show an LDR and the circuit symbol used to represent it.

LDR

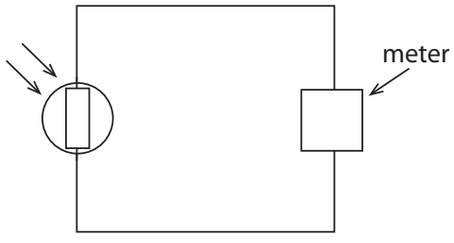


Circuit symbol for the LDR

You have been asked to write a plan for an investigation to find out how the power supplied to the lamp in circuit A is related to the resistance of the LDR in circuit B.



A



B

Changing the brightness of light produced by the lamp in circuit A can change the resistance of the LDR in circuit B.

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
- methods for data collection and analysis to test the hypothesis:
  - quantities to be measured
  - the number and range of measurements to be taken
  - how equipment may be used
  - control variables
  - brief method for data collection analysis.

You may include in your plan the use of any standard laboratory apparatus, electrical components or electrical meters.

(12)

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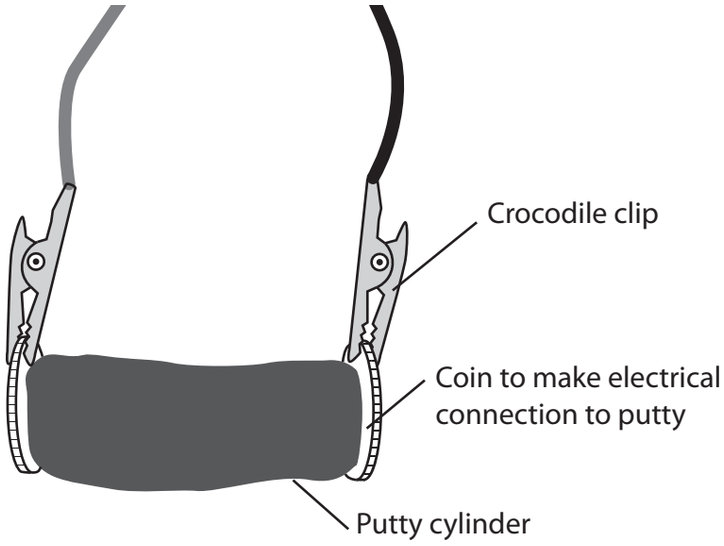
(Total for Question 4 = 12 marks)

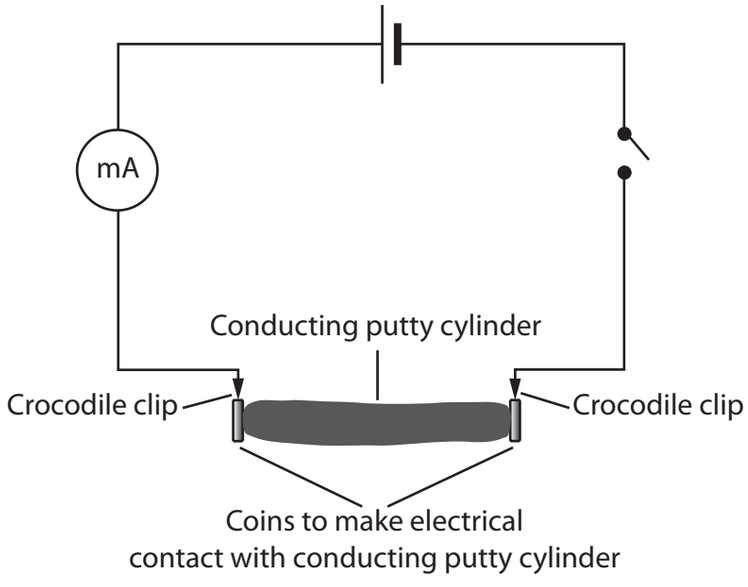
5 Conducting putty is a material that will conduct an electric current.

The conducting putty can be cut to any length.

The image shows a roll of conducting putty with connections to a circuit.



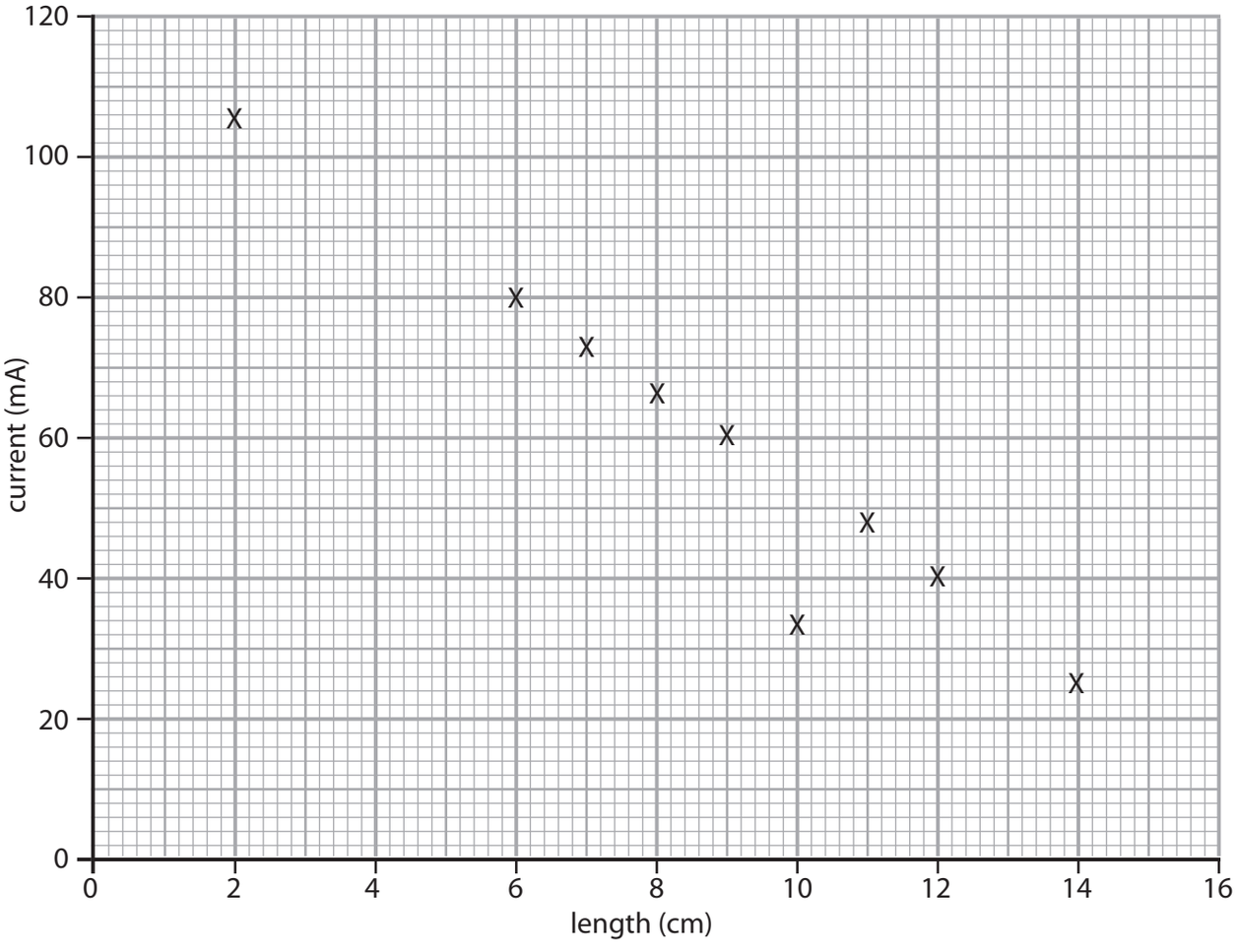
A learner sets up the circuit shown to investigate how the current in the conducting putty varies as its length changes.



Here is the method the learner used.

- measure the length of the conducting putty cylinder
- connect the conducting putty cylinder to the circuit
- measure the current
- cut the conducting putty to a new length
- measure the current for each new length of conducting putty.

The graph shows the results of the learner's investigation.



The learner concludes that:

'The current passing through the conducting putty cylinder decreases as the length of the cylinder decreases'.

Evaluate the learner's investigation.

Your answer should include reference to the:

- method of the experiment
- 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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