Pearson BTEC Level 3 Nationals Extended Certificate

Applied Science/Forensic and Criminal Investigation
Unit 3: Science Investigation Skills
Teacher / technician notes and guidance – confidential

Part P

June series 2019

Paper Reference
31619H

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

The teacher/technician 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 ROMM 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 the 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.

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. For example, molten marshmallow or grease may drip.

Technician's list of equipment

- Retort stand boss and clamp
- Metal calorimeter with lid
- Thermometer
- 25 cm^3 pipette
- Glass stirring rod
- Heatproof mat
- Mounted needle
- Bunsen burner
- Four carbohydrate foods: maize puffs, marshmallows, popped popcorn, rice cakes

Technicians should ensure that the foods are suitable to be mounted on the needle and will burn readily and give a temperature change.

Method for technicians

1. Clamp the metal calorimeter in a level position above a heatproof mat.
2. Use a pipette to measure 25 cm^3 of water into the metal calorimeter.
3. Measure and record the initial temperature of the water and place the lid onto the metal calorimeter.
4. Check that the first carbohydrate food will attach securely to the mounted needle.
5. Safely, holding the needle, ignite the carbohydrate food, using a Bunsen burner.
6. Immediately place the burning food approximately 1 cm under the metal calorimeter.
7. When the carbohydrate food has stopped burning, stir the water and measure and record the final temperature of the water.
8. Ensure there is measurable temperature change of the water.
9. Carefully empty, clean and dry the inside and outside of the calorimeter.
10. Repeat steps 1–9 to check that the three other carbohydrate foods mount the needle, give a measurable temperature change and are not a health hazard e.g drip too much or spit oil.

Learner's list of equipment

Each learner/pair of learners will need:

- Retort stand boss and clamp
- Metal calorimeter with lid
- Thermometer
- 25 cm^3 pipette
- Glass stirring rod
- Heatproof mat
- Mounted needle
- Bunsen burner
- Weighing boat
- Access to a balance reading to at least two decimal places
- Four carbohydrate foods: maize puffs, marshmallows, popped popcorn, rice cakes

Please note learners may be given any variety or flavouring of the four carbohydrate foods.

Technicians should ensure that the foods are suitable to be mounted on the needle and will burn readily and give a temperature change.

Learners will:

1. Measure and record the mass of the carbohydrate food that has been burned.
2. Measure and record the temperature change of the water.
3. Record any other relevant observations.

Method for learners

1. Clamp the metal calorimeter in a level position above a heatproof mat.
2. Use a pipette to measure 25 cm^3 of water into the metal calorimeter.
3. Measure and record the mass of a small piece of the first carbohydrate food to be tested.
4. Measure and record the initial temperature of the water and place the lid onto the metal calorimeter.
5. Carefully attach the first carbohydrate food to the mounted needle.
6. Safely, holding the needle, ignite the carbohydrate food using a Bunsen burner.
7. Immediately place the burning food approximately 1 cm under the metal calorimeter.
8. When the carbohydrate food has stopped burning, stir the water and measure and record the final temperature of the water.
9. Measure and record the mass of any remaining carbohydrate food.
   Note: this value may be very small for some foods.
10. Calculate and record the mass of the carbohydrate food that has been burned.
11. Calculate and record the temperature change of the water.
12. Carefully empty, clean and dry the inside and outside of the calorimeter.
13. Repeat steps 1–12 to get three results for the first carbohydrate food.
14. Repeat steps 1–13 for the other three carbohydrate foods.

Please note that depending on the food burnt and the precision of the balance, some foods may register as zero grams after burning. This is acceptable.

Write your name here

Surname	Other names

Pearson BTEC Level 3 Nationals Extended Certificate

Applied Science / Forensic and Criminal Investigation

Unit 3: Science Investigation Skills

Part A

26 April 2019 – 9 May 2019	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, 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, teachers/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 ROMM 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 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 a research scientist working for a food manufacturer.

You have been asked to investigate the energy content of four different carbohydrate foods:

- maize puffs
- marshmallows
- popped popcorn
- rice cakes.

Safety information

Do not eat any of the carbohydrate foods.

You may have allergies to the carbohydrate foods. Take necessary precautions and make sure that you wash your hands after carrying out the investigation.

Caution: Take care when handling the hot equipment, molten marshmallow or grease may drip.

You will:

1. Measure and record the mass of the carbohydrate food that has been burned.
2. Measure and record the temperature change of the water.
3. Record any other relevant observations.

Follow this method to obtain a set of results.

1. Clamp the metal calorimeter in a level position above a heatproof mat.
2. Use a pipette to measure 25 cm^3 of water into the metal calorimeter.
3. Measure and record the mass of a small piece of the first carbohydrate food to be tested.
4. Measure and record the initial temperature of the water and place the lid onto the metal calorimeter.
5. Carefully attach the first carbohydrate food to the mounted needle.
6. Safely, holding the needle, ignite the carbohydrate food using a Bunsen burner.
7. Immediately place the burning food approximately 1 cm under the metal calorimeter.
8. When the carbohydrate food has stopped burning, stir the water and measure and record the final temperature of the water.
9. Measure and record the mass of any remaining carbohydrate food.
   Note: this value may be very small for some foods.
10. Calculate and record the mass of the carbohydrate food that has been burned.
11. Calculate and record the temperature change of the water.
12. Carefully empty, clean and dry the inside and outside of the calorimeter.
13. Repeat steps 1–12 to get three results for the first carbohydrate food.
14. Repeat steps 1–13 for the other three carbohydrate foods.

Please note that depending on the food burnt and the precision of the balance, some foods may register as zero grams after burning. This is acceptable.

Record your results/observations in the space provided.

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Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson BTEC Level 3 Nationals Extended Certificate

Centre Number | Learner Registration Number

Thursday 9 May 2019

Supervised hours: 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 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 the average temperature change of water and the average mass of the carbohydrate food burned, in a suitable table using the space provided. Circle any anomalous results.

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(b) (i) Calculate the average heat energy in joules per gram supplied to the water for each of the foods that you tested.

Use the following equation:

$$\text{average heat energy per gram} = \frac{25 \times 4.2 \times \text{average temperature rise of water}}{\text{average mass of food burned}}$$

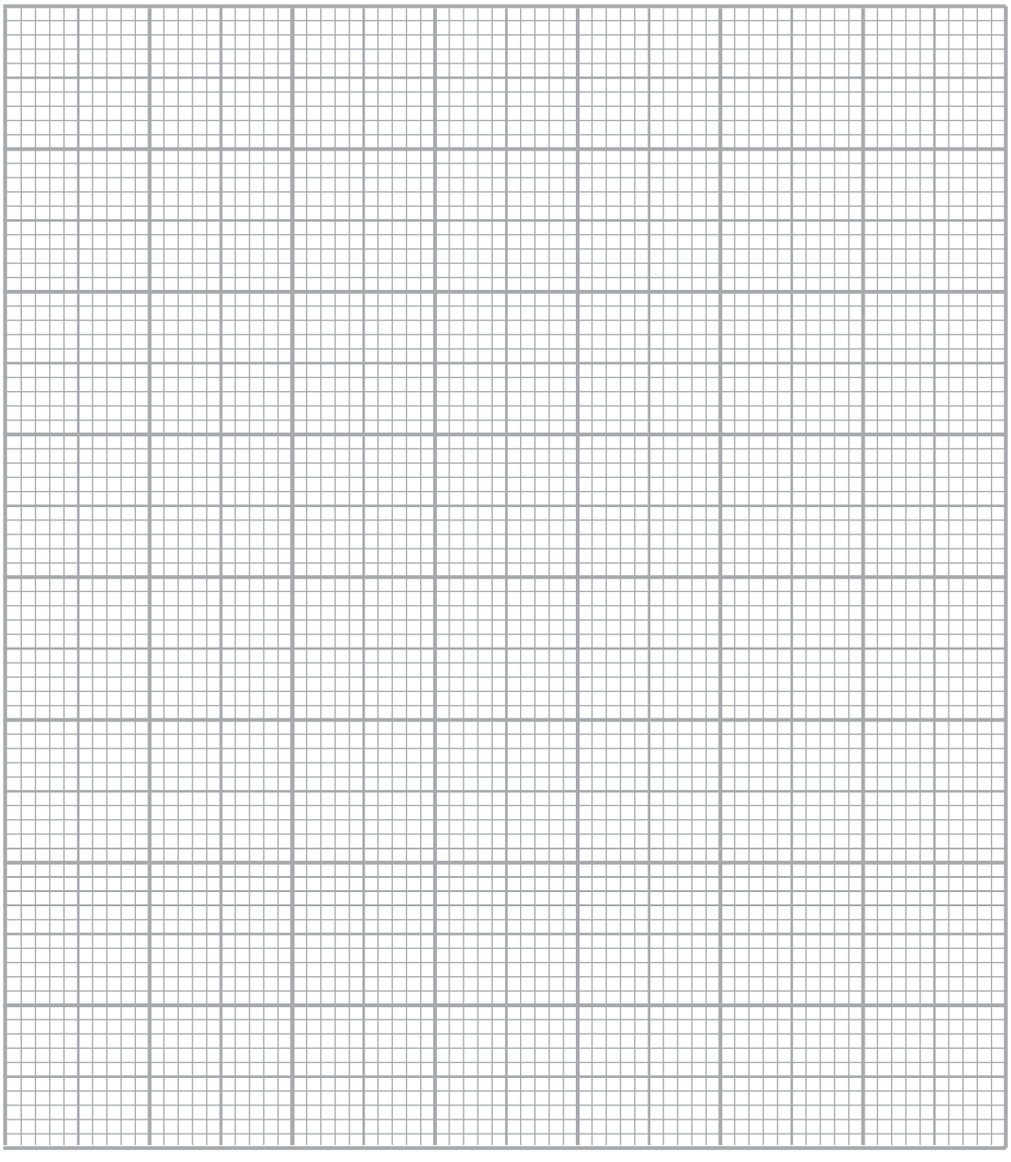
Show your working and write your answers in the table provided.

(4)

carbohydrate food	maize puffs	marshmallows	popped popcorn	rice cakes
average heat energy per gram ($J\ g^{-1}$)				

(ii) Draw a bar chart of average heat energy per gram for the carbohydrate foods.

(3)



(iii) Describe your results, using the information in the graph.

(2)

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(c) State **two** observations you made when burning the carbohydrate foods.

(2)

1 .....

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2 .....

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(d) Describe how you used the pipette to measure the 25cm^3 of water accurately.

(2)

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(e) Give **one** reason why a lid was used on the calorimeter.

(1)

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(f) (i) State **one** hazard in your experiment.

(1)

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(ii) Explain how you minimised **one** risk from the hazard in (f)(i).

(2)

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(Total for Question 1 = 20 marks)

2 (a) Your colleague repeated the investigation.

For one of the trials, they recorded an initial temperature of 23°C and a final temperature of 45°C.

They used a thermometer that measured in 1°C increments.

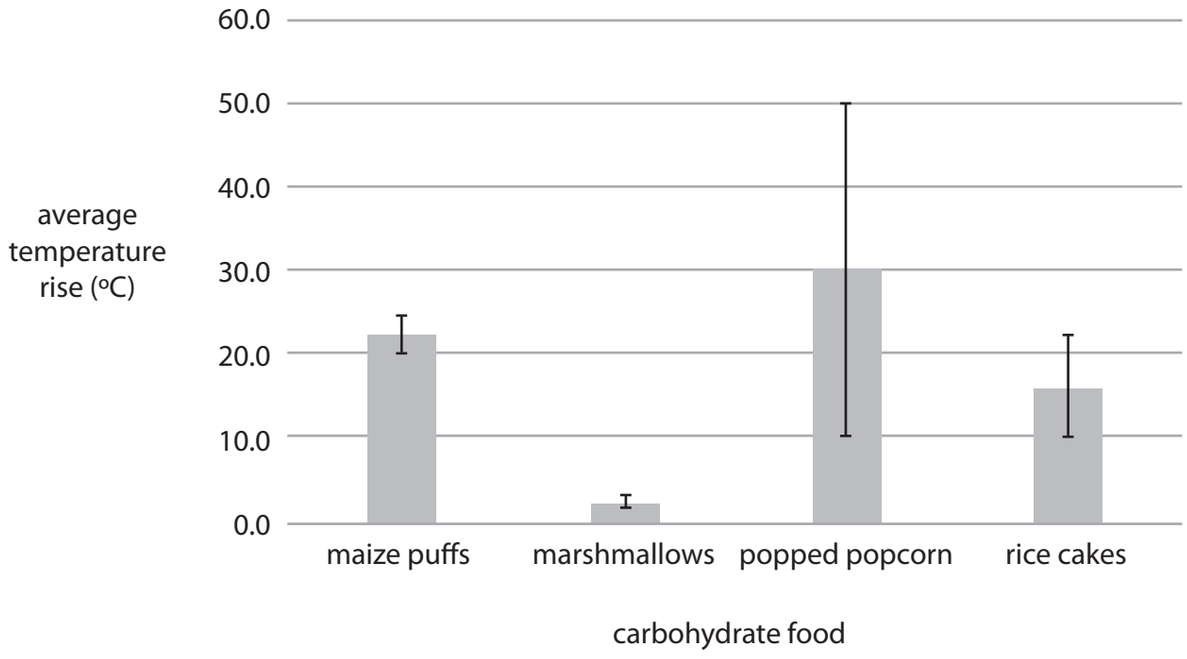
Calculate the total percentage error, using the initial and final readings, for this temperature rise.

(3)

total percentage error = ...%

(b) Your colleague calculated the average and the standard deviation for the temperature rises.

They draw a graph of their results.



(i) Explain, using information from the graph, whether there is a significant difference between the average temperature rise for each of the carbohydrate foods.

(4)

(ii) Explain, using information from the graph, which carbohydrate food has the least reliable results.

(2)

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(c) Your colleague calculated the heat energy per gram supplied to the water for two of the carbohydrate foods that they tested.

carbohydrate food	heat energy supplied to water per gram of carbohydrate food (J g^{-1})				
	trial 1	trial 2	trial 3	trial 4	mean
maize puffs	4653	4732	4685	4666	
rice cakes	3300	3181	3258	3229	3242

(i) Calculate the mean heat energy per gram supplied to the water for maize puffs.

(1)

mean heat energy per gram = ... J g^{-1}

(ii) The manufacturer states on the packaging that rice cakes should produce 3699J g^{-1}.

Suggest **two** reasons why the value obtained by your colleague is less than the value stated by the manufacturer.

(2)

1 .....

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2 .....

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(Total for Question 2 = 12 marks)

3 (a) The material the calorimeter was made from was one of the variables that you controlled in your investigation.

State **two** other variables you controlled in your investigation.

(2)

1 .....

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2 .....

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(b) Explain why the mass of the carbohydrate food was recorded before and after burning in your investigation.

(2)

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(c) Explain **two** ways in which you could extend your investigation.

(4)

1 .....

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2 .....

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(Total for Question 3 = 8 marks)

TOTAL FOR SECTION 1 = 40 MARKS

SECTION 2

4 Plant growth

Plants use carbon dioxide and water to produce glucose and oxygen.

This process is called photosynthesis.

The rate of photosynthesis is affected by many factors, such as light intensity.

Aquatic plants release visible bubbles of oxygen gas into the surrounding water when they photosynthesise.

Pond weed is an example of an aquatic plant.

You have been asked to write a plan to investigate the effect of light intensity on the rate of photosynthesis in pond weed.

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 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 soil affects the growth of plants.

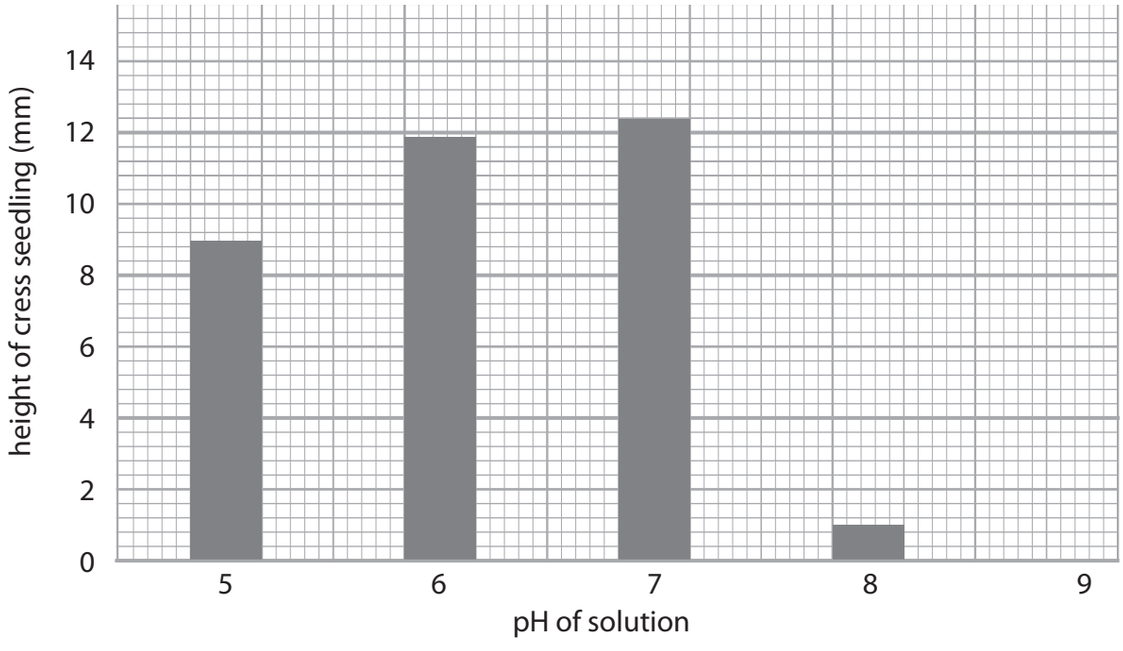
The pH of the soil can be changed by the solution used to water the plants.

A learner investigated the effect of pH on the growth of cress seedlings.

Here is the learner's method.

- Label five beakers with pH values 5, 6, 7, 8 and 9.
- Place a piece of dry cotton wool into each beaker.
- Place one cress seed onto the cotton wool in each beaker.
- Water the cress seed with a solution with the labelled pH value.
- Once grown, measure the height of the cress seedling in each solution.

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



The learner concludes that:

"The cress seedlings must be grown in soil at pH 7."

Evaluate the learner's investigation.

Your answer should make 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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