

**Pearson BTEC Level 3 Nationals Extended Certificate**

**January series 2019**

Paper Reference **31619H**

**Applied Science/Forensic and Criminal Investigation**

**Unit 3: Science Investigation Skills**

**Teacher/Technician notes and guidance - Confidential**

**Part P**

**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/Technicians

### Set task

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

Both **Parts 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 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 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/Technicians 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

Each learner/pair of learners will need:

- two new D type 1.5 V alkaline cells in a double cell holder with leads
- six M.E.S. lamps 2.5 V 0.25 A or six M.E.S lamps 2.5 V 0.30 A
- six M.E.S. lamp holders with leads
- switch or tapping key
- voltmeter or multi-meter reading to 5 V d.c. and two decimal places.

If a multi-meter is used, fix the multi-meter range by putting tape over the dial and tape over any connections not to be used.

### Method for technicians for one learner/pair of learners

1. Set up the circuit as shown in Figure 1.

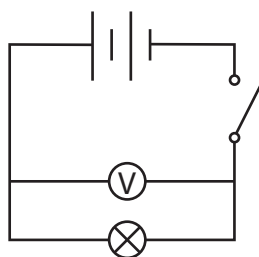


Figure 1

2. Check that the lamp lights.
3. Repeat step 2 for all six lamps.
4. Disassemble the circuit.
5. Mark the positive and negative terminals on the voltmeters or multi-meters and the cells.
6. If a multi-meter is used, set to the correct d.c. voltage range.

### Learner's list of equipment needed

Each learner/pair of learners will need:

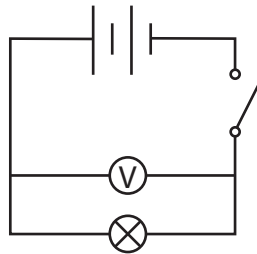
- two new D type 1.5 V alkaline cells in a double cell holder with leads
- six M.E.S. lamps 2.5 V 0.25 A or six M.E.S lamps 2.5 V 0.30 A
- six M.E.S. lamp holders with leads
- switch or tapping key
- voltmeter or multi-meter reading to 5 V d.c. and two decimal places
- spare lamps to replace any that 'blow'
- spare new D type 1.5 V alkaline cells to replace any that become flat
- spare leads and connectors.

**Learners will:**

1. Record the number of lamps being used in parallel.
2. Measure and record the voltmeter readings each time a lamp is added.
3. Record any other relevant observations.

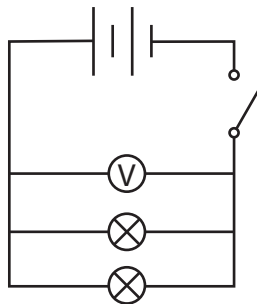
**Method for learners**

1. Set up the circuit shown in Figure 2.



**Figure 2**

2. Close the circuit.
3. As soon as the circuit is closed, record the reading on the voltmeter.
4. Open the circuit.
5. Repeat steps 2 to 4 to get three voltmeter readings.
6. Record the number of lamps in the circuit.
7. Add a second lamp to the circuit in parallel with the first lamp, as shown in Figure 3.



**Figure 3**

8. Repeat steps 2 to 6.
9. Add another lamp in parallel and repeat steps 2 to 6.
10. Repeat step 9 until there are six lamps in parallel in the circuit.

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**

8 January 2019 – 21 January 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 task book 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 EAR deadline at which point they may be recycled or destroyed.

Refer carefully to the instructions in this task book and the BTEC Nationals Instructions for Conducting External Assessments (ICEA) document to ensure that the preparatory period is conducted correctly and that the 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 task book out of the classroom 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 task book, and they will be given back to you when you begin the set task in **Part B**.

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### 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 junior technician working in the quality control laboratory of Evacell, a company that makes cells and batteries. You have been asked to test two random cells to check that they meet production standards.

Cells and batteries store energy that can be transferred to a lamp to make it light.

You will set up circuits to measure the voltage across a number of lamps in parallel.

You will find out how the voltage across the lamps changes with the number of lamps in parallel in the circuit.

#### **Safety information**

The chemicals used in cells are corrosive and are irritants. Do not attempt to open the cells. Do not short the cells as they may overheat.

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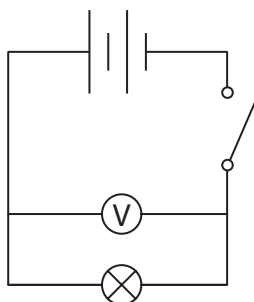
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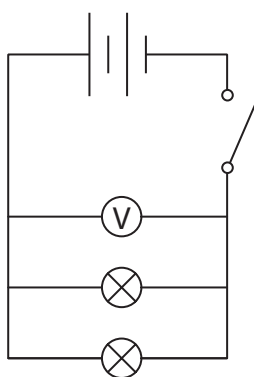
## Method

1. Set up the circuit shown in Figure 1.



**Figure 1**

2. Close the circuit.
3. As soon as the circuit is closed, record the reading on the voltmeter.
4. Open the circuit.
5. Repeat steps 2 to 4 to get three voltmeter readings.
6. Record the number of lamps in the circuit.
7. Add a second lamp to the circuit in parallel with the first lamp, as shown in Figure 2.



**Figure 2**

8. Repeat steps 2 to 6.
9. Add another lamp in parallel and repeat steps 2 to 6.
10. Repeat step 9 until there are six lamps in parallel in the circuit.

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Record your results and observations in the space provided.

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Candidate surname					Other names					
Pearson BTEC Level 3 Nationals Extended Certificate	Centre Number					Learner Registration Number				
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<b>Monday 21 January 2019</b>										
Supervised hours: 1 hour 30 minutes					Paper Reference <b>31619H</b>					
<b>Applied Science / Forensic and Criminal Investigation</b>										
<b>Unit 3: Science Investigation Skills</b>										
										<b>Part B</b>
<b>You must have:</b> 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 voltage in a suitable table, using the space provided. Circle any anomalous results.

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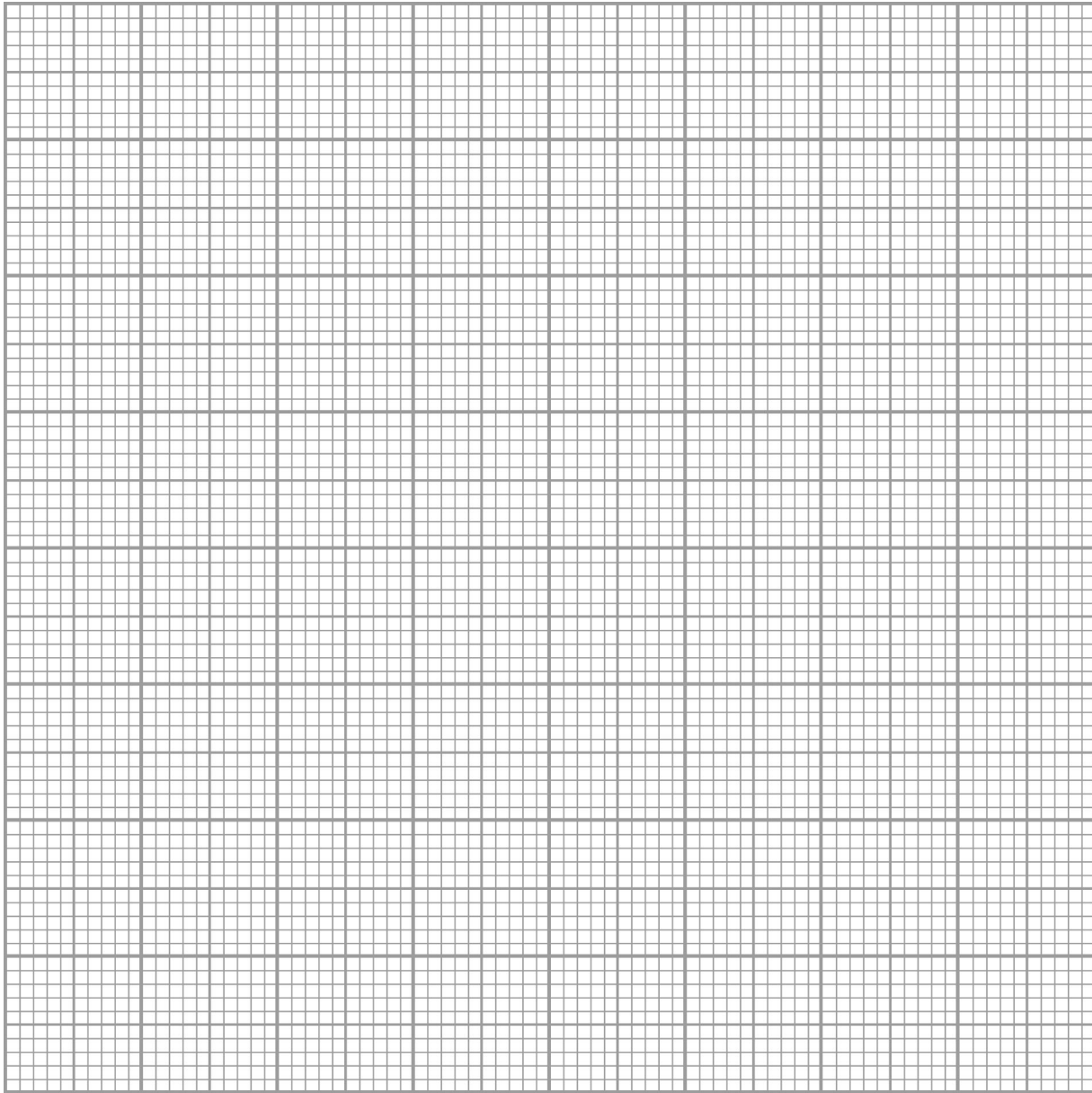
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(b) Plot a graph of average voltage across the lamps against number of lamps in parallel in the circuit.

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(c) (i) State the independent variable in your investigation. (1)

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(ii) State the dependent variable in your investigation. (1)

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(d) Describe, using information from your graph, the relationship between the voltage across the lamps and the number of lamps in parallel. (2)

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(e) State **two** observations you made about the brightness of the lamps. (2)

1 .....

2 .....

(f) Explain why it was necessary to open the switch in between taking voltmeter readings. (2)

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(Total for Question 1 = 14 marks)

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2 Your colleague carried out a similar investigation into the effect of the voltage across an increasing number of lamps in parallel.

They measured the current in the circuit as the number of lamps in parallel was increased from one to six.

Figure 1 shows a graph of their results.

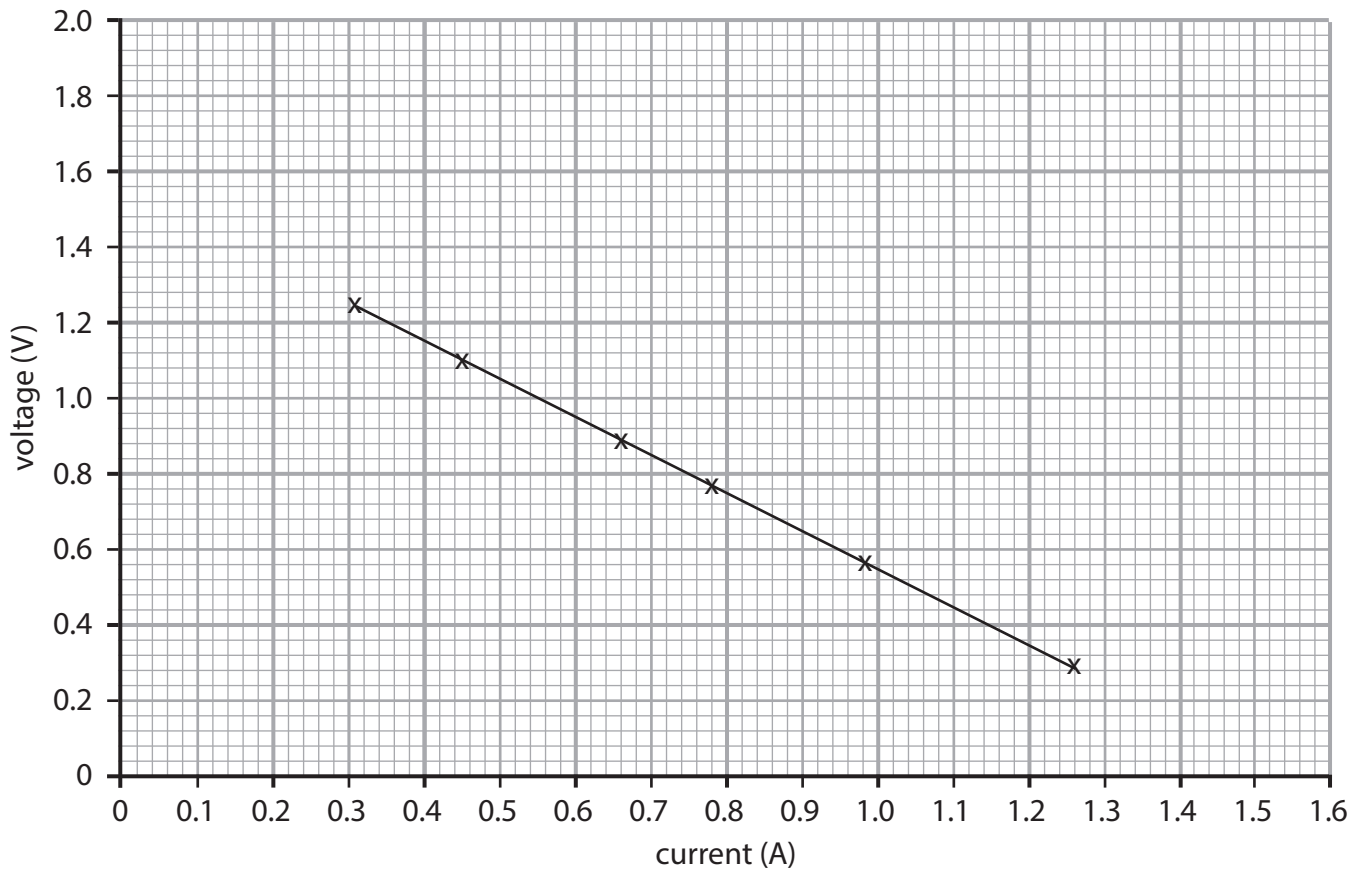


Figure 1

(a) (i) Identify, using the graph, the voltage when the current is 0.6 A.

(1)

voltage = ..... V

(ii) Draw an extension of the line on the graph to cut both the x and y axes.

(1)



(b) The equation of the line is given by  $y = -mx + c$ .

(i)  $c$  is the value of the intercept on the y-axis.

Estimate the value of  $c$ .

(1)

$$c = \dots\dots\dots V$$

(ii) Estimate the value of the intercept on the x-axis.

(1)

$$\text{intercept on x-axis} = \dots\dots\dots A$$

(iii)  $-m$  is the gradient of the line.

Calculate  $m$ .

Use the equation

$$m = \frac{c}{(\text{x-axis intercept})}$$

(2)

$$m = \dots\dots\dots V/A$$

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- (c) (i) Your colleague notes that when one lamp is used in the circuit the voltage across the lamp is 1.26 V and the current is 0.31 A.

Show that the power of the lamp is approximately 0.4 W.

Use the equation

$$\text{Power} = VI \text{ (voltage} \times \text{current)}$$

Show your working.

(2)

power = ..... W

- (ii) Your colleague needs to find out how long one of these lamps would keep working in a torch with a cell.

Your colleague finds out that the energy stored by a cell is 9360 J.

Assume the power output of the lamp is a constant 0.4 W.

Calculate the time in hours that the cell would deliver current to the lamp.

Use the equation

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

Show your working.

(4)

time for lamp to keep working = ..... hours



(d) Your colleague used a voltmeter that had a maximum error (uncertainty) of 0.01 V when the measured value was 1.11 V.

Calculate the percentage error in the measurement.

(2)

Use the equation

$$\text{percentage error} = \frac{\text{maximum error}}{\text{measured value}} \times 100$$

percentage error = ..... %

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(e) Your colleague finds some data about how the current varies with the number of lamps in a parallel circuit. Figure 2 shows the data.

Number of lamps	Current in the circuit (A)
1	0.62
2	1.08
3	1.50
4	1.88
5	2.22
6	2.52

**Figure 2**

Your colleague predicts

'When seven lamps are added in parallel the current will be 2.98 A.'

Comment on whether you think their prediction is correct.

Use your colleague's results to support your answer.

(2)

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



3 (a) You used the same voltmeter throughout your investigation.

Explain how **one** other variable was controlled.

(2)

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(b) Repeatability and reproducibility can be used to test the reliability of an investigation.

Explain these **two** ways in which the reliability of your data could be tested.

(4)

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(c) One way of extending your investigation is by using an ammeter to measure the current in the circuit.

Explain **two** other ways your investigation could be extended.

(4)

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**(Total for Question 3 = 10 marks)**

**TOTAL FOR SECTION 1 = 40 MARKS**





## SECTION 2

- 4 Diffusion is the random movement of particles from an area of high concentration to an area of low concentration.

The rate of diffusion of sulfuric acid into a cube of agar is being investigated. The agar contains a mixture of sodium hydroxide with phenolphthalein.

Sulfuric acid reacts with sodium hydroxide in a neutralisation reaction.

Phenolphthalein is an indicator that is pink in alkaline conditions and colourless in acidic conditions.

You have been asked to write a plan for an investigation into the effect of surface area on the rate of diffusion of sulfuric acid through agar containing sodium hydroxide and phenolphthalein.

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
  - the 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.

(12)

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(Total for Question 4 = 12 marks)



5 A learner investigates the effect of temperature on the rate of diffusion in liquids.

This is the learner's method:

- collect a beaker of water
- add one drop of food colouring to the edge of the beaker
- start a stopwatch
- stop the stopwatch when the colour has spread throughout the whole beaker
- repeat the experiment with water at 30°C, 50°C, 60°C and 100°C.

The results of the learner's investigation are shown in Figure 3.

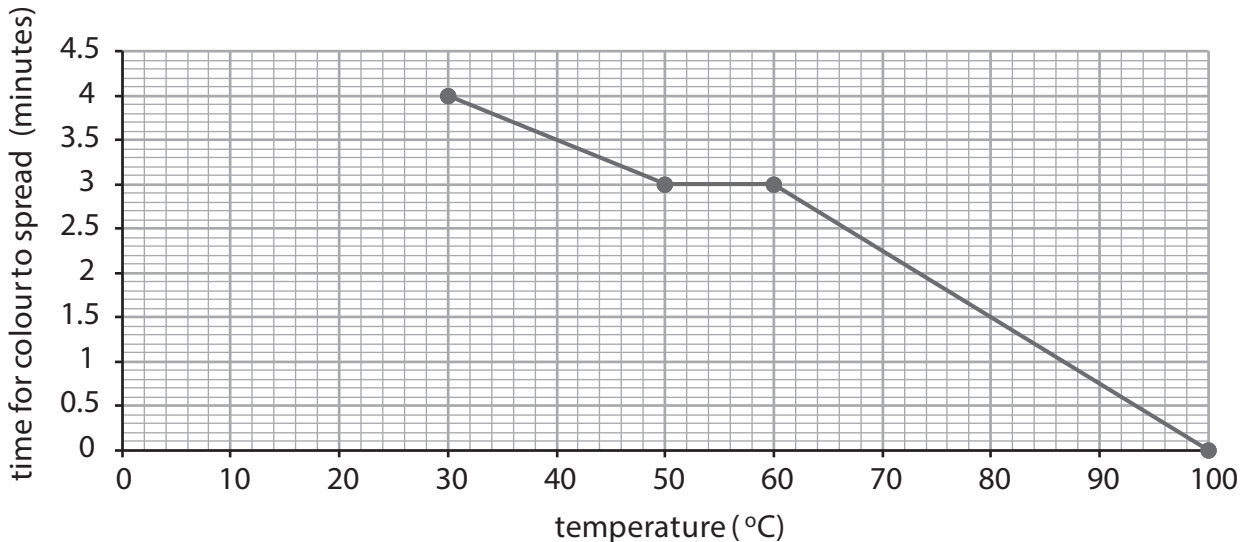


Figure 3

The learner concludes that the rate of diffusion of food colouring through water increases with increasing temperature.

Evaluate the learner's investigation.

Your answer should include reference to:

- the method of the experiment and the equipment used
- the results collected
- the 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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