

Please check the examination details below before entering your candidate information

Candidate surname

Other names

Pearson BTEC  
Level 3 Nationals  
Extended  
Certificate

Centre Number

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Learner Registration Number

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**Monday 21 January 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.

Turn over ►

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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.

(3)

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

(3)



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

(1)

(ii) State the dependent variable in your investigation.

(1)

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

(2)

(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)

(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.

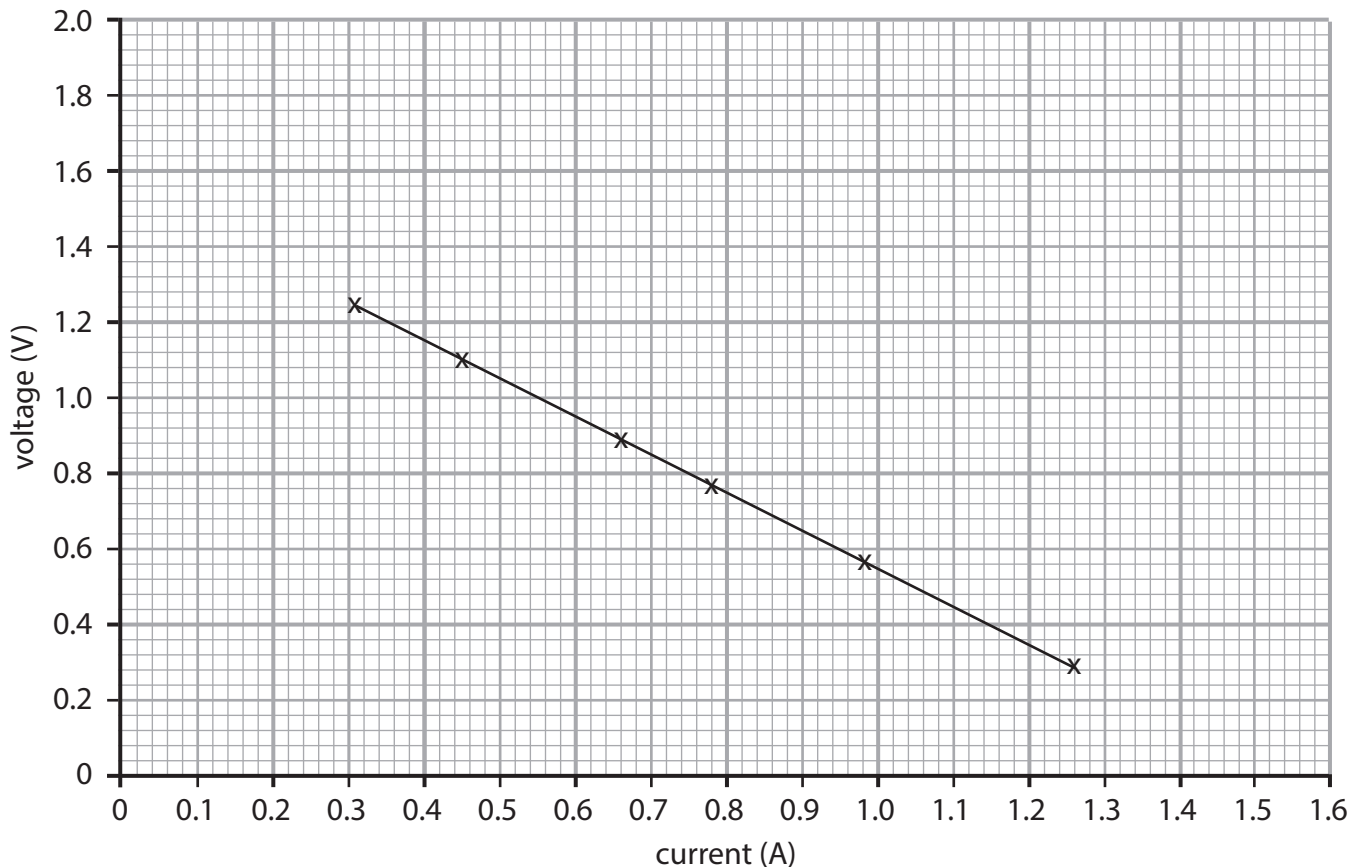


Figure 1

(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)



P 5 3 9 8 6 A 0 5 2 0

(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)

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)

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



- (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



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(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 = ..... %





- (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)

1 .....

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2 .....

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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)



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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.

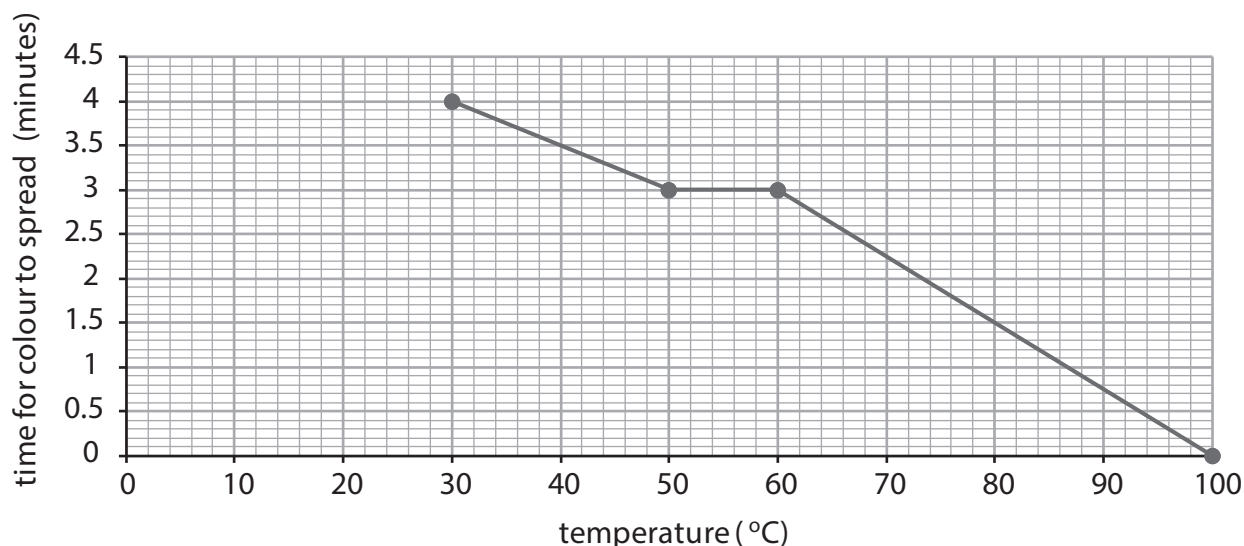


Figure 3

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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