Pearson BTEC Level 3 Nationals Extended Certificate

Applied Science

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

Part P

January 2018

Paper Reference
31619H

You do not need any other 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 **Part 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 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.

Technician's list of equipment needed

- 0.1 M, 0.5 M, 1 M, 1.5 M, 2 M hydrochloric acid
- Agar powder
- 250ml beaker
- Magnetic hot plate
- Magnetic stirrer
- Moulds of at least 2 cm depth
- 0.01 M sodium hydroxide solution
- Phenolphthalein
- Cork borer (used to cut agar cylinders to fit in boiling tubes e.g. size 6)
- Boiling tubes
- 10 cm^3 measuring cylinder with 0.1 cm^3 increments
- Stopwatch/ stop clock
- White tile/ white paper
- Clamp stand and clamp

Learner's list of equipment needed

- 0.1 M, 0.5 M, 1 M, 1.5 M, 2 M hydrochloric acid (50 cm^3 of each concentration)
- Boiling tubes
- 10ml measuring cylinder with 0.1ml increments
- Stopwatch/ stop clock
- White tile/ white paper
- 15 size 6 agar cylinders
- Clamp stand and clamp
- Gloves

Method for technicians

To make agar for at least fifteen size 6 cylinders:

1. Stir 2 g of plain (technical) agar powder into 100$cm^3$of 0.01M NaOH with 5 cm^3 phenolphthalein.
2. Mix for 10 minutes on a hot plate.
3. Pour the hot agar into moulds of at least 2 cm depth.
4. Allow the agar to cool and set.
5. Use a size 6 cork borer to cut identical size cylinders of agar.
6. Remove and store safely until required for use.

Technicians will need to make up at least 15 size 6 cylinders of agar for each learner.

Learners will:

1. Record the concentration of the acid.
2. Measure and record the time taken for the pink colour in the agar cylinders to disappear.
3. Record any other relevant observations.

Method for learners

Carry out all experiments at room temperature.

1. Clamp a boiling tube onto a clamp stand in front of a white tile/sheet of white paper.
2. Pour 10cm^3 of 0.1 M hydrochloric acid solution into the boiling tube.
3. Place an agar cylinder containing sodium hydroxide solution and phenolphthalein indicator into the boiling tube and start the stopwatch/ stop clock immediately.
4. Time how long it takes for the pink colour to disappear.
5. Repeat the experiment to get three results for 0.1M hydrochloric acid solution.
6. Repeat steps 1 – 5 for each concentration of hydrochloric acid, 0.5M, 1M, 1.5M and 2M, using a clean boiling tube each time.

Write your name here

Surname	Other names

Pearson BTEC Level 3 Nationals Extended Certificate

Applied Science

Unit 3: Science Investigation Skills

Part A

January 2018	Paper Reference **31619H**

You do not need any other materials.

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 Information 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.

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 taskbook and the Information 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 may give guidance on when you can complete the practical investigation.

Your teacher cannot give you feedback during the practical investigation.

You must not take this taskbook out of the classroom at any time and you must hand it in to your teacher 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 investigating diffusion. You have been asked to investigate how concentration will affect the rate of diffusion of a liquid.

Diffusion is the process where molecules move from an area of high concentration to an area of low concentration.

When an agar cylinder is placed in hydrochloric acid, the hydrochloric acid will diffuse through the cylinder.

If the agar cylinder contains sodium hydroxide, a neutralisation reaction will take place.

If an indicator is present, the neutralisation reaction can be seen by a change in colour.

Safety Information

Hydrochloric acid and sodium hydroxide are irritants/corrosive. Take care not to touch the acid or the agar cylinder with bare hands.

Method

Carry out all experiments at room temperature.

1. Clamp a boiling tube onto a clamp stand in front of a white tile/sheet of white paper.
2. Pour 10cm^3 of 0.1M hydrochloric acid solution into the boiling tube.
3. Place an agar cylinder containing sodium hydroxide solution and phenolphthalein indicator into the boiling tube, making sure the agar cylinder is covered with hydrochloric acid and start the stopwatch/ stop clock immediately.
4. Time how long it takes for the pink colour to disappear.
5. Repeat the experiment to get three results for 0.1M hydrochloric acid solution.
6. Repeat steps 1 – 5 for each concentration of hydrochloric acid, 0.5M, 1M, 1.5M and 2M, using a clean boiling tube each time.

Record your results/observations in the space provided.

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Write your name here

Surname	Other names

Pearson BTEC Level 3 Nationals Extended Certificate

Centre Number | | | | | | |

Learner Registration Number | | | | | | | | |

Applied Science

Unit 3: Science Investigation Skills

Part B

Friday 19 January 2018
Supervised hours: 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 time for the colour to disappear, in a suitable table, using the space provided. Circle any anomalous results.

(3)

(b) Explain **two** ways you made sure your results were accurate when carrying out the investigation.

(4)

(c) The average rate of diffusion can be calculated using the equation

$$\text{average rate } (s^{-1}) = \frac{1}{\text{average time (s)}}$$

Calculate the average rate of diffusion for each concentration of hydrochloric acid.

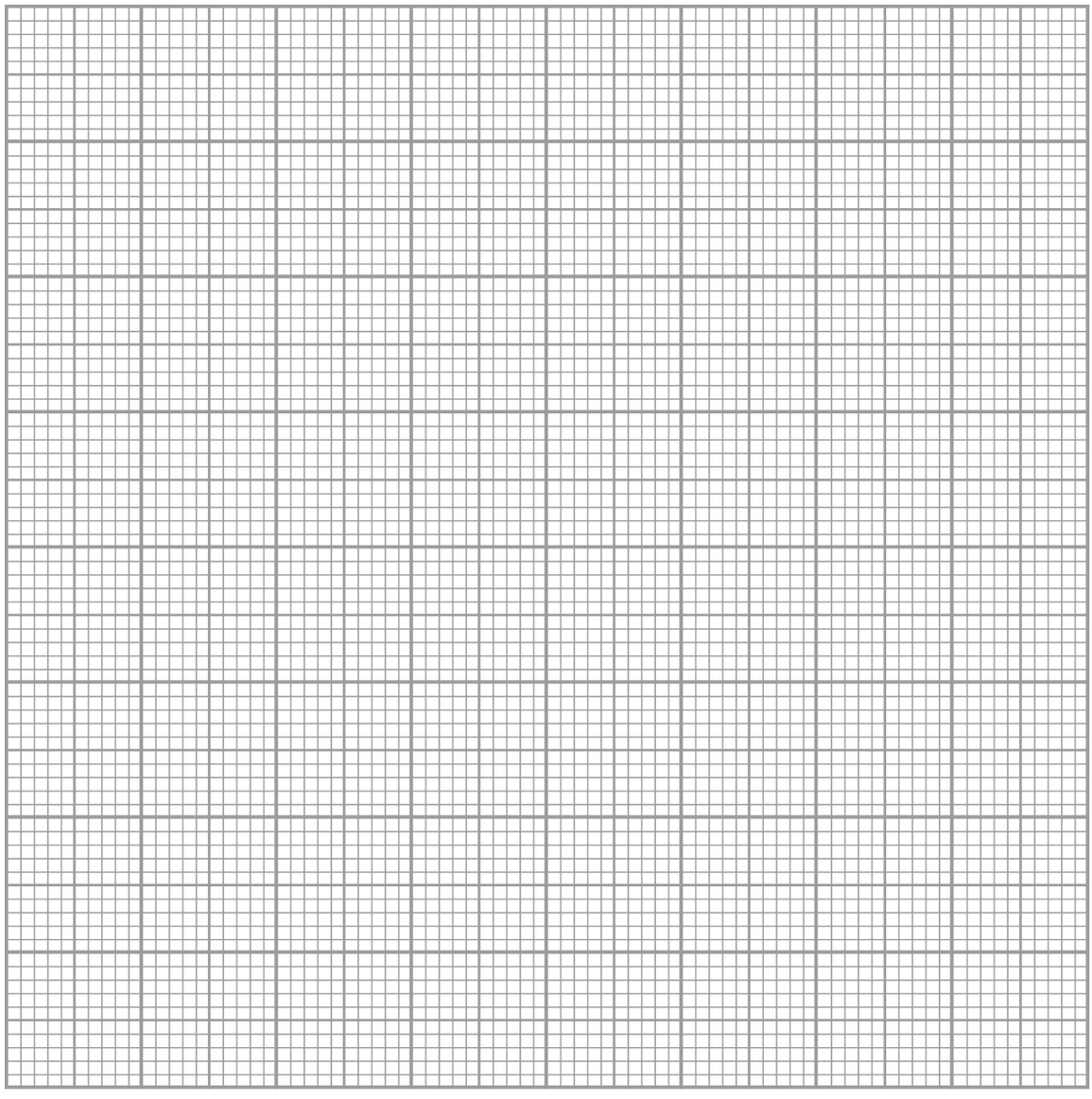
Show your working and write your answers in the table provided.

(2)

Concentration of hydrochloric acid (M)	0.1	0.5	1.0	1.5	2.0
Average rate of diffusion (s^{-1})					

(d) Plot a graph of average rate of diffusion against concentration of hydrochloric acid.

(3)



(e) Describe, using the graph, the relationship between the concentration of hydrochloric acid and the average rate of diffusion.

(2)

.....

.....

.....

.....

(Total for Question 1 = 14 marks)

2 Your colleague carried out a similar investigation into the effect of the concentration of a different acid on the rate of diffusion through an agar cylinder.

Your colleague used sulfuric acid in their investigation.

Here are their results.

concentration of sulfuric acid (M)	average rate of diffusion (s^{-1})
0.1	0.0003
0.5	0.0016
1.0	
1.5	0.0047
2.0	0.0072
2.5	

(a) Estimate, using the information in the table, a value for the average rate of diffusion of 1.0M sulfuric acid.

(1)

average rate of diffusion ..... s^{-1}

(b) Your colleague calculated three rates of diffusion for 2.5 M sulfuric acid.

The three rates they calculated were 0.0084 s^{-1}, 0.0083 s^{-1} and 0.0088 s^{-1}.

(i) Calculate, using the three values, the average rate of diffusion for 2.5 M sulfuric acid.

Show your working.

(1)

Average rate of diffusion = ... s^{-1}

(ii) Calculate the standard deviation for 2.5 M sulfuric acid.

$$S = \sqrt{\frac{\sum (x - \bar{x})^2}{N - 1}}$$

Show your working.

(5)

Standard deviation = ...

(c) (i) Your colleague used sulfuric acid instead of hydrochloric acid.

Give **three** other reasons for any similarities or differences between your results and theirs.

(3)

(ii) Your colleague observed that the agar cylinder became smaller in the 2.5M sulfuric acid.

Explain why the agar cylinder became smaller in the 2.5M sulfuric acid.

(2)

(d) Your colleague predicts:

"The rate of diffusion in concentrations of sulfuric acid above 2.5 M will be faster than in lower concentrations."

Comment on whether you think their prediction is correct.

Use your colleague's results to support your answer.

(4)

(Total for Question 2 = 16 marks)

3 (a) Type of acid and alkali were variables that were controlled in your investigation.

Explain how **two** other variables were controlled in your investigation.

(4)

(b) Explain why temperature should be controlled when investigating the effect of concentration of acid on rate of diffusion.

(2)

(c) Your colleague extends their investigation by using a larger range of concentrations of sulfuric acid.

Explain **two** other ways their investigation can be extended.

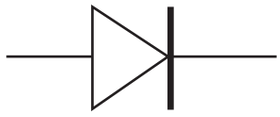
(4)

(Total for Question 3 = 10 marks)

TOTAL FOR SECTION 1 = 40 MARKS

SECTION 2

4 Diodes and conduction



Diode

Diodes are semiconductor devices.

Diodes only allow a current to pass in one direction in a circuit (forward direction).

The potential difference (p.d.) at which the diode will allow a current to pass in the circuit is called the threshold p.d.

Write a plan to find the threshold p.d. and its direction to enable a current to pass.

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)

(Total for Question 4 = 12 marks)

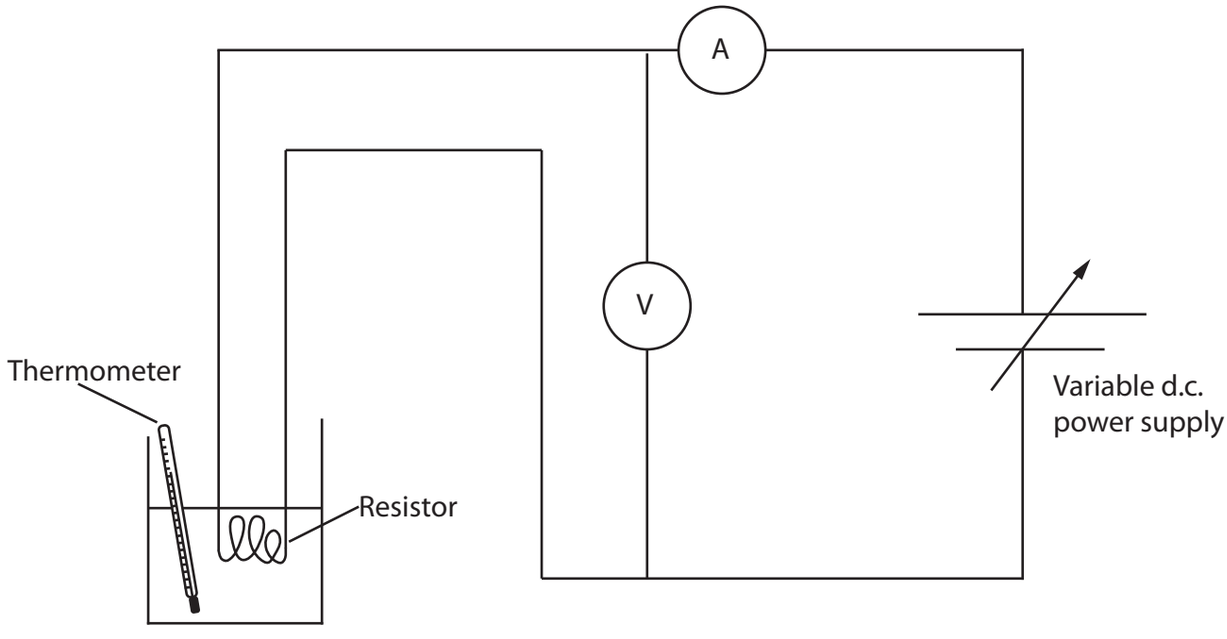
5 A resistor is placed in a beaker of water. The resistor heats up when it is supplied with electrical power. The hot resistor then heats the water in the beaker.

A learner investigates how the electrical power supplied to a resistor affects the increase in temperature of water in a glass beaker.

Here is the learner's method.

- Connect the resistor to a power source.
- Place the resistor into a glass beaker of water.
- Measure the temperature of the water.
- Leave the resistor in the water for a few minutes.
- Change the output voltage from the power supply. Measure the current passing in the circuit using an ammeter.
- Calculate the power produced by the resistor using the equation P = V x I.

The diagram shows the set-up of the equipment.



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

power/W	temperature increase of the water / °C
12	10
24	20
36	30
48	37
60	43

The learner concludes that:

"Up to 36 W the increase in temperature is proportional to the power supplied. Above 36 W the increase in temperature is no longer proportional to the power supplied."

Evaluate the learner's investigation.

Your answer should include reference to:

- method of the experiment
- results collected
- conclusion made.

(8)

(Total for Question 5 = 8 marks)

TOTAL FOR SECTION 2 = 20 MARKS
TOTAL FOR PAPER = 60 MARKS

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