GCSE

WJEC GCSE
The Sciences (Double Award)

Approved by Qualifications Wales

Sample Assessment Materials

Unit 7: Scientific Enquiry

Teaching from 2026
For award from 2028

This Qualifications Wales regulated qualification is not available to centres in England.

Made for Wales.
Ready for the world.

WJEC would like to thank the students and teachers of Fitzalan High School, Cardiff and Llanwern High School, Newport for their participation in the creation of these covers.

Contents

WJEC GCSE The Sciences (Double Award)

Assessment Arrangements Pack

Unit 7: Scientific Enquiry

Information for teachers and technicians

First assessment Spring term 2028

About this pack: information for teachers and technicians

This pack contains the assessment instructions for Unit 7: Scientific Enquiry (Unit 7a, Unit 7b and Unit 7c).

Within this pack, you will find information for teachers and technicians on how to manage arrangements for assessment.

Managing the assessment

This is a WJEC marked (external) assessment.

Key documentation / dates

Document	Purpose	Format	Date received	Date for use
Apparatus List	Enables centres to prepare for the task by ordering in any additional apparatus if needed. The title of the task is not included.	Post	September	Upon receipt
Enquiry Methodology	Enables teachers/technicians at centres to view and trial the methodology.	Portal /Post	Autumn term	First day of the spring term
Assessments	Three assessments. Learners must complete two of these assessments.	Post	Autumn term (for secure storage on receipt in preparation for the assessment during the spring term)	Spring term. Must only be opened on the first day of the assessment as chosen by the centre.

All documents must be stored securely by the centre. Appropriate check-out and check-in procedures must be established for these documents when they are being used by science teachers or technicians. A log must be maintained to record all instances of usage. These documents must not be stored within the science department when not actively in use by a teacher or technician.

To maintain confidentiality, the assessments can only be given to the teacher conducting the assessments on the date(s) on which each group will complete each particular assessment.

Task setting

These assessments have been produced by WJEC and cannot be changed. Candidates are required to complete two assessments from a choice of three.

Time

The assessment window runs from any school day in January or February (in the first half of the spring term) in the final year of study.

Candidates must be allowed **2 hours** to complete each assessment. For each assessment, candidates should spend:

- 1 hour completing Task A (practical task)
- 1 hour completing Task B (written response)

Centres may schedule the tasks at their discretion during the assessment window. There can be no changes to the timings for this assessment.

Resources

Task A - Candidates must have access to the question paper and any necessary apparatus and resources – one set of apparatus per group. Task A must be collected from the candidates at the end of session and returned to the exams officer for secure storage.

Task B - Candidates should have access to their Task A question paper, as they need the results obtained in the first session to answer the questions in Task B. Task B should not be given to candidates until the second session.

Both sections should be collected in following the completion of Task B and returned to the exams officer.

Collaboration

Task A – Group work is allowed. Candidates to work in small groups, of no more than three candidates. Teachers should ensure that each group has adequate working space and that the groups are set a reasonable distance apart

Task B – Group work is **not** allowed. Candidates must complete all Task B individually.

Supervision

Task A – Candidates must be supervised by science teachers whilst completing the activities. Centres may use additional laboratories, provided that a science teacher is available to always supervise all groups. Technical support should be available in case it is needed.

Task B – This must be carried out under direct supervision. This is a high level of control, i.e. candidates work individually, set a suitable distance apart and under supervision. This could be carried out in the laboratory or in an examination hall.

Monitoring visits will take place using a random sample of centres to ensure the assessment unit is being administered correctly. WJEC will contact selected centres in advance of such a visit to clarify arrangements.

Authentication

Supervision must be in place to ensure the authenticity of evidence produced for summative assessment.

Teachers should not provide input or guidance to candidates during the assessment time. This includes providing formative feedback on the evidence being produced.

All candidates must attempt to obtain results in Section A. In exceptional circumstances where a candidate is unable to obtain results using the practical equipment, it is acceptable for them to be provided with unformatted teacher-generated results. WJEC will not supply these results; they must be generated by the centre during the task trial.

Please ensure that the unformatted results are noted and included in the submission for the candidates who were provided with this data.

Task marking

WJEC will mark all evidence produced by candidates.

Further information

Any access arrangements a candidate is entitled to for the written examination units apply to this Scientific Enquiry assessment also. Please ensure that WJEC are made aware of any modified papers that are required by candidates as soon as possible.

Apparatus Lists

Unit 7a

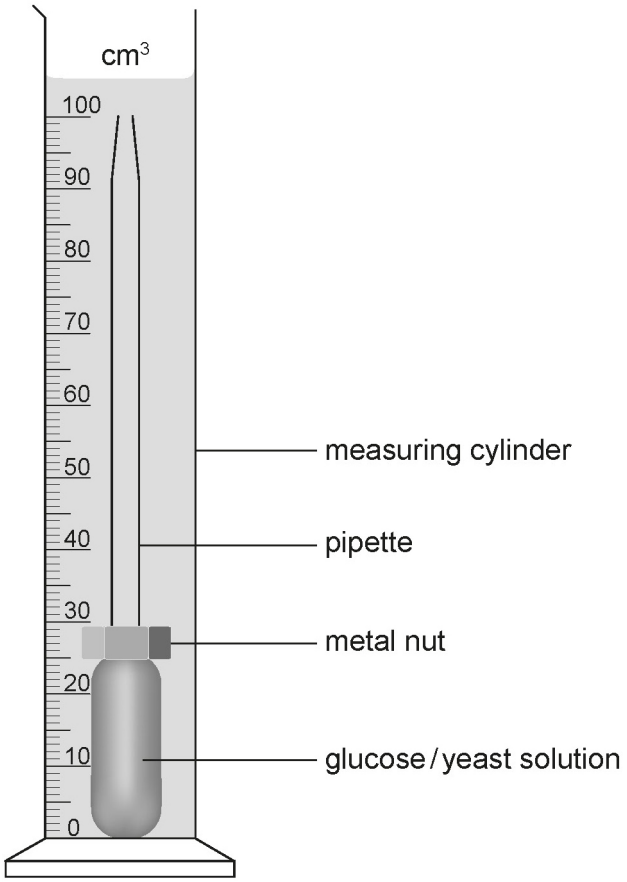
Apparatus Required

The following apparatus is required for each group: (each group should consist of no more than three candidates).

eye protection
1 × 100 cm^3 measuring cylinder
5 × 3 cm^3 plastic pipette
1 × thermometer
1 × stopwatch
1 × 8 or 9 mm metal nut
1 × forceps
20 cm^3 yeast / glucose solution

Access to:
water baths at 20 – 60°C
paper towels.

Diagram



Teacher/Technician Notes

- 10% yeast solution – fast action dried yeast can be obtained easily from any supermarket.
- 20% glucose solution.
- The yeast/glucose solution provided to the candidates should be made up using 50% of the yeast solution and 50% of the glucose solution.
- Desk top water baths can be made by candidates during the experiment by mixing water from a recently boiled kettle and cold water. Use the thermometer to detect when the mixture is at approximately the required temperature.
- Fresh yeast/glucose solution should be used for each temperature.
- Ensure that the water level sufficiently covers the top of the pipette so that bubbles can be produced and counted.

Unit 7b

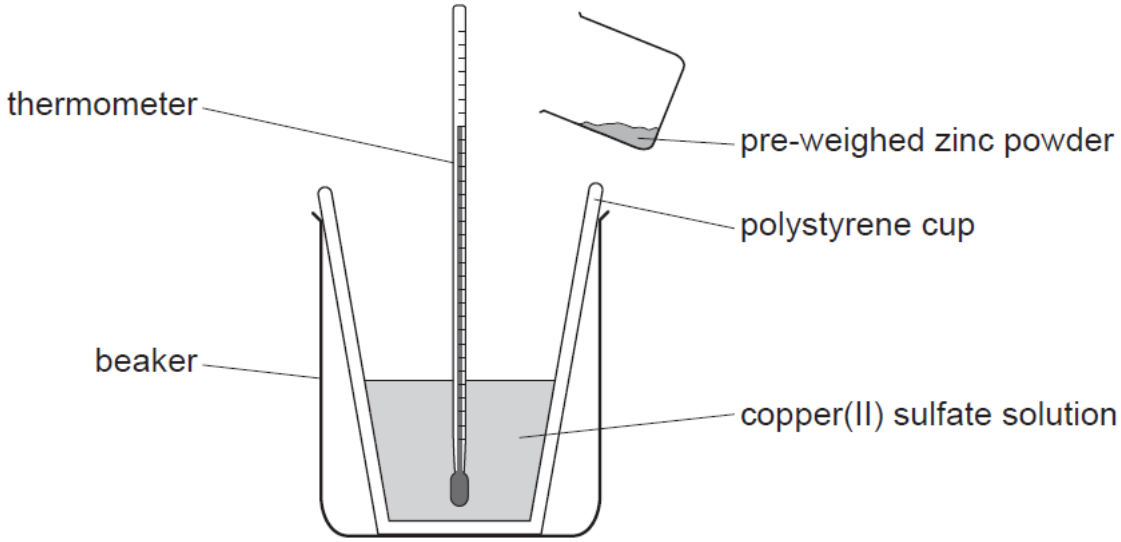
Apparatus Required

The following apparatus is required for each group: (each group should consist of no more than three candidates).

eye protection
1 × polystyrene cup
1 × 100 cm^3 measuring cylinder
1 × 250 cm^3 beaker
1 × 250 cm^3 beaker containing approximately 60 cm^3 of 0.5 mol / dm^3 copper(II) sulfate solution
2 × pre-weighed sample of zinc powder (2.5 g in each sample)
1 × thermometer
1 × stopwatch

Access to:
waste bowl.

Diagram



Teacher/Technician Notes

- The copper(II) sulfate solution should be made up by dissolving 125 g of the solute in 1000 cm^3 of water.
- Ensure the polystyrene cup fits inside the 250 cm^3 beaker.
- The pre-weighed samples of zinc powder should be approximately 2.5 g each.
- Please follow standard laboratory procedures governing the disposal of the waste produced from the experiment.
    - Waste from each class should be dealt with separately.
    - Clamp a large filter funnel and filter paper above a large beaker.
    - Pour the waste and rinse the residual solid from each group into the filter funnel.
    - Waste solution should be washed down the drain with 10 times the volume of water.
    - Filter paper and solid waste should be put in the bin.

Unit 7c

Apparatus Required

The following apparatus is required for each group: (each group should consist of no more than three candidates)

1 × rectangular Perspex or glass block
1 × ray box with a single slit and no lens
1 × protractor
1 × 30 cm ruler
1 × 12 V d.c. power supply

Teacher/Technician Notes

- Ray boxes get very hot.
- Do not use lasers in place of ray boxes in this experiment.
- Please note that the protractor should only be used to measure angle B.
- Please ensure that light exits from the bottom face of the block for all angles used.

Enquiry Methods (for the purpose of trialling the tasks only)

Unit 7a

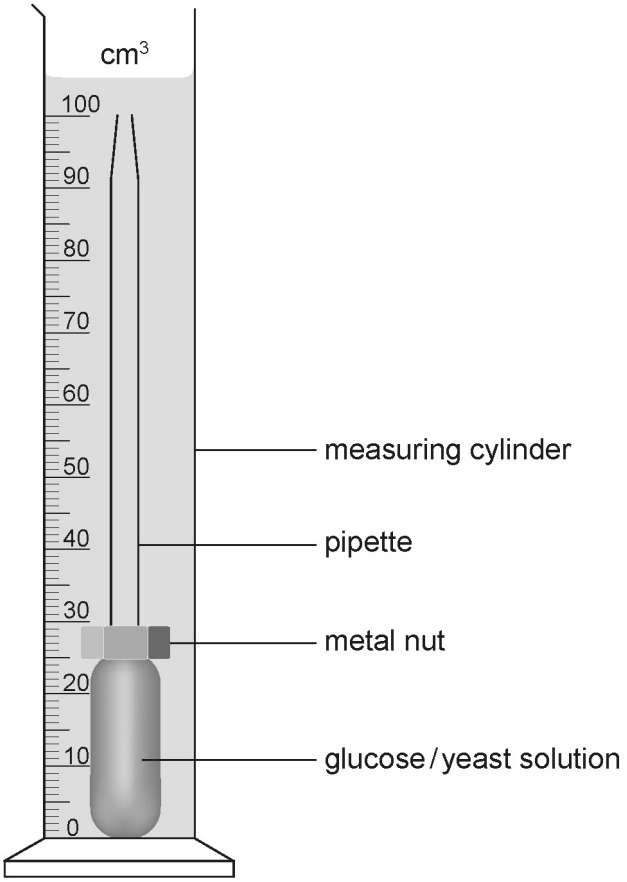
INVESTIGATING THE EFFECT OF TEMPERATURE ON RESPIRATION IN YEAST

Apparatus Required

The following apparatus is required for each group: (each group should consist of no more than three candidates).
eye protection
1 × 100 cm^3 measuring cylinder
5 × 3 cm^3 plastic pipette
1 × thermometer
1 × stopwatch
1 × 8 or 9 mm metal nut
1 × forceps
20 cm^3 yeast / glucose solution

Access to:
water baths at 20 – 60°C
paper towels.

Diagram



Method

1. Wear eye protection.

2. Fill a 100 cm^3 measuring cylinder with 100 cm^3 of water at approximately 20 °C.

3. Pipette 2 cm^3 of the glucose / yeast solution and hold the pipette upside down so that the solution flows into the bulb.

4. Wipe any excess solution from the tip of the pipette to clear it using the paper towel.

5. Drop a metal nut around the top of the bulb of the pipette and drop the pipette bulb first into the measuring cylinder.

6. Wait for 1 minute.

7. Start the stopwatch and record the number of bubbles produced in 2 minutes.

8. Reset the stopwatch and record the number of bubbles produced in another 2 minutes. **This is your repeat reading for this temperature.**

9. Repeat steps 2 – 8 for water at approximately 30 °C, 40 °C, 50 °C and 60 °C.

Teacher/Technician Notes

- 10% yeast solution – fast action dried yeast can be obtained easily from any supermarket.
- 20% glucose solution.
- The yeast/glucose solution provided to the candidates should be made up using 50% of the yeast solution and 50% of the glucose solution.
- Desk top water baths can be made by candidates during the experiment by mixing water from a recently boiled kettle and cold water. Use the thermometer to detect when the mixture is at approximately the required temperature.
- Fresh yeast/glucose solution should be used for each temperature.
- Ensure that the water level sufficiently covers the top of the pipette so that bubbles can be produced and counted.

Unit 7b

INVESTIGATING THE CHANGES IN TEMPERATURE IN AN EXOTHERMIC REACTION

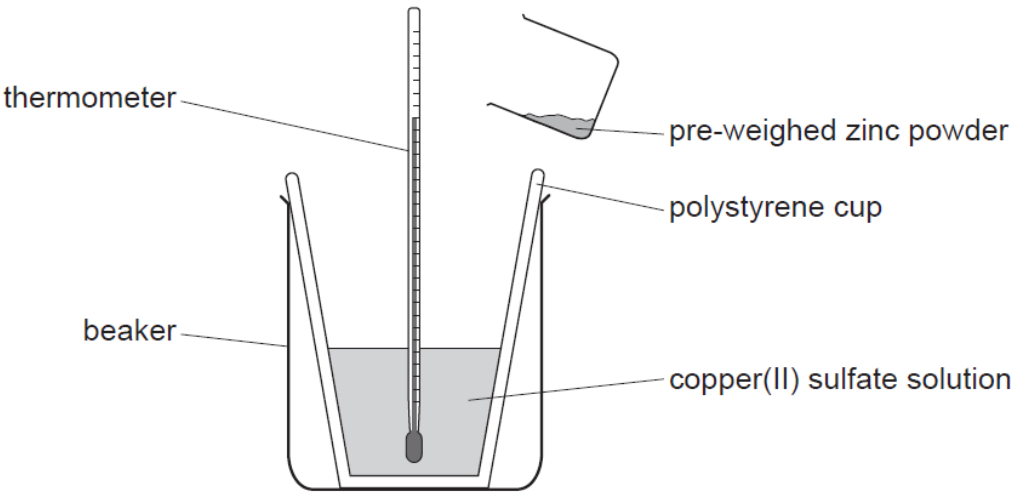
Apparatus

The following apparatus is required for each group: (each group should consist of no more than three candidates).

eye protection
1 × polystyrene cup
1 × 100 cm^3 measuring cylinder
1 × 250 cm^3 beaker
1 × 250 cm^3 beaker containing approximately 60 cm^3 of 0.5 mol / dm^3 copper(II) sulfate solution
2 × pre-weighed sample of zinc powder (2.5 g in each sample)
1 × thermometer
1 × stopwatch

Access to:
waste bowl.

Diagram:



Method

1. Wear eye protection.

2. Measure 25 cm^3 of 0.5 mol / dm^3 copper(II) sulfate solution using the measuring cylinder.

3. Place the polystyrene cup in the beaker for stability.

4. Pour the copper(II) sulfate solution into the polystyrene cup.

5. Record the temperature of the copper(II) sulfate solution. This is the start temperature at 0 seconds.

6. Add the pre-weighed zinc powder to the polystyrene cup and start the stopwatch.

7. Stir the mixture constantly with the thermometer and record the temperature every 30 seconds for 180 seconds.

8. Empty the contents of the polystyrene cup into the waste bowl and rinse with cold water.

9. Repeat steps 2–8 one more time to get a total of two sets of results.

Teacher/Technician Notes

- The copper(II) sulfate solution should be made up by dissolving 125 g of the solute in 1000 cm^3 of water.
- Ensure the polystyrene cup fits inside the 250 cm^3 beaker.
- The pre-weighed samples of zinc powder should be approximately 2.5 g each.
- Please follow standard laboratory procedures governing the disposal of the waste produced from the experiment.
    - Waste from each class should be dealt with separately.
    - Clamp a large filter funnel and filter paper above a large beaker.
    - Pour the waste and rinse the residual solid from each group into the filter funnel.
    - Waste solution should be washed down the drain with 10 times the volume of water.
    - Filter paper and solid waste should be put in the bin.

Unit 7c

INVESTIGATING THE ANGLE OF LIGHT REFRACTION

Apparatus

The following apparatus is required for each group: (each group should consist of no more than three candidates)

1 × rectangular Perspex or glass block
1 × ray box with a single slit and no lens
1 × protractor
1 × 30 cm ruler
1 × 12 V d.c. power supply

Method

1. Place the glass block on the paper template on the next page with the block against the solid line.

2. Use the ray box to shine a single ray of light into the glass at 20° to the normal (angle **A**) as shown on the diagram below.

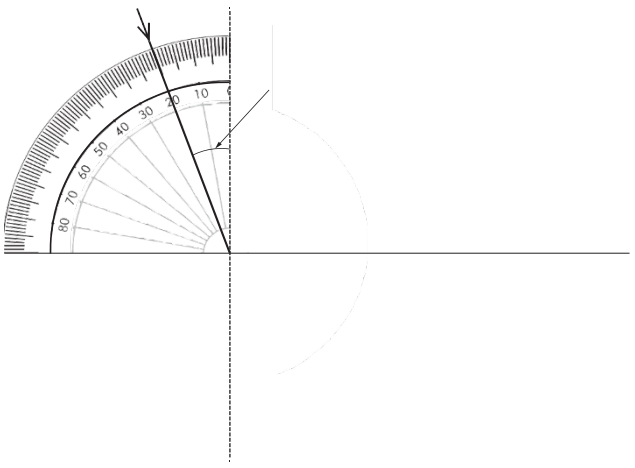
3. Mark with a pencil the exit point of the ray from the bottom face of the glass block.

4. Turn off the ray box and remove the glass block.

5. Draw a straight line to mark the path of the ray through the block.

6. Use the protractor to measure and record the angle between the path of the ray through the block and the normal (angle **B**).

7. Repeat steps 2 to 6 for values of angle **A** of 30°, 40°, 50°, 60° and 70°.



Teacher/Technician Notes

- Ray boxes get very hot.
- Do not use lasers in place of ray boxes in this experiment.
- Please note that the protractor should only be used to measure angle B.
- Please ensure that light exits from the bottom face of the block for all angles used.

Surname	Centre number	Candidate number
First name(s)		0

GCSE

GCSE THE SCIENCES (Double Award) – Unit 7a

3455U7
SCIENTIFIC ENQUIRY

AN ENQUIRY INTO THE EFFECT OF TEMPERATURE ON RESPIRATION IN YEAST

Task A

1 hour

SAMPLE ASSESSMENT MATERIALS

ADDITIONAL MATERIALS

A calculator and ruler.

For Examiner's use only		
	Maximum Mark	**Mark Awarded**
Task A	**6**	

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do **not** use gel pen or correction fluid.

You may use a pencil for graphs and diagrams only.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet. If you run out of space, use the additional page(s) at the back of the booklet, taking care to number the question(s) correctly.

INFORMATION FOR CANDIDATES

This assessment is in 2 sections, Task A and Task B. You will complete Task A in one session and Task B in a different session.

The total number of marks available for Task A is 6.

The number of marks is given in brackets at the end of each question or part-question.

Introduction

Respiration is an exothermic reaction in which energy from a chemical store is transferred to a thermal store.

Yeast are microscopic organisms. They typically respire aerobically in bread making, using oxygen to produce energy and carbon dioxide, which causes the dough to rise.

The rate of respiration of yeast varies with temperature.

In this enquiry you will look at the effect of temperature on the rate of respiration in yeast.

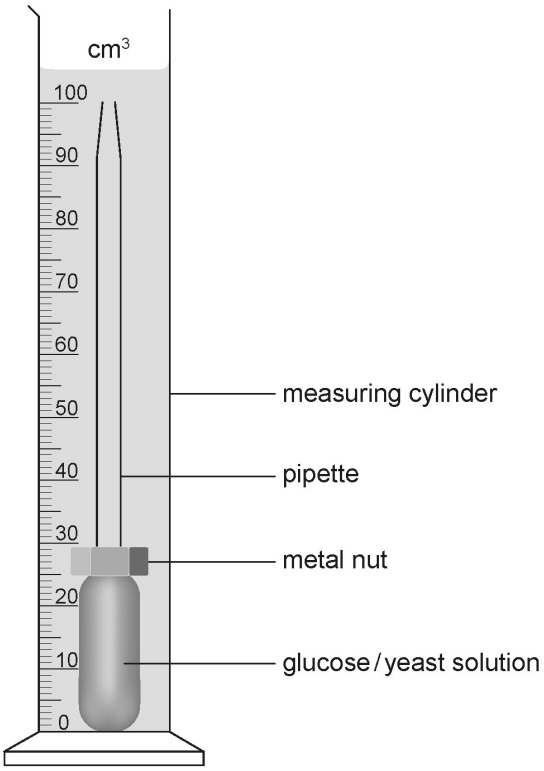
Apparatus Required

The following apparatus is required for each group: (each group should consist of no more than three candidates).

eye protection
1 × 100 cm^3 measuring cylinder
5 × 3 cm^3 plastic pipette
1 × thermometer
1 × stopwatch
1 × 8mm or 9mm metal nut
1 × forceps
20 cm^3 yeast / glucose solution

Access to:
water baths at 20 – 60 °C
paper towels.

Diagram



Read the method and answer question 1. (a) before carrying out the experiment and recording your results.

Method

1. Wear eye protection.

2. Fill a 100 cm^3 measuring cylinder with 100 cm^3 of water at approximately 20 °C.

3. Pipette 2 cm^3 of the glucose / yeast solution and hold the pipette upside down so that the solution flows into the bulb.

4. Wipe any excess solution from the tip of the pipette to clear it using the paper towel.

5. Drop a metal nut around the top of the bulb of the pipette and drop the pipette bulb first into the measuring cylinder.

6. Wait for 1 minute.

7. Start the stopwatch and record the number of bubbles produced in 2 minutes.

8. Reset the stopwatch and record the number of bubbles produced in another 2 minutes. **This is your repeat reading for this temperature.**

9. Repeat steps 2 – 8 for water at approximately 30 °C, 40 °C, 50 °C and 60 °C.

TASK A

Answer **all** questions.

1. (a) State a hypothesis for this enquiry. [1]

Examiner only

……

……

(b) Suggest what the nut is used for in this method. [1]

……

……

You may record raw results in the space below.

(c) Present your results in a table. Include all of your results. [4]

Examiner only

END OF PAPER

6

Question number	Additional page, if required. Write the question number(s) in the left-hand margin.
	…… ……

Examiner only

Surname	Centre number	Candidate number
First name(s)		0

GCSE

GCSE THE SCIENCES (Double Award) – Unit 7(a)

3455U7
SCIENTFIC ENQUIRY

INVESTIGATING THE EFFECT OF TEMPERATURE ON RESPIRATION IN YEAST

Task B

1 hour

SAMPLE ASSESSMENT MATERIALS

ADDITIONAL MATERIALS

A calculator and your Task **A** exam paper.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen or correction fluid. You may use a pencil for graphs and diagrams only.

For Examiner's use only		
	Maximum Mark	**Mark Awarded**
Task B	**22**	

Write your name, centre number and candidate number in the spaces at the top of this page. Answer **all** questions.

Write your answers in the spaces provided in this booklet. If you run out of space, use the additional page(s) at the back of the booklet, taking care to number the question(s) correctly.

INFORMATION FOR CANDIDATES

This assessment is in 2 sections, Task A and Task B. You will have completed Task A in a previous lesson.

The total number of marks available for Task B is 22.

The number of marks is given in brackets at the end of each question or part-question.

TASK B

Answer **all** questions.

Examiner only

2. (a) State the resolution of the measuring cylinder used in Task A. [1]

Resolution =± …… cm^3

(b) State the range of the independent variable in Task A. [1]

……

(c) In step 6 of the method in Task A you are asked to 'wait for one minute'.

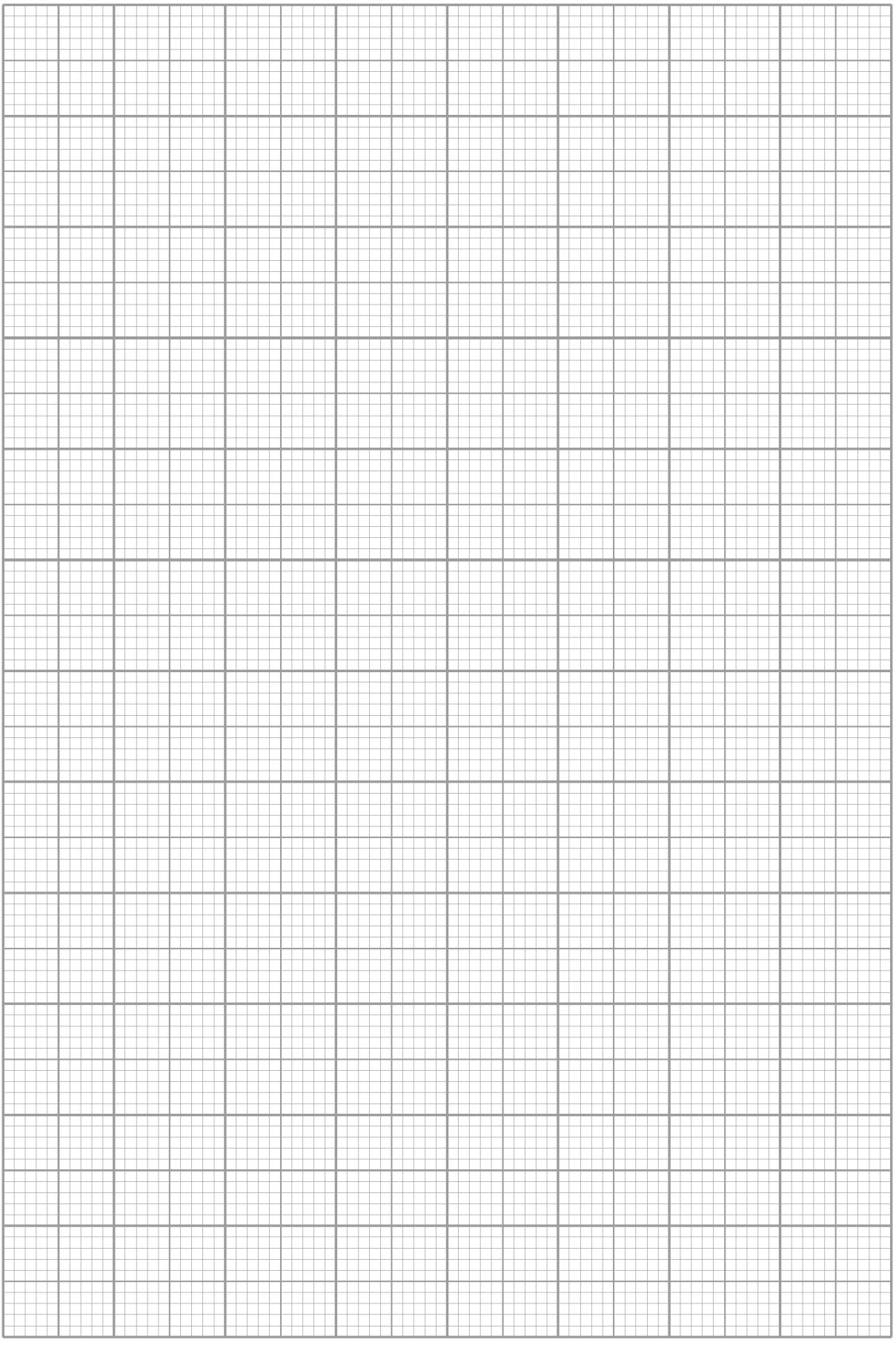
Explain why. [1]

……

……

(d) (i) Use your results from Task **A** to draw **a line graph** on the grid opposite for the number of bubbles (vertical axis) against temperature (horizontal axis). [5]

Examiner only



Examiner only

(ii) I. Use your graph to describe the relationship between the number of bubbles and the temperature. [1]

……

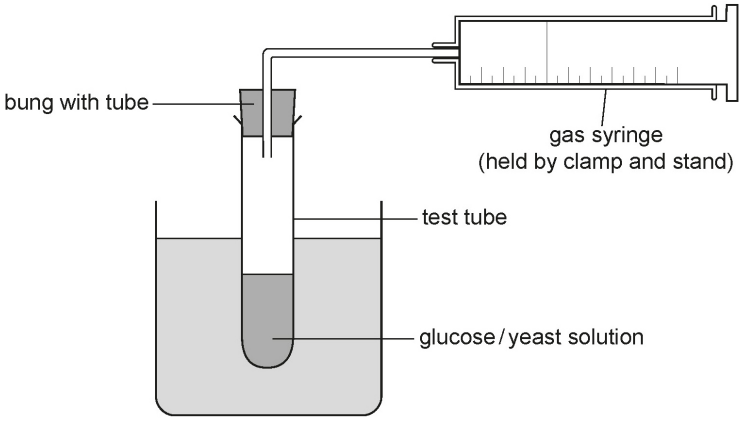
……

II. Evaluate how this relationship compares to the suggested hypothesis in **Task A question 1(a)**. [1]

……

……

(e) (i) The diagram shows one way of adapting the apparatus to reduce the effect of inaccuracies. Explain how this improves the experiment. [2]



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……

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……

(ii) State one other source of inaccuracy in this experiment and explain how it can be reduced. [2]

……

……

……

……

Examiner only

(f) A group of students extend the investigation. They use the same apparatus but want to investigate how a different factor affects respiration in yeast.

Their method is shown below.

1. Wear eye protection
2. Fill a 100 cm^3 measuring cylinder with 100 cm^3 water at 20 ^0C.
3. Draw 1 cm^3 of glucose solution and 1 cm^3 of 5% yeast solution into the same pipette. Hold the pipette upside down so that the solutions mix and flow into the bulb.
4. Wipe any excess solution from the tip of the pipette to clear it using the paper towel.
5. Drop a metal nut around the top of the bulb of the pipette and drop the pipette bulb first into the measuring cylinder.
6. Start the stopwatch and record the number of bubbles produced.
7. Repeat steps 2 – 6 for two different concentrations of the glucose solution.

(i) Fill in the table below to identify some of the variables in this experiment. [4]

Independent variable	
Dependent variable	
Two controlled variables	1.
	2.

(ii) There are some problems with the students' method.

State **three** improvements that the students should make to their method. [3]

- ……

  ……
- ……

  ……
- ……

  ……

(iii) The students complete the experiment and evaluate their results. This is part of their report.

*"We had great precision in our results, but we don't know if they were **accurate**."*

Explain what is meant by the term accurate. [1]

……

……

Examiner only

22

END OF PAPER

Question number	Additional page, if required. Write the question number(s) in the left-hand margin.
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Examiner only

Surname	Centre number	Candidate number
First name(s)		0

GCSE

GCSE THE SCIENCES (Double Award) – Unit 7b

3455U7
SCIENTIFIC ENQUIRY

AN ENQUIRY INTO THE CHANGES IN TEMPERATURE IN AN EXOTHERMIC REACTION

TASK A

1 hour

SAMPLE ASSESSMENT MATERIALS

ADDITIONAL MATERIALS

A calculator and ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do **not** use gel pen or correction fluid.

For Examiner's use only		
	Maximum Mark	**Mark Awarded**
Task A	**6**	

You may use a pencil for graphs and diagrams only.

Write your name, centre number and candidate number in the spaces at the top of this page. Answer **all** questions.

Write your answers in the spaces provided in this booklet. If you run out of space, use the additional page(s) at the back of the booklet, taking care to number the question(s) correctly.

INFORMATION FOR CANDIDATES

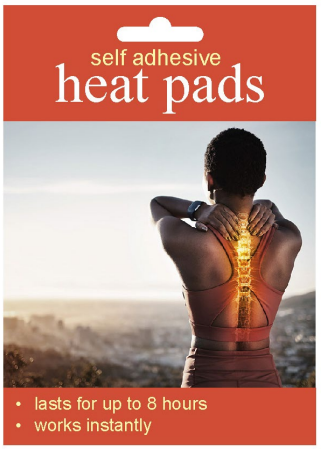
This assessment is in 2 sections, Task A and Task B. You will complete Task A in one session and Task B in a different session.

The total number of marks available for Task A is 6.

The number of marks is given in brackets at the end of each question or part-question.

Introduction

Heat packs are used to apply heat to the body for healing purposes. They work by increasing blood flow to the affected area, which can help relax muscles, reduce inflammation, and deliver nutrients and oxygen for healing.



Exothermic reactions are the foundation of how many heat packs work. These reactions release heat to their surroundings, therefore they are suitable for use in heat packs.

Heat packs are convenient because they can be made portable and do not require a separate heat source to activate.

The reaction between zinc and copper(II) sulfate solution is exothermic. In this enquiry you will look at how the heat given out from this reaction changes with time.

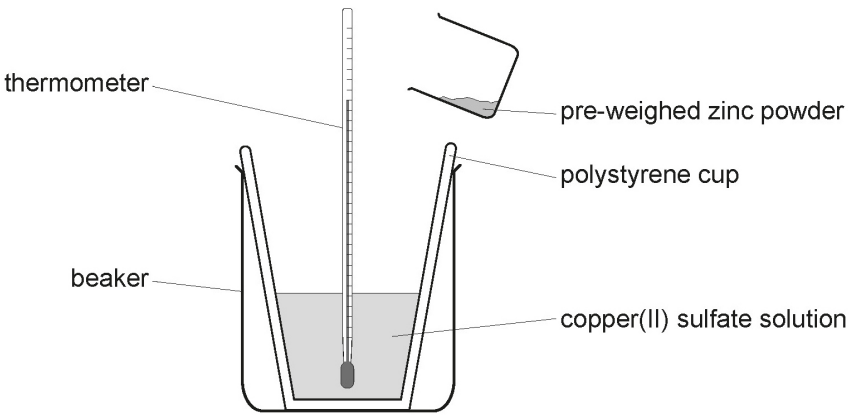
Apparatus

The following apparatus is required for each group: (each group should consist of no more than three candidates).

eye protection
1 × polystyrene cup
1 × 100 cm^3 measuring cylinder
1 × 250 cm^3 beaker
1 × 250 cm^3 beaker containing approximately 60 cm^3 of 0.5 mol / dm^3 copper(II) sulfate solution
2 × pre-weighed sample of zinc powder (2.5 g in each sample)
1 × thermometer
1 × stopwatch

Access to:
waste bowl.

Diagram



Method

1. Wear eye protection.

2. Measure 25 cm^3 of 0.5 mol / dm^3 copper(II) sulfate solution using the measuring cylinder.

3. Place the polystyrene cup in the beaker for stability.

4. Pour the copper(II) sulfate solution into the polystyrene cup.

5. Record the temperature of the copper(II) sulfate solution. This is the start temperature at 0 seconds.

6. Add the pre-weighed zinc powder to the polystyrene cup and start the stopwatch.

7. Stir the mixture constantly with the thermometer and record the temperature every 30 seconds for 180 seconds.

8. Empty the contents of the polystyrene cup into the waste bowl and rinse with cold water.

9. Repeat steps 2–8 one more time to get a total of two sets of results.

You may record all the raw results in the space below.

TASK A

Answer **all** questions.

1. (a) Present your results in a table. Include all of your results. [4]

Examiner only

(b) Give **two** inaccuracies in the method that may affect the quality of your results. [2]

Inaccuracy 1:

……

……

Inaccuracy 2:

……

……

6

END OF PAPER

Question number	Additional page, if required. Write the question number(s) in the left-hand margin.
	…… ……

Examiner only

Surname	Centre number	Candidate number
First name(s)		0

GCSE

GCSE THE SCIENCES (DOUBLE AWARD) – Unit 7b

3455U7
SCIENTIFIC ENQUIRY

INVESTIGATING THE CHANGES IN TEMPERATURE IN AN EXOTHERMIC REACTION

TASK B

1 hour

SAMPLE ASSESSMENT MATERIALS

ADDITIONAL MATERIALS

A calculator and your Task A exam paper.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen or correction fluid. You may use a pencil for graphs and diagrams only.

For Examiner's use only		
	Maximum Mark	**Mark Awarded**
Task B	**22**	

Write your name, centre number and candidate number in the spaces at the top of this page. Answer **all** questions.

Write your answers in the spaces provided in this booklet. If you run out of space, use the additional page(s) at the back of the booklet, taking care to number the question(s) correctly.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question. This assessment is in 2 sections, Task A and Task B. You will have completed Task A in a previous session.

The total number of marks available for Task B is 22.

TASK B

Answer **all** questions.

Examiner only

2. (a) The temperature change for the reaction can be calculated using the following equation: [2]

temperature change = mean temperature – temperature at start

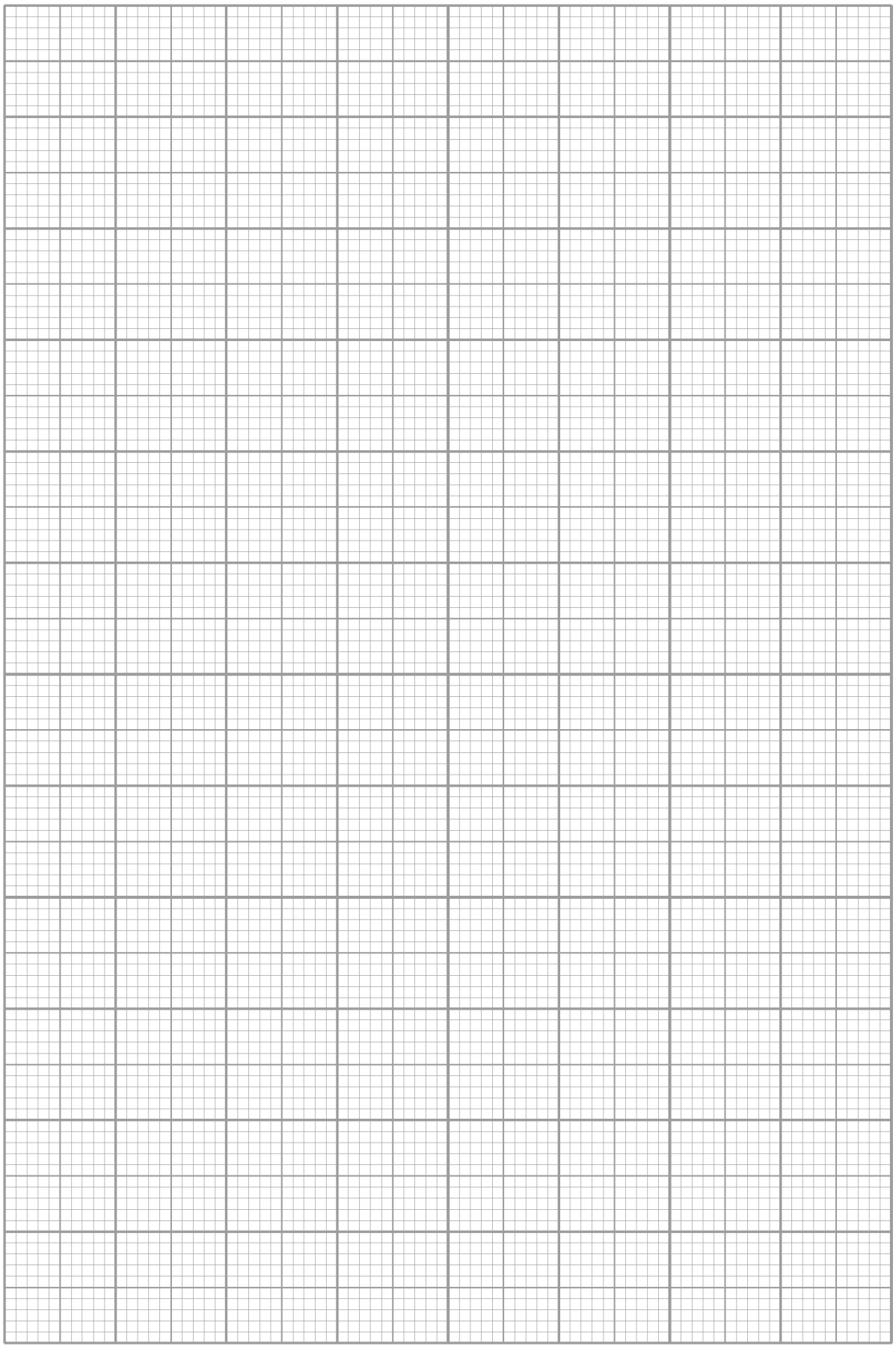
Use this equation and your results from Task A to complete the table below:

Time (s)	Mean temperature (°C)	Temperature change (°C)
0	0	0
30		
60		
90		
120		
150		
180		

(b) (i) Draw a graph of temperature change (vertical axis) against time (horizontal axis) on the grid opposite.

Include a plot for the start temperature at 0 seconds. [5]

Examiner only



(ii) Use your graph to describe the relationship between temperature change and time. [2]

Examiner only

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(c) The energy change for the reaction can be found by using the following equation:

$$\text{Energy change} = 4.2 \times m \times \Delta T$$

m = mass of water (assumed to be 200 g)
ΔT = maximum temperature change for the reaction

(i) State the maximum value of ΔT for your experiment. This is the value at 180 s from the table in part (a). [1]

Maximum ΔT = ...°C

(ii) Use this value and the equation to calculate the energy change for this experiment. [1]

Energy change = ... J

Examiner only

(d) The theoretical value of the energy change for this experiment is 46 200 J. Evaluate your data collected in Task A. In your answer you should: [2]

- Comment on the accuracy of your data
- Explain why your results were repeated.

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……

(e) A group of students used the same method to investigate the temperature change when different metals reacted with copper(II) sulfate solution.

Their results are given below.

Metal	Maximum temperature rise when added to copper(II) sulfate solution (°C)		
	Trial 1	Trial 2	Trial 3
zinc	20	23	22
magnesium	39	40	42
iron	11	15	19

(i) Comment on the precision of the results of the group. [2]

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(ii) One of the students suggests that the first temperature rise for iron (11 °C) must be an anomalous result.

Explain whether you agree. [2]

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Examiner only

(f) Hand warmers are single use heat packs that provide everyday warmth and are ideal for keeping your hands warm when the temperature gets cold.

A group of students were given 3 different brands of heat packs. They were asked to find out which heat pack gave out the most heat in one minute.

They used the following method.

1. Measure out 200 cm^3 of water using a measuring cylinder.
2. Pour the water into a beaker.
3. Record the temperature of the water using a thermometer.
4. Activate hand warmer **A**.
5. Place hand warmer **A** into the beaker so it is fully submerged in the water and start the stopwatch.
6. Stir the contents of the beaker with the thermometer and record the temperature of the water after 1 minute.
7. Calculate the temperature increase of the water.
8. Repeat steps 1 – 6 for hand warmers **B** and **C**.

(i) Identify the variables in the students' experiment. [4]

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(ii) Write a hypothesis for how the effectiveness of the brand of handwarmer affects the temperature increase of the water. [1]

Examiner only

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……..……

22

END OF PAPER

Question number	Additional page, if required. Write the question number(s) in the left-hand margin.
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Examiner only

Surname	Centre number	Candidate number
First name(s)		0

GCSE

GCSE THE SCIENCES (Double Award) – Unit 7c

3455U7
SCIENTIFIC ENQUIRY

AN ENQUIRY INTO THE ANGLE OF LIGHT REFRACTION

TASK A

1 hour

SAMPLE ASSESSMENT MATERIALS

ADDITIONAL MATERIALS

A calculator and ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen or correction fluid. You may use a pencil for graphs and diagrams only.

For Examiner's use only		
	Maximum Mark	**Mark Awarded**
Task A	**6**	

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet. If you run out of space, use the additional page(s) at the back of the booklet, taking care to number the question(s) correctly.

INFORMATION FOR CANDIDATES

This assessment is in 2 sections, Task A and Task B. You will complete Task A in one session and Task B in a different session.

The total number of marks available for Task A is 6.

The number of marks is given in brackets at the end of each question or part-question.

Introduction

When light travels into a different medium it changes speed, and this can cause a change in direction. This is called refraction. Refraction is important in animal biology because when light passes through the eye it changes direction at the lens and is focussed on the retina.

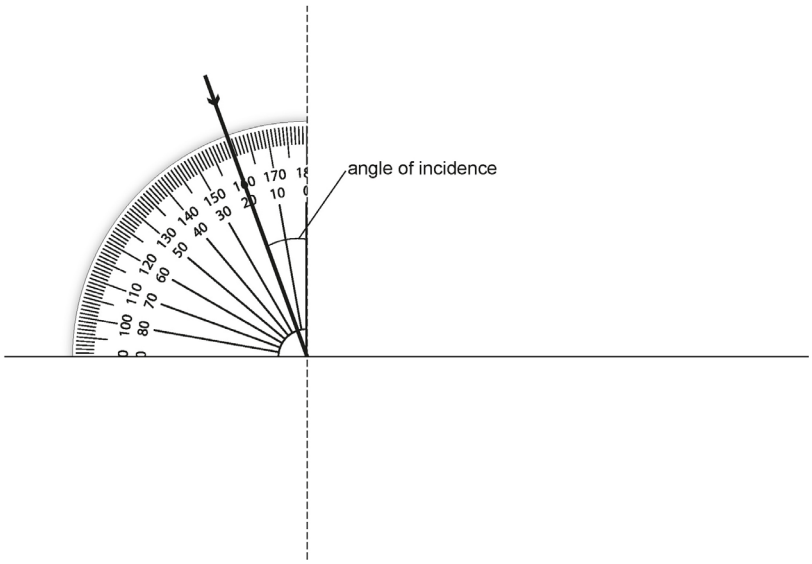
In this enquiry you will look at measuring the angle of refraction of light travelling into a glass block at different angles of incidence.

Apparatus

The following apparatus is required for each group: (each group should consist of no more than three candidates)

1 × rectangular Perspex or glass block
1 × ray box with a single slit and no lens
1 × protractor
1 × 30 cm ruler
1 × 12 V d.c. power supply

Diagram



Method

1. Place the glass block on the diagram with the block against the solid line.

2. Use the ray box to shine a single ray of light into the glass at 20° to the normal (angle of incidence) as shown on the template.

3. Mark with a pencil the exit point of the ray from the bottom face of the glass block.

4. Turn off the ray box and remove the glass block.

5. Draw a straight line to mark the path of the ray through the block.

6. Use the protractor to measure and record the angle between the path of the ray through the block and the normal (angle of refraction).

7. Repeat steps 2 to 6 for values of the angle of incidence of 30°, 40°, 50°, 60° and 70°.

TASK A

Answer **all** questions.

Examiner only

1. (a) Step 4 in the method states: “turn off the ray box ….”

Explain why this step is important for working safely. [2]

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……

(b) Present your results in a table. Include all of your results. [3]

(c) State the resolution of the measuring instrument used in this experiment. [1]

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6

END OF PAPER

Surname	Centre number	Candidate number
First name(s)		0

GCSE

GCSE THE SCIENCES (Double Award) – Unit 7c

3455U7
SCIENTIFIC ENQUIRY

INVESTIGATING THE ANGLE OF LIGHT REFRACTION

TASK B

1 hour

SAMPLE ASSESSMENT MATERIALS

ADDITIONAL MATERIALS

A calculator and your Task **A** exam paper.

For Examiner's use only		
	Maximum Mark	**Mark Awarded**
Task B	**22**	

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen or correction fluid. You may use a pencil for graphs and diagrams only.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet. If you run out of space, use the additional page(s) at the back of the booklet, taking care to number the question(s) correctly.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question. This assessment is in 2 sections, Task A and Task B. You will have completed Task A in a previous session.

The total number of marks available for Task B is 22.

TASK B

Answer **all** questions.

2. (a) Identify the variables from the method followed in Task A. [4]

Examiner only

independent variable

……

dependent variable

……

controlled variable 1

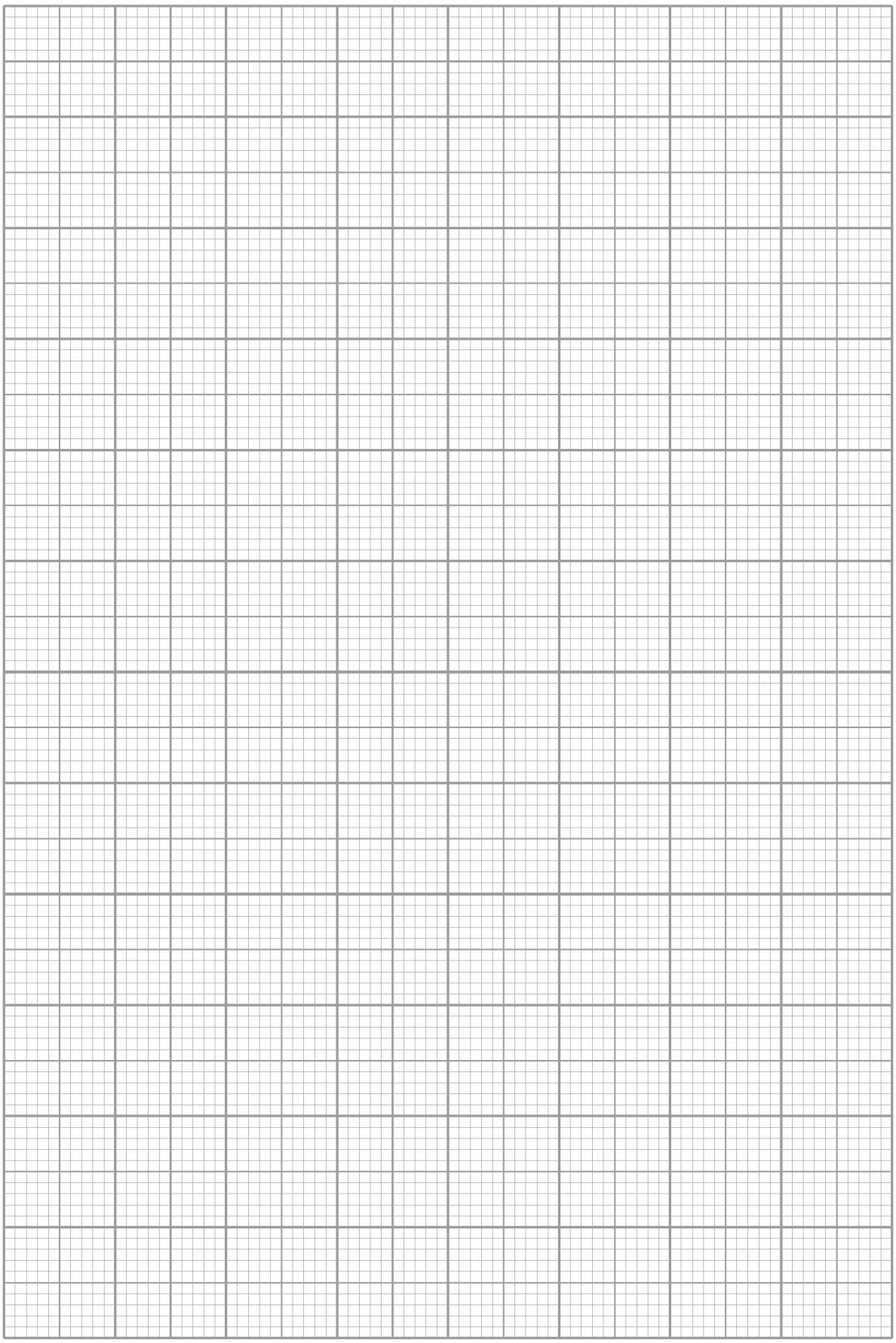
……

controlled variable 2

……

(b) Use your results from Task A to plot a graph on the grid opposite. [5]

Examiner only



Examiner only

(c) Brogan made the following hypothesis for the same experiment that you carried out.

"I predict that when the angle of incidence increases the angle of refraction will increase at a constant rate."

Explain whether your results support Brogan's hypothesis. [2]

……

……

(d) Evaluate the method that you followed in Task A. You should include in your answer:

- One inaccuracy in the method that made it difficult to collect results
- One suggestion for an improvement to the method. [2]

……

……

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Examiner only

(e) Brogan carried out the same experiment that you did to test her hypothesis. Her results are shown below.

Ange of incidence (°)	Angle of refraction (°)			
	Trial 1	Trial 2	Trial 3	Mean
20	12	16	14	14
40	26	35	24	25
60	38	36	39	……..
80	43	43	41	……..

(i) Complete the table by calculating the missing means.

Show your workings below. [2]

(ii) Explain why the mean at 40° is 25° and not 28°. [1]

……...

……...

(iii) For the Perspex block that Brogan used in her experiment, theory suggests that if angle **A** is 40°, angle **B** will be 25.4°.

Evaluate what this tells Brogan about the accuracy of her results. [1]

……...

……...

Examiner only

(f) The students want to extend their enquiry into the behaviour of light.

They want to find out the effect of using different coloured filters on the transmission of light.

They have red, blue, green, magenta and yellow filters available.

Plan a method they can follow. You must include a prediction in your answer. [3]

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……...

……...

(g) Marine biologists are investigating how the eyes of fish are adapted to see at different depths in the ocean.

They want to compare fish that live close to the surface with fish that live in the mid and deep ocean.

They will study a variety of different species.

They will investigate in many different locations.

They will include many fish from each depth.

Explain what is good about the sampling techniques they plan to use. [2]

……...

……...

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22

END OF PAPER

Question number	Additional page, if required. Write the question number(s) in the left-hand margin.
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Examiner only

MARK SCHEME

GCSE THE SCIENCES (DOUBLE AWARD)

UNIT 7 – SCIENTIFIC ENQUIRY

Recording of marks

Examiners must mark in red ink.

One tick must equate to one mark (apart from the questions where a level of response mark scheme is applied). Question totals should be written in the box at the end of the question.

Question totals should be entered onto the grid on the front cover and these should be added to give the script total for each candidate.

Marking rules

All work should be seen to have been marked.

Marking schemes will indicate when explicit working is deemed to be a necessary part of a correct answer. Crossed out responses not replaced should be marked.

Credit will be given for correct and relevant alternative responses which are not recorded in the mark scheme.

Marking abbreviations

The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

cao = correct answer only

ecf = error carried forward

bod = benefit of doubt

Unit 7a Mark Scheme

Task A

Question		Marking details	Marks available					
			AO1	AO2	AO3	Total	Maths	Enquiry Skills
1.	(a)	Accept any hypothesis that links independent variable with dependent variable. e.g. Increasing the temperature, increases the number of bubbles produced.	1			1		1
	(b)	To weigh down the pipette			1	1		1
	(c)	All data recorded and logically organised (1) Suitable column headings (temperature / number of bubbles) (1) Appropriate units (°C) included in headings (1) Correct calculation of mean (1)	 1 1 	1 1		4	2	4
		Task A total	**3**	**2**	**1**	**6**	**2**	**6**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Enquiry Skills
2.	(a)	[±] 1 [cm^3]			1					1
	(b)	20-60 / 60-20 / 40 [^0C]				1				1
	(c)	So that the yeast / glucose mixture reaches the correct temperature				1				1
	(d)	(i)	Axes labelled with correct orientation (1) and ecf headings and units from the table Appropriate scales chosen so that data covers at least ½ of graph paper (1) All plots correctly plotted within < 1 small square tolerance (2) 1 error (1) >1 error (0) Appropriate line of best fit (1) Accept point to point Do not accept a thick, double, wispy line.		1 1	2 1		5	5	5
		(ii)	I.	As the temperature increases the number of bubbles counted increases Accept candidates own correct description of results		1		1		1
			II.	Any statement comparing the suggested hypothesis in Task A			1	1		1
	(e)	(i)	This measures the volume of oxygen produced (1) This is better than counting bubbles which aren't always the same size / may be too quick to count. (1)			1	1	2		2
		(ii)	The water bath will cool during the experiment (1) Use a thermostatically controlled water bath (1)			1	1	2		2

<table>
<tr><td></td><td>(f)</td><td>(i)</td><td><table><tr><td>Independent variable</td><td>Concentration of glucose solution</td></tr><tr><td>Dependent variable</td><td>Number of bubbles</td></tr><tr><td>Two controlled variables</td><td>Volume of glucose/ volume of yeast solution/ concentration of yeast/ temperature</td></tr></table></td><td></td><td>4</td><td></td><td>4</td><td></td><td>4</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>Any three (x1) from
No reference to time to count bubbles (1)
no repeat planned (1)
no values for the independent variable (1)
only plans to do 3 values of the IV (1)</td><td></td><td></td><td>3</td><td>3</td><td></td><td>3</td></tr>
<tr><td></td><td></td><td>(iii)</td><td>A measurement result is considered accurate if it is close to the true value.</td><td>1</td><td></td><td></td><td>1</td><td></td><td></td></tr>
<tr><td colspan="4">Task B total</td><td>4</td><td>12</td><td>6</td><td>22</td><td>7</td><td>22</td></tr>
</table>

Unit 7b Mark Scheme

Task A

Question		Marking details	Marks Available					
			AO1	AO2	AO3	Total	Maths	Enquiry Skills
1.	(a)	Logically organised table (1) Suitable column headings (time, temperature) (1) Appropriate units (s / °C) in headings (1) Both repeats recorded (1)	 1 1 1	1		4		4
	(b)	**Inaccuracies – any 2 × (1) from:** Measuring out the (volume of copper(II) sulfate) solution Delay between timing and reading the {thermometer/temperature} Heat loss (from the top/cup)			2	2		2
		Task A total	**3**	**1**	**2**	**6**	**0**	**6**

Task B

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Enquiry Skills
2.	(a)		Correct calculation of all mean values (1) Correct calculation of all temperature changes (1)		2		2	2	2
	(b)	(i)	Axes with correct orientation and labelled correctly with units (1) **ecf** headings and units from the table. Appropriate scales chosen that use at least ½ of graph paper (1) All plots correctly plotted with ± < 1 small square tolerance (2) 1 error (1) >1 error (0) Appropriate line of best fit (1) Do not accept a thick, double, wispy line or point to point	1 1	2 1		5	5	5
		(ii)	As the time increases, the temperature (change) increases and then decreases (1) Correct reference to time at the maximum temperature rise (1) Accept candidates own correct description of results		2		2		2
	(c)	(i)	Maximum ΔT calculated from candidate's results	1			1	1	1
		(ii)	Energy change calculated correctly using candidate's results		1		1	1	1

	(d)		**Accuracy of data (1)** Comparison of calculated value and theoretical value with sensible comparison and comment on accuracy **Reason for repeating results (1)** Results repeated to check for anomalies / to check precision of repeats / to get a mean		1	1 2		2
	(e)	(i)	Good [precision] for zinc and magnesium (1) because the results are close together (1) OR Poor [precision] for iron (1) because the results are not close together (1)			2	2		2
		(ii)	Use of data e.g. 11 is just as far from 15 as 19 / all results are equally spread apart / owtte (1) so {either / any} could be anomalous (1)			2	2		2
	(f)	(i)	Independent variable – brand [of handwarmer / heat pack] (1) Dependent variable – temperature increase [of water] (1) Controlled variables – volume of water / size of {handwarmer / heat pack} / time for heating [water] / {size/ material} of beaker (any 2 from) Type of variable should be clearly identified to award marks.		4		4		4
		(ii)	The more effective the {handwarmer / heatpack} the higher the {temperature / temperature increase} [of the water] The hypotheses must be correct.		1		1		1
			Task B total	**4**	**13**	**5**	**22**	**9**	**22**

Unit 7c Mark Scheme

Task A

Question		Marking details	Marks Available					
			AO1	AO2	AO3	Total	Maths	Enquiry Skills
1.	(a)	Lamp will get hot if left switched on (1) If you touch it, it will burn you. (1)	1	1		2		2
	(b)	All data recorded and logically organised (1) Suitable column headings (angle of incidence, angle of refraction) (1) Appropriate units (°)(seen anywhere in table) (1)	1 1	1		3		3
	(c)	±1	1			1		1
		Task A total	**4**	**2**	**0**	**6**	**0**	**6**

Task B

Question		Marking details	Marks Available					
			AO1	AO2	AO3	Total	Maths	Enquiry Skills
2.	(a)	Independent variable – angle of incidence (1) Dependent variable – angle of refraction (1) Controlled variables – the material of block / density of block and {colour / frequency / wavelength} of light (any two from)		4		4		4
	(b)	Axes with correct orientation (angle of incidence on the x-axis) and labelled correctly. (1) **ecf** headings and units from the table. Appropriate scales chosen that use at least ½ of graph paper (1) All plots correctly plotted with ± < 1 small square tolerance (2) 1 error (1) >1 error (0) Appropriate line of best fit (1) Do not accept a thick, double, wispy line or point to point	1 1	2 1		5	5	5
	(c)	Correct trend identified from graph, e.g. as the angle of incidence increases the angle of refraction increases (1) at a constant rate [so agrees with Brogan's hypothesis] (1)		2		2	2	2

	(d)		**Inaccuracy** Difficulty in measuring the angle of refraction due to the width of beam leaving block (1) **Improvement** This could be improved with using a sharper beam of light/narrower slit / use a lens / use a laser Accept – hard to see the ray OR Complete the experiment in a darkened room (1)			2	2	2	2
	(e)	(i)	At least one correct substitution seen (1) Both means correct – 38 (37.7) **and** 42 (42.3) (1)	1	1		2	2	2
		(ii)	35° is an anomaly and shouldn't be included in the calculation			1	1		1
		(iii)	Her values are very close to the true value, so her data is accurate			1	1		1
	(f)		Method includes: An outline of how the apparatus including the ray box and screen will be set up (1) A logical description of changing the filters and recording the result (1) Prediction – different coloured filters will absorb different colours of light, transmitting only certain colours.			3	3		3
	(g)		They have ensured that the sample is representative OWTTE (1) Because they have a large sample / included different species / included different locations (1)		2		2		
			Task B total	**3**	**12**	**7**	**22**	**7**	**22**