AQA Required Practical Activities Practice Questions

We have created 15 exam-style questions to support schools and their students with the required practical activities specified in the 9-1 AQA GCSE science specifications.

Disclaimer:

We have built these questions in a similar style to that presented within the exam board's sample assessment materials. There can be no guarantee of the extent to which these questions will reflect the actual examination questions students will sit. We hope that schools and students find these questions useful in the exam preparations. However, EzyEducation Ltd takes no responsibility for the relevance of this document to actual examinations sat.

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AQA Biology Required Practical Questions + Mark Scheme

Q1 Based on taste a student suggests that the cells in one type of apple contain more sugar than the cells of a different type of apple.

Describe and explain how a student can use a sugar solution of low concentration to test this hypothesis.

Your account should include

- a list of equipment and a description of how it would be used;
- details of the measurements you would make;
- details of how you would ensure that the experiment is fair;
- the outcome you would expect if the hypothesis is correct.

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[8 marks]

Q2 A student used the equipment shown in **Figure 1** to model the effect of amylase on starch in the gut.

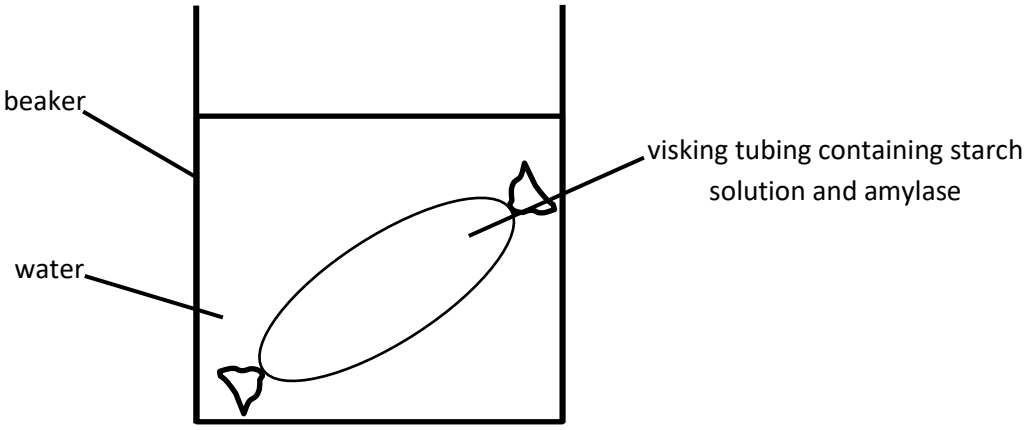

Figure 1

(a) At one-minute intervals the student used a pipette to remove a small volume of the water from the beaker.

This water was then mixed with Benedict's solution in a test tube, which was then placed in a hot water bath at 60 °C.

For the first four samples there was no change in the colour of the Benedict's solution, but for the fifth sample the colour of the Benedict's solution changed from blue to red.

Explain what this colour change indicates.

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[2 marks]

(b) The student wanted to test the water in the beaker for starch.

Describe the steps that the student should follow and explain how the student will know if starch is present or not.

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[2 marks]

(c) Buffer solution resists change to its pH when small amounts of an acid or an alkali are added to it. Buffer solutions can be used to keep the pH of a substance constant during an experiment. For example, if pH 5.5 buffer solution is added to a mixture of amylase and starch solution, the pH of the mixture will remain constant at 5.5.

The student has the following buffer solutions available: 5.5, 6.0, 6.5, 7.0, 7.5 and 8.0.

Describe how the student can adapt the visking tube experiment to investigate the effect of pH on the action of amylase.

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[6 marks]

Q3 A group of students investigated the effect of changing light intensity on the rate of photosynthesis in the water plant *Elodea*.

Figure 1 shows the equipment set up to carry out the experiment.

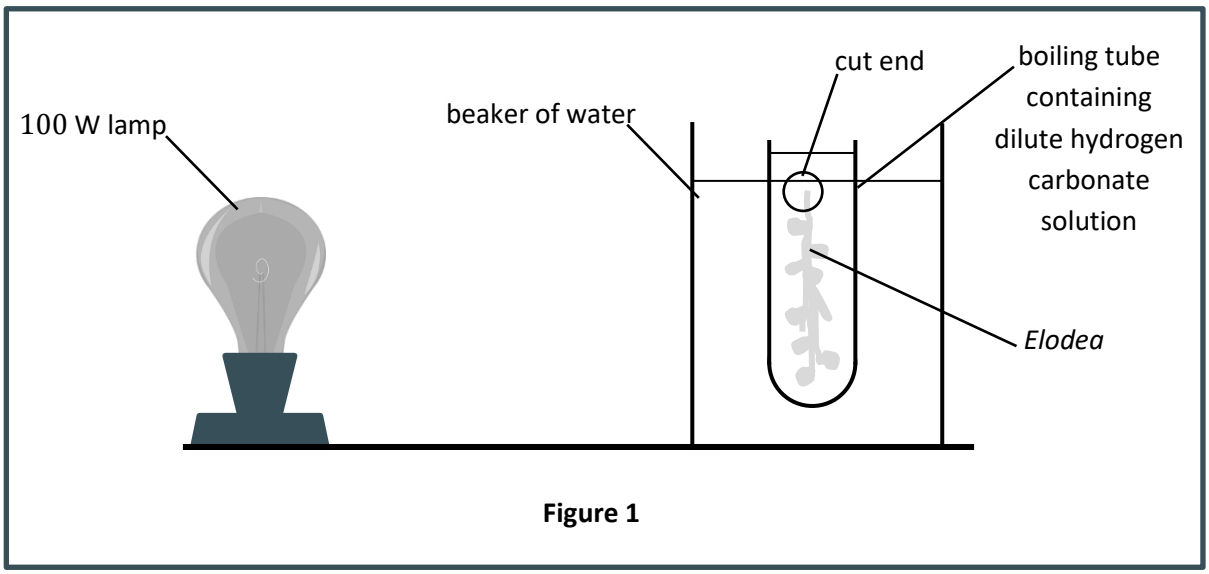

Figure 1

With the lamp at different distances from the *Elodea* the students counted the number of bubbles leaving through the cut end in one minute.

(a) Explain why the experiment was carried out with the lamp at different distances from the *Elodea*.

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[2 marks]

(b) Explain the purpose of the beaker of water.

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[2 marks]

(c) Explain why the *Elodea* was placed in dilute hydrogen carbonate solution.

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[2 marks]

(d) Before the sample of Elodea used in the experiment was cut from a plant, the plant was placed in a beaker of water in front of the lamp for two hours.

Explain why this was necessary.

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[1 mark]

Q4 A group of students investigated the hypothesis that humans can get used to loud sounds if exposed to them long enough, so that the sound no longer affects their concentration.

The students used a computer reaction timer that involved the volunteer student watching a computer screen and pressing the space bar on the keyboard when a red square appeared momentarily on the screen. The computer measured the time between the red square appearing and the space bar being pressed.

The volunteer student carried out this test 5 times in silent conditions.

The student then rested for 10 minutes and then carried out the test another 5 times with the noise of applause playing at a high level.

The set of 5 tests was carried out 9 more times with rest periods of 10 minutes in between and with the noise of applause playing at the same high level each time.

(a) (i) What factor needs to be considered when ensuring the welfare of the volunteer student?

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[1 mark]

(ii) Why was the first test carried out in silence?

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[1 mark]

(b) The table in **Figure 1** shows the results of the experiment.

set	noise level	reaction time (s)	mean reaction time (s)
1	silent	0.21, 0.24, 0.19, 0.22, 0.36	0.22
2	high	0.46, 0.44, 0.78, 0.51, 0.55	
3	high	0.39, 0.42, 0.44, 0.38, 0.40	0.41
4	high	0.33, 0.31, 0.35, 0.37, 0.32	0.34
5	high	0.29, 0.31, 0.28, 0.28, 0.33	0.30
6	high	0.31, 0.28, 0.33, 0.30, 0.27	0.30
7	high	0.33, 0.29, 0.31, 0.32, 0.30	0.31
8	high	0.29, 0.32, 0.31, 0.33, 0.31	0.31
9	high	0.30, 0.26, 0.29, 0.31, 0.33	0.30
10	high	0.32, 0.27, 0.33, 0.31, 0.31	0.31

Figure 1

(i) Complete the table by calculating the mean reaction time for set 2.

[2 marks]

(ii) Explain the extent to which these results support the hypothesis being investigated.

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[4 marks]

Biology Only

Q5 Aseptic technique is used to prepare an uncontaminated culture containing only *E. coli* bacteria on an agar plate.

(a) Describe and explain how to ensure that only *E. coli* bacteria are present on the agar plate.

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[6 marks]

(b) A student used an uncontaminated culture of E. coli bacteria on an agar plate to compare the effectiveness of three disinfectants.

The student soaked three circular discs of filter paper in the three disinfectants and a fourth in distilled water.

The student placed each disc on the agar plate, as shown in **Figure 1**.

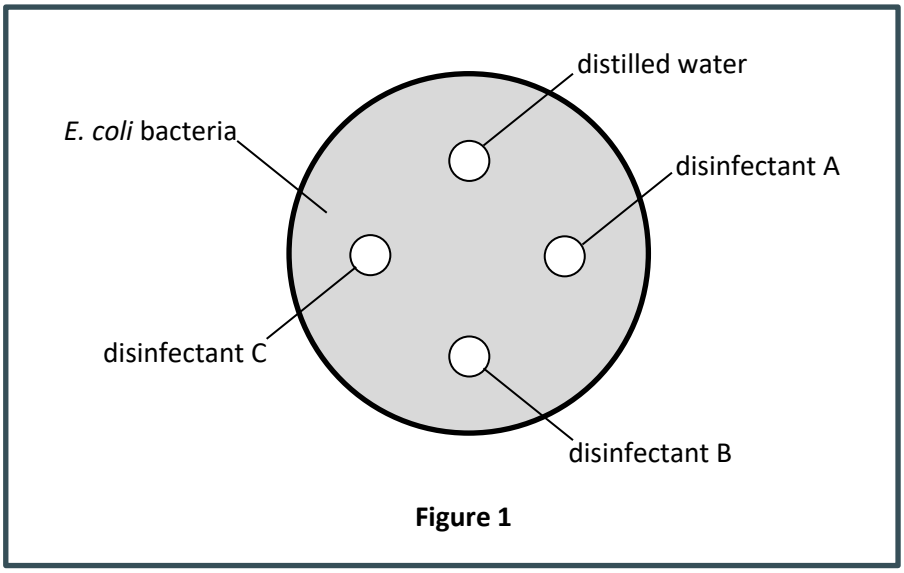

Figure 1

Figure 2 shows the agar plate after four days.

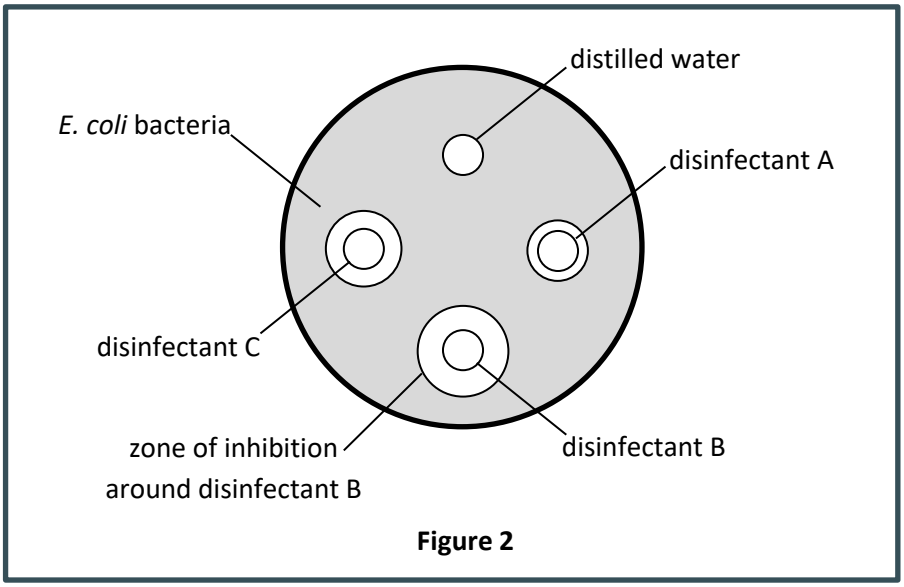

Figure 2

Figure 3 shows the diameter of the zone of inhibition around disinfectant B being measured with a ruler.

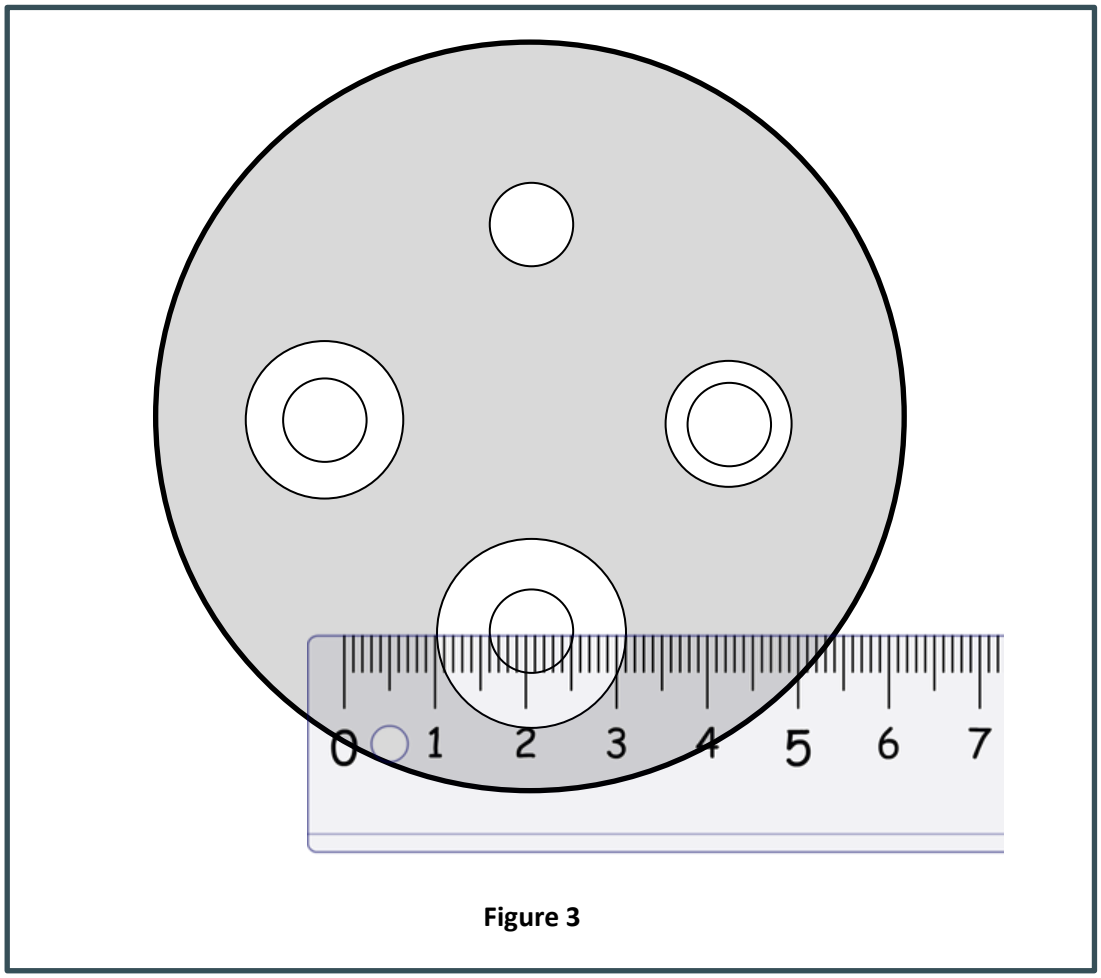

Figure 3

(i) Use information in Figure 3 and the equation $A = \pi r^2$ to calculate the area of the zone of inhibition around disinfectant B.

Area of zone of inhibition =..... cm^2 **[2 Marks]**

The table in **Figure 4** shows the results for five students.

student	**area of zone of inhibition (cm^2)**		
	disinfectant A	**disinfectant B**	**disinfectant C**
1	2.1	3.2	2.7
2	3.6	4.6	4.1
3	5.2	1.6	2.2
4	2.9	3.9	3.3
5	1.9	3.5	2.3
mean	2.6		3.1

Figure 4

(ii) Calculate the mean area of the zone of inhibition around disinfectant B and complete the table.

[2 marks]

(iii) Write a conclusion for these results.

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[2 marks]

Q1 Mark Scheme

Answers	Extra guidance	Mark	AO/ Spec. Ref
Cut a piece (pieces) (of the same size) from each apple (with a sharp knife)		**1**	**AO1/2 B4.1.3.2**
Measure the dimensions / mass of each piece of apple		**1**	
Place the pieces in (equal volumes) of (the same) sugar solution and leave for some time	Accept specific times that exceed one hour	**1**	
Measure the dimensions / mass of each piece after they have been removed from the sugar solution		**1**	
Equipment: ruler, sharp knife, balance	This mark to be given for a list of equipment that fits the particular method described – an actual list is not essential as long as all of the appropriate equipment is seen	**1**	
Measurements: the dimensions / mass of the pieces of apple to be measured before **and** after they have been in the sugar solution	It must be clear that measurements are made before and after so that a change can be calculated	**1**	
Fair testing: the idea that the pieces of apple should have the same dimensions	Accept same concentration of sugar solution in place of the dimensions of the pieces	**1**	
Outcome: The apple with the higher sugar content (the sweetest apple) will undergo the greatest increase in size / length / mass	Accept reverse argument from the point of view of water leaving the cells – the apple with the higher sugar content will undergo the smallest decrease in size / length / mass	**1**	

Q2 Mark Scheme

	Answers	Extra guidance	Mark	AO/ Spec. Ref
a	Glucose / sugar is present in the water	'Glucose has passed out through the visking' tubing or 'Glucose has been produced by the digestion of / action of amylase on starch' scores both marks	**1**	**AO1/2 B4.2.2.1**
a	Having come from inside the visking tubing / from the digestion of the starch	Accept idea of diffusion	**1**	
b	Add (small amount) water to iodine		**1**	**AO1/2 B4.2.2.1**
b	Which will turn blue/black/dark if starch is present	Accept reverse argument – will remain red/brown if starch is not present	**1**	
c	Add (known) volumes of starch solution, amylase and buffer solution to the visking tubing and place in beaker of water		**1**	**AO1/2 B4.2.2.1**
c	Check water in the beaker using Benedict's solution at regular intervals	Accept 'check for glucose' and specific time intervals no longer than one minute and no shorter than 30 seconds	**1**	
c	Continue checking until the Benedict's solution changes colour	Accept 'until glucose is detected'	**1**	
c	Repeat with different buffer solutions	Accept 'at different pH values'	**1**	
c	The pH with the shortest time for the Benedict's solution to change colour is closest to the optimum value	The idea that what is being looked for is the shortest time for the digestion of the starch to take place scores this mark	**1**	
c	Idea of fair testing – identify at least two control variables	Any two from: volume of starch solution, amylase, buffer solution; concentration of amylase, starch solution; temperature; volume of water in beaker (to be kept constant)	**1**	

Q3 Mark Scheme

	Answers	Extra guidance	Mark	AO/ Spec. Ref
a	To change light intensity	Accept 'light intensity is the independent variable'	**1**	**AO1/2 B4.4.1.2**
a	Light intensity increases as the lamp is brought closer	Accept reverse argument – light intensity decreases as the lamp is moved away	**1**	
b	The water absorbs heat (energy) / thermal energy		**1**	**AO1/2 B4.4.1.2**
b	To keep temperature (of the *Elodea* / hydrogen carbonate solution) constant	Accept 'temperature is a control variable'	**1**	
c	(The hydrogen carbonate solution) provides carbon dioxide		**1**	**AO1/2 B4.4.1.2**
c	To increase the rate of photosynthesis / make it more measurable	The idea that carbon dioxide is used in photosynthesis on its own not enough for the mark	**1**	
d	To get photosynthesis taking place at full rate	The idea that photosynthesis doesn't start immediately at the maximum rate when light is switched on scores this mark	**1**	**AO1/2 B4.4.1.2**

Q4 Mark Scheme

	Answers	Extra guidance	Mark	AO/ Spec. Ref
ai	Loudness of sound / repetition of sound	The idea that 'too much' sound might damage the ears is what is being looked for here	**1**	**AO1/2 WS2.4**
aii	For comparison with experimental results	The idea of a 'base line' reaction time or normal reaction time is what is being looked for here.	**1**	**AO1/2 WS2.4**
bi	0.49 scores two marks 0.55 or 0.548 scores 1 mark	The action of adding values together and dividing by the number of values scores one mark regardless of the answer.	**1/2**	**AO1/2 WS3.6**
bii	The reaction times do decrease with practice		**1**	**AO1/2 WS3.5**
bii	BUT settle at a value above that for no noise		**1**	**AO1/2 WS3.5**
bii	This is just for one person / just on one day / one type of noise		**1**	**AO1/2 WS3.5**
bii	Experiment needs to be carried out over a wider range of conditions if hypothesis is to be supported		**1**	**AO1/2 WS3.5**

Q5 Mark Scheme

<table>
<tr><th></th><th></th><th></th><th>Mark</th><th>AO/
Spec. Ref</th></tr>
<tr><td>a</td><td>Level 1 – Describes one method of ensuring no contamination takes place</td><td rowspan="3">Methods
Spray work surfaces with disinfectant and wipe with paper towels
Wash hands with antibacterial hand wash
Sterilise the Petri dish and agar before using
Heat the inoculating loop in a hot Bunsen burner flame and allow to cool before using it to spread the E. coli bacteria on the agar plate
Only partially open the lid when spreading the E. coli bacteria on the agar plate
Secure the lid of the Petri dish with adhesive tape

Explanations
Work surfaces will carry bacteria from contact with other organisms and substances
Hands regularly come into contact with bacteria and soap may not kill all bacteria
The Petri dish and agar will be contaminated with bacteria when being handled
Fierce heat will kill any bacteria on the inoculating loop, but it must be allowed to cool to avoid the E. coli being killed
Only partially opening the lid of the Petri dish and then securing the lid with adhesive tape will reduce the risk of air borne-bacteria contaminating the agar

General explanation – bacteria in the environment need to be killed or prevented from reaching the agar.

The mark given in a level depends on the accuracy and clarity of the information given – the bold text indicates ideas that might score the top marks in a particular level</td><td>1/2</td><td>AO1/2
B4.1.1.6</td></tr>
<tr><td>a</td><td>Level 2 – Describes and explains one method of ensuring no contamination takes place
OR
Describes two methods of ensuring no contamination and gives a general explanation</td><td>3/4</td><td>AO1/2
B4.1.1.6</td></tr>
<tr><td>a</td><td>Level 3 – Describes and explains two methods of ensuring no contamination</td><td>5/6</td><td>AO1/2
B4.1.1.6</td></tr>
</table>

bi	Diameter = 2.1 cm or radius = 1.05 cm	Any evidence of this to be credited	**1**	**AO1/2 WS3.5**
bi	3.5	Accept any correctly rounded form of 3.464055 Accept a correct calculation of A based on an incorrect radius for one mark	**1**	**AO1/2 WS3.5**
bii	3.8 scores two marks 3.36 or 3.4 scores one mark	3.8 is obtained by removing the results for student 3, which do not fit the pattern followed by the other results	**1/2**	**AO1/2 WS3.3**
biii	Disinfectant B is the most effective		**1**	**AO1/2 WS3.5**
biii	Against *E. coli*		**1**	**AO1/2 WS3.5**

AQA Chemistry Required Practical Questions + Mark Scheme

Q1 A student makes the following prediction about the reaction about the reaction between magnesium and hydrochloric acid:

The temperature rise caused by the reaction between magnesium and hydrochloric acid is bigger if the acid is more concentrated.

(a) Describe an experiment that the student can carry out to test this prediction.

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[6 marks]

(b) A student investigated the reaction between solutions of citric acid and sodium hydrogen carbonate.
Figure 1 shows the procedure and the results.

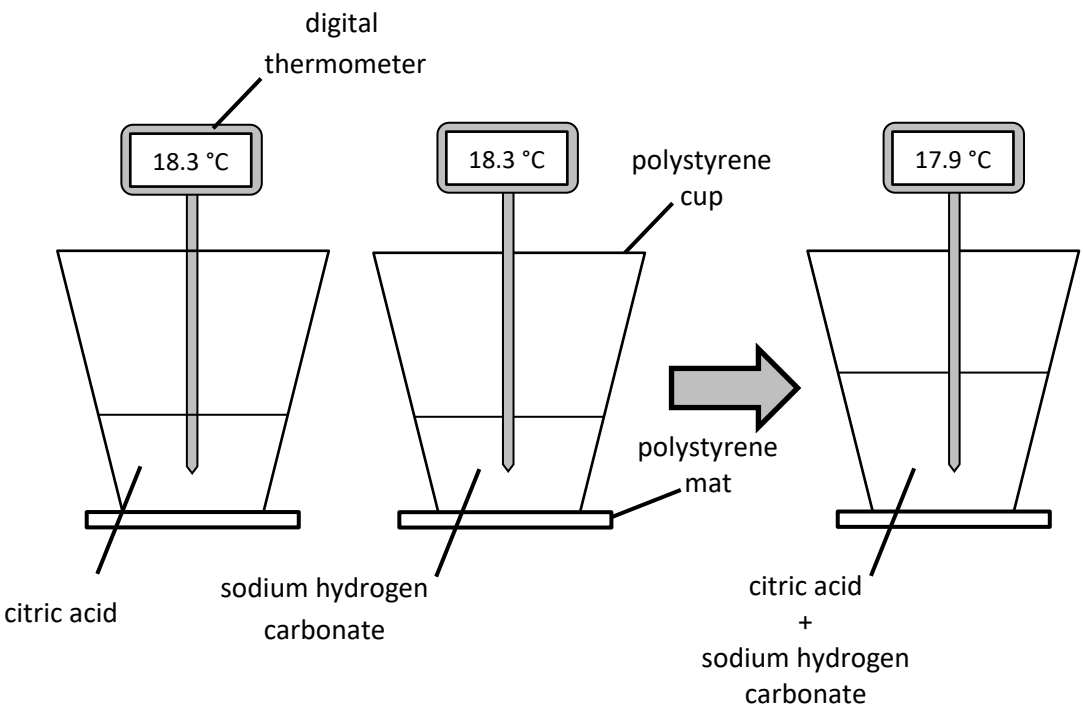

Figure 1

(i) Describe and explain two steps that the student has taken to make the results of this experiment as accurate as possible.

Step 1:

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Step 2:

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[2 marks]

(ii) Explain if this reaction is endothermic or exothermic.

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[1 mark]

Chemistry Only

Q2 A student carried out an experiment to determine the volume of hydrochloric acid needed to neutralise 20 cm^3 sodium hydroxide.

The student followed the steps below:

- Measure out 20 cm^3 sodium hydroxide and place it in a glass beaker.
- Add three drops of universal indicator to the sodium hydroxide.
- Measure out 100 cm^3 hydrochloric acid in a measuring cylinder.
- Use a dropping pipette to transfer hydrochloric acid from the measuring cylinder to the sodium hydroxide one drop at a time.
- Continue adding drops of hydrochloric acid to the sodium hydroxide until the universal indicator turns from purple to green.
- Return any hydrochloric acid still in the pipette to the measuring cylinder and then measure the volume of hydrochloric acid remaining.
- Calculate the volume of hydrochloric acid added to the sodium hydroxide to neutralise it.
- Repeat the experiment four times to obtain a total of five values of the volume of hydrochloric acid needed to neutralise the hydrochloric acid.

Figure 1 shows the measuring cylinder after one experiment to determine the volume of hydrochloric acid needed to neutralise 20 cm^3 hydrochloric acid.

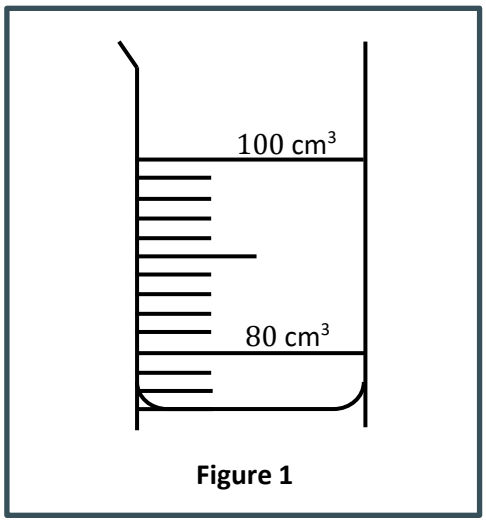

Figure 1

Figure 2 shows the five results for this experiment.

volume of hydrochloric acid (cm^3)					
trial 1	trial 2	trial 3	trial 4	trial 5	mean
24	26	25	44	27	

Figure 2

(a) (i) Which trial is shown in **Figure 1**?

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[1 mark]

(ii) Complete the table in **Figure 2** by calculating the mean value of hydrochloric acid needed to neutralise the 20 cm^3 sodium hydroxide.

[2 marks]

(b) Describe and explain an improvement that can be made to this experiment to make the results more accurate.

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[2 marks]

Q3 The equation shows the reaction between magnesium oxide and sulfuric acid.

$$MgO(s) + H_2SO_4(aq) \rightarrow MgSO_4(aq) + H_2O(l)$$

Describe and explain how to obtain a pure, dry sample of magnesium sulfate crystals using this reaction.

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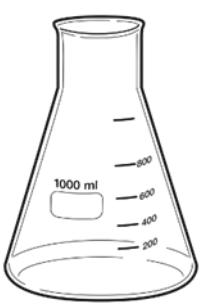
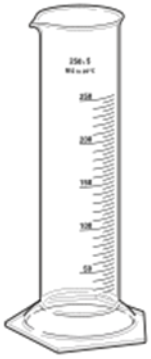
[6 marks]

Q4 One of the products of the chemical reaction between sodium thiosulfate and hydrochloric acid is sulfur, which forms a solid precipitate.

The equipment shown in **Figure 1** can be used to investigate how the concentration of the hydrochloric acid affects the rate of production of sulfur.

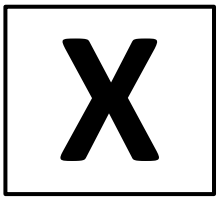


conical flask



measuring cylinders

digital timer



card with 'X' written on it.

Figure 1

In this experiment the sodium thiosulfate is mixed with the hydrochloric acid in the conical flask. The conical flask is then placed on top of the card with 'X' written on it and the time taken for the 'X' to be completely obscured by the sulfur precipitate when viewed from above is measured.

(a) Identify the independent, dependent and control variables in this experiment.

independent variable: .....

dependent variable: .....

control variables: .....

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[3 marks]

(b) The time taken for the 'X' to be completely obscured should be measured three times at each concentration of hydrochloric acid.

Explain how this makes the results of the experiment more accurate.

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[2 marks]

(c) The table in **Figure 2** shows a set of results for this experiment.

concentration of hydrochloric acid (mol/dm^3)	time taken for the 'X' to become obscured (s)			
	trial 1	trial 2	trial 3	mean
0.5	122	134	128	128
1.0	59	63	65	62
1.5	63	41	43	42
2.0	33	29	31	31
2.5	21	24	19	21

Figure 2

(i) Explain how the mean time for a concentration of 1.5 mol/dm^3 has been calculated.

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[2 marks]

(ii) Plot a graph for these results on the grid in **Figure 3**.

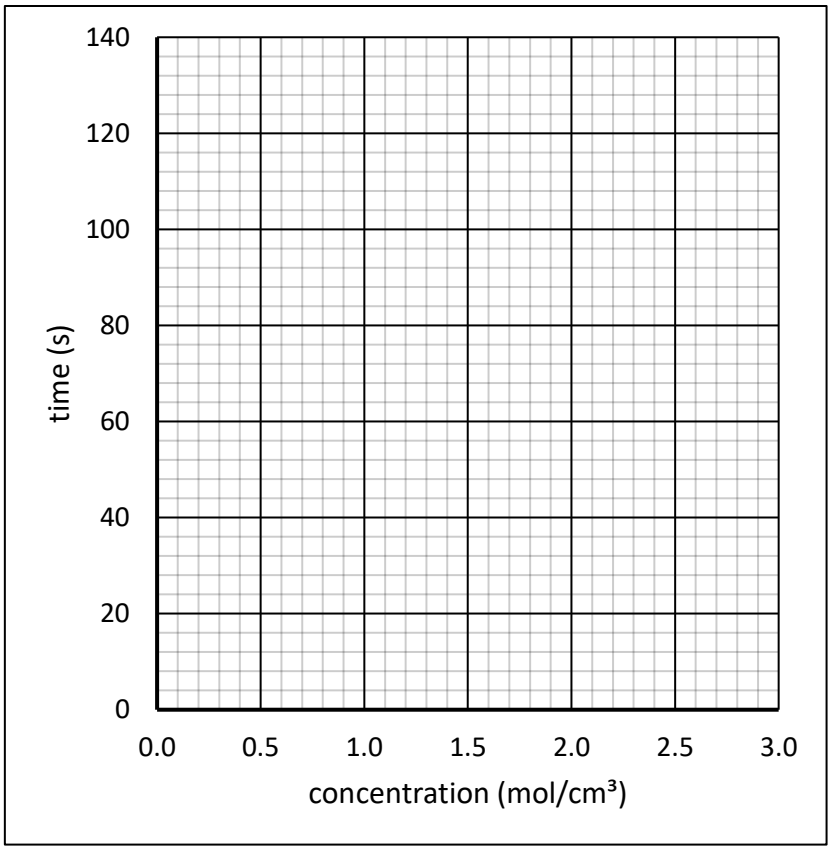

Figure 3

[2 marks]

(iii) Write a conclusion for this experiment.

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[2 marks]

Chemistry Only

Q5 **(a)** A scarlet flame is observed when a flame test is carried out on a solution.

Which metal ion is present in the solution?

Tick one box in **Figure 1**.

calcium	☐
copper	☐
lithium	☐
potassium	☐
sodium	☐

Figure 1

(b) A student mixed sodium hydroxide with a sample of water from a pond and based on what she observed, the student concluded that the sample contained aluminium, calcium or magnesium ions.

(i) What did the student observe?

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[1 mark]

(ii) Describe the steps the student should follow to confirm that the solution does or does not contain aluminium ions.

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[2 marks]

(c) A student suspects that a sample of water contains chloride ions.

What does the student expect to observe when the water is mixed with silver nitrate and nitric acid?

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[1 mark]

(d) Describe the test for sulfate ions.

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[2 marks]

Q1 Mark Scheme

	Answers	Extra guidance	Mark	AO/ Spec. Ref
a	Measure out (a known volume of) hydrochloric acid **and** measure its temperature	Both points need to be seen for this mark	**1**	**AO1/2 WS2.2**
a	Measure out (a known mass of powder or ribbon or length of ribbon) of magnesium and add to acid		**1**	
a	Measure the **maximum** temperature reached by the liquid / magnesium chloride solution	The idea that the temperature is measured when it has stopped rising is what is being looked for here. Accept 'acid' for liquid or magnesium chloride solution	**1**	
a	Calculate the change in temperature		**1**	
a	Repeat the experiment for different concentrations of hydrochloric acid	Accept specified values – at least four not exceeding 2.5 M	**1**	
a	Idea of fair testing – identify two control variables – volume of hydrochloric acid and amount of magnesium (mass or length)		**1**	
bi	Insulated containers and/or mats have been used to reduce heat loss have been used	The step and its intended impact must both be seen The idea of insulation can score once only	**1**	**AO1/2 WS2.3**
bi	A (digital) thermometer measuring to the nearest 0.1^0C has been used to measure **small** temperature changes more accurately	The idea that the temperature change being small is an issue here must be seen	**1**	**AO1/2 WS2.3**
bii	It is endothermic **because** the temperature drops	The meaning of 'endothermic' must be clear	**1**	**AO1/2 C4.5.1.1**

Q2 Mark Scheme

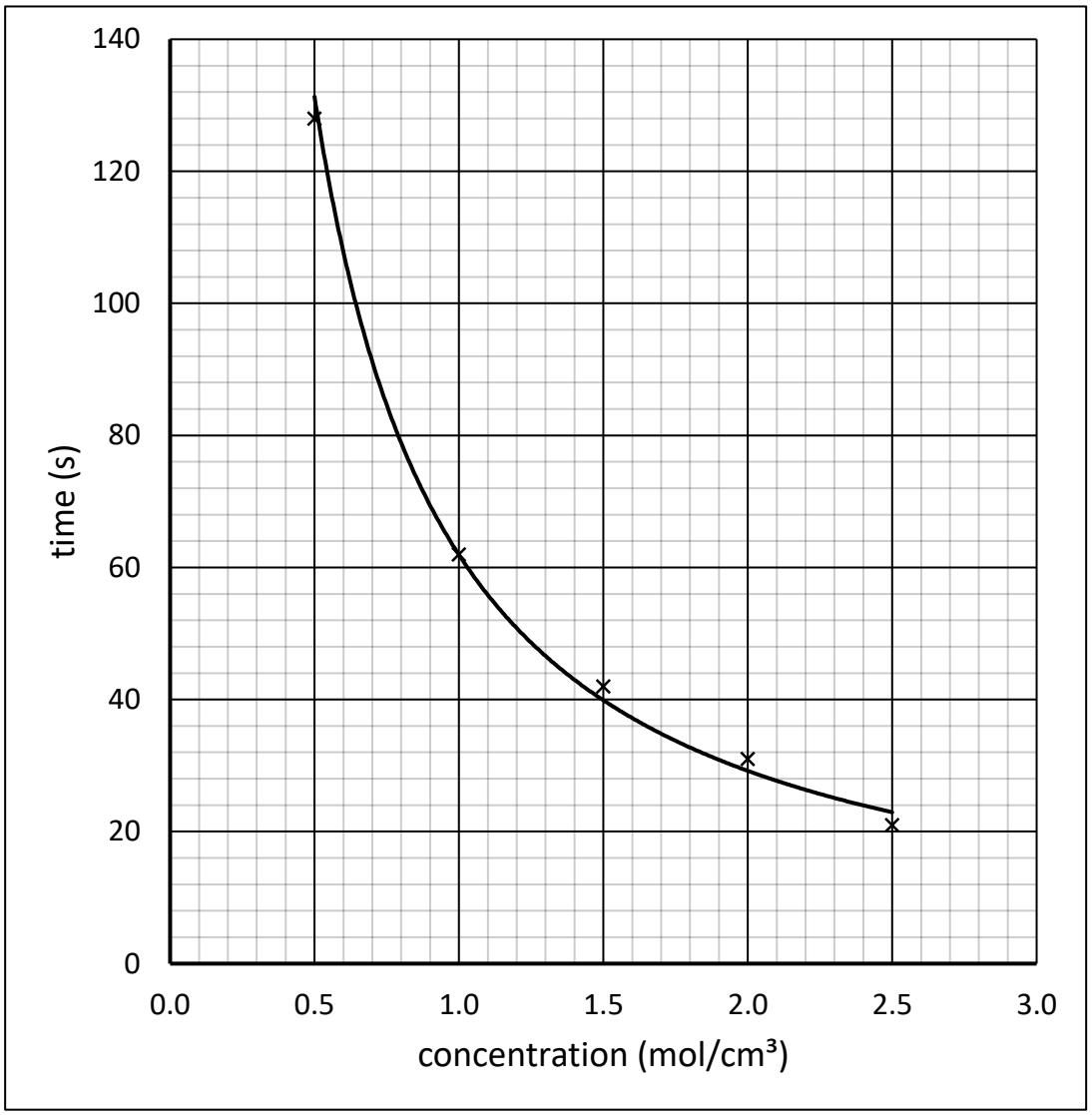
	Answers	Extra guidance	Mark	AO/ Spec. Ref
ai	Trial 2 (26 cm^3)		**1**	**AO1/2 WS3.3**
aii	26 (25.5) scores two marks 29 (29.2) scores one mark	The action of adding values together and dividing by the number of values scores one mark regardless of the answer.	**1/2**	**AO1/2 WS3.3**
b	Use a burette instead of a measuring cylinder OR use a pH meter instead of indicator solution	Accept the use of a measuring cylinder with a scale of **greater resolution** for one mark	**1**	**AO1/2 WS2.2**
b	The burette allows the volume of acid to be measured with a greater resolution OR pH meter removed human judgement	The idea that the volume can be measured to the nearest 0.1 cm^3 rather than the nearest 1 cm^3 can gain this mark as long as a clear comparison is made	**1**	**AO1/2 WS2.2**

Q3 Mark Scheme

Answers	Extra guidance	Mark	AO/ Spec. Ref
Add excess magnesium oxide	Accept alternatives to 'excess' such as 'until no more reacts'	**1**	AO1/2 4.4.2.3
To completely neutralise the acid	Accept the idea of using up all the acid	1	
Filter the mixture		**1**	
To remove excess magnesium oxide		1	
Heat filtrate		**1**	
To evaporate some water / bring to the point of crystalisation / bring to the point of saturation		1	
Leave remaining filtrate to cool / stand		**1**	
To allow crystals to form		1	
Maximum 6 marks available. The first four marks are for the main steps (in bold) in the correct order – deduct one mark if the steps are not in the correct order The remaining two marks are for any two explanation points (not in bold)			

Q4 Mark Scheme

	Answers	Extra guidance	Mark	AO/ Spec. Ref
a	concentration of hydrochloric acid (independent) AND time taken for 'X' to become obscured (dependent)	Accept 'acid' but not just 'concentration' or 'concentration of sodium thiosulfate'. Accept just 'time', time for 'X' or cross to disappear, time of reaction	**1**	**AO1/2 WS2.2**
a	Two control variables scores one mark Four or more control variables scores two marks	Possible control variables: Volume of hydrochloric acid Volume of sodium thiosulfate Concentration of sodium thiosulfate Temperature Size / shape of conical flask	**1/2**	**AO1/2 WS2.2**
b	There are large random errors/uncertainties in the time measurements	Accept the idea of errors / uncertainties related to human reaction time	**1**	**AO1/2 WS3.7**
b	Calculating the mean time cancels out random errors		**1**	**AO1/2 WS3.7**
ci	Anomalous value (of time) removed	Accept 'trial 1' or '63 s' removed	**1**	**AO1/2 WS3.3**
ci	Remaining times added together and divided by two	This mark depends on the previous mark and cannot be scored if the previous mark has not – a general description of how to calculate a mean value is not enough Accept (41 + 43)/2	**1**	**AO1/2 WS3.3**
cii	All points correctly plotted	See graph on next page	**1**	**AO1/2 WS3.1**
cii	Smooth curve through points		**1**	**AO1/2 WS3.1**
ciii	Time (for 'X' to be obscured) decreases as (acid) concentration increases	Accept rate of reaction increases as (acid) concentration increases	**1**	**AO1/2 WS3.5**
ciii	Rate of decrease in time gets smaller as concentration gets higher	'Time / rate inversely proportional to concentration' scores both marks	**1**	**AO1/2 WS3.5**


140
120
100
80
60
40
20
0
time (s)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
concentration (mol/cm³)

Q5 Mark Scheme

	Answers	Extra guidance	Mark	AO/ Spec. Ref
a	Lithium	If more than one box is ticked no mark is awarded	**1**	**AO1 C4.8.3.1**
bi	White (precipitate)	The colour itself is enough for this mark	**1**	**AO1 C4.8.3.2**
bii	Add more sodium hydroxide		**1**	**AO1 C4.8.3.2**
bii	If the white (precipitate) dissolves aluminium ions are present	Accept reverse argument – if the white (precipitate) does not dissolve, aluminium ions are not present OR either calcium or magnesium ions are present	**1**	**AO1 C4.8.3.2**
c	White precipitate	Accept 'white solid formed' Both parts needed	**1**	**AO1 C4.8.3.4**
d	Mix with barium chloride **and** (dilute) hydrochloric acid		**1**	**AO1 C4.8.3.5**
d	A white precipitate is formed if sulfate ions are present	Accept 'white solid formed' Both parts needed	**1**	**AO1 C4.8.3.5**

AQA Physics Required Practical Questions + Mark Scheme

Q1 **(a)** A student carrying out an experiment to determine the density of cooking oil records the following results:

mass of empty measuring cylinder $= 53.2$ ***grams***

mass of measuring cylinder containing 50 ***cm³ cooking oil*** $= 92.9$ ***grams***

Use these results to calculate a value for the density of cooking oil.

density of cooking oil $=$ …….. g/cm^3

[3 marks]

(b) Describe how a student would use a measuring cylinder to find the volume of an irregularly shaped stone.

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[3 marks]

(c) The diagrams in **Figure 1** show the dimensions of a rectangular metal block being measured with a ruler.

The mass of the block is then measured on a balance and the results are used to calculate the density of the metal.

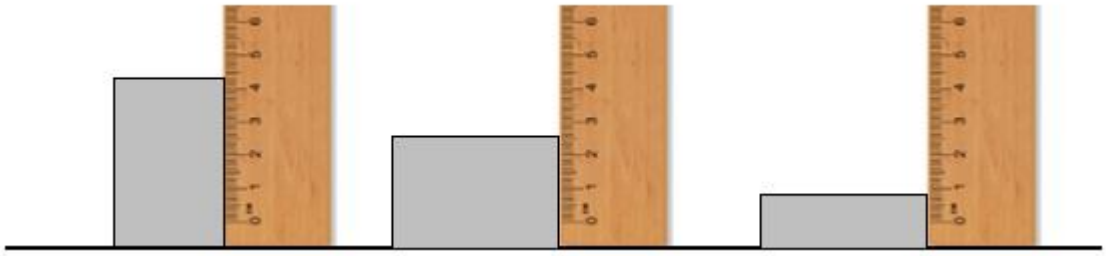

Figure 1

The same mistake is made in each of the measurements shown in **Figure 1**.

Explain if this mistake will give rise to a value of density that is too high or too low.

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[3 marks]

Q2 A student used the equipment shown in **Figure 1** to determine a value of the specific heat capacity of aluminium.

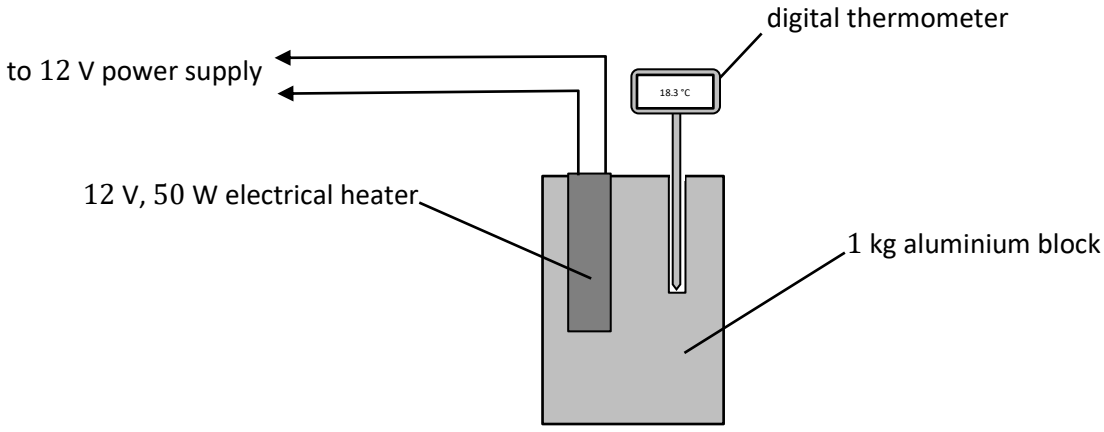

Figure 1

The heater was switched on for 5 minutes and it was found that the temperature rose by 12.5 °C in that time.

The student calculated that the energy supplied by the heater was 15,000 J.

(a) Explain how the student arrived at the value of 15,000 J for the energy supplied by the heater.

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[2 marks]

(b) Use the equation $\Delta E = mc\Delta\theta$ and the results given above to calculate a value for the specific heat capacity of aluminium.

specific heat capacity = …… J/kg°C

[2 marks]

(c) The value obtained by the student was too high.

Explain an improvement that the student could have made to obtain a more accurate value.

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[3 marks]

Q3 The circuit in **Figure 1** was used by a student to investigate the effect on the current in a circuit of adding resistors in parallel to the circuit.

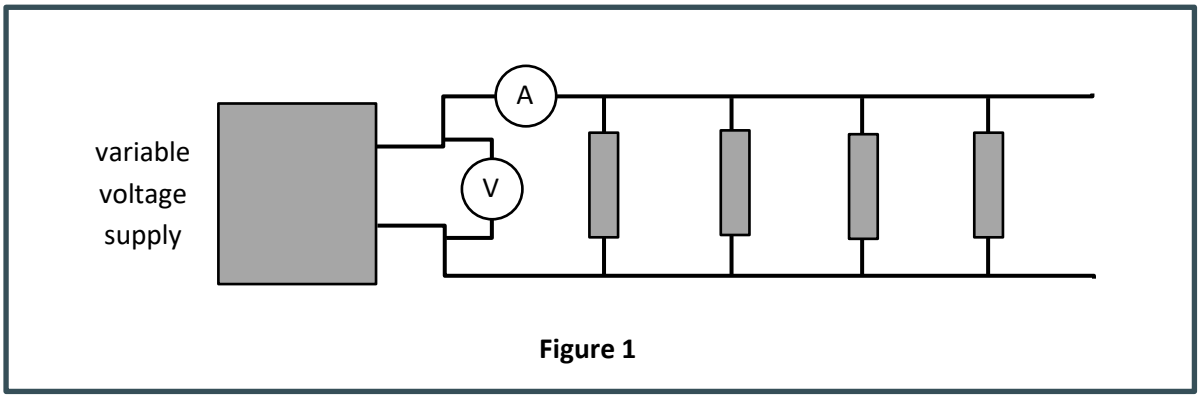

Figure 1

The student used identical $10\ \Omega$ resistors in the circuit.

(a) The diagrams in **Figure 2** show the ammeter and voltmeter readings with one $10\ \Omega$ resistor connected to the variable voltage power supply.

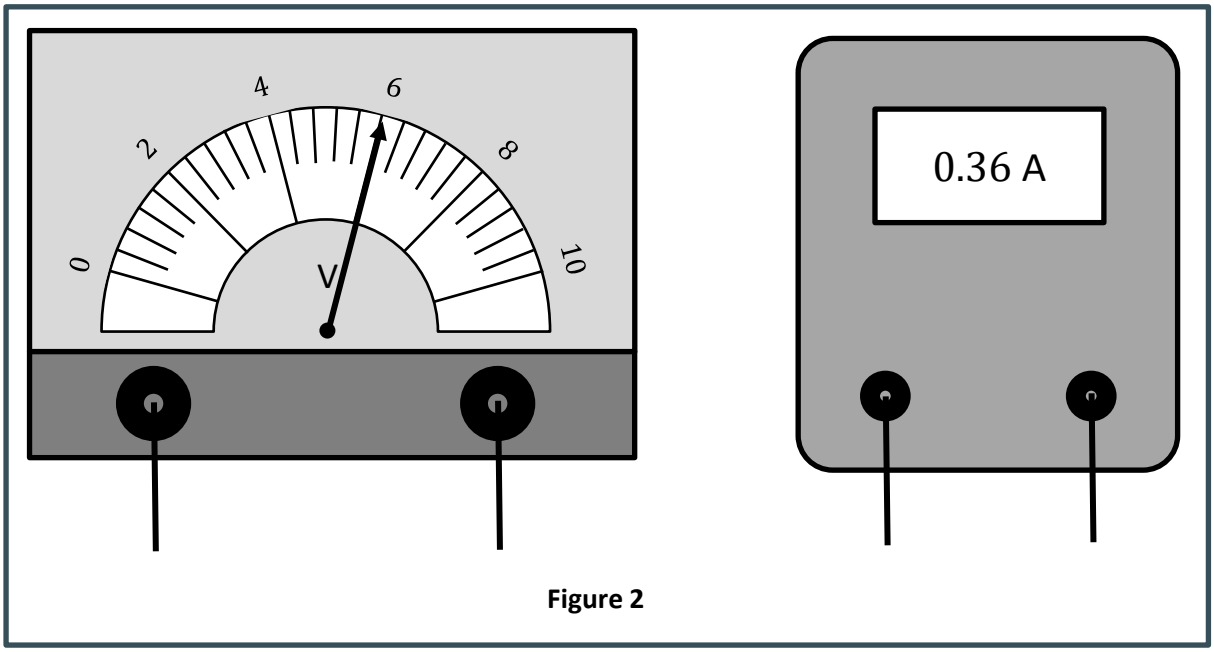

Figure 2

Identify the resolution of each meter.

Tick one box for each meter on **Figure 3**.

	voltmeter		**ammeter**
0.1 V	☐	0.001 A	☐
0.2 V	☐	0.01 A	☐
0.4 V	☐	0.1 A	☐
2 V	☐	1 A	☐

Figure 3

[1 mark]

(b) Identify the independent, dependent and control variables in this experiment.

Independent variable: .....

Dependent variable: .....

Control variables: .....

.....

[2 marks]

(c) In an experiment to measure the time taken for a toy car to travel 20 cm the student was told to repeat the experiment four times.

In this experiment the student was told that it was not necessary to repeat the experiment.

Explain why it was not necessary to repeat measurements in this experiment.

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[2 marks]

Q4 **Figure 1** shows an experiment to investigate the relationship between the acceleration of an object and the force acting on it.

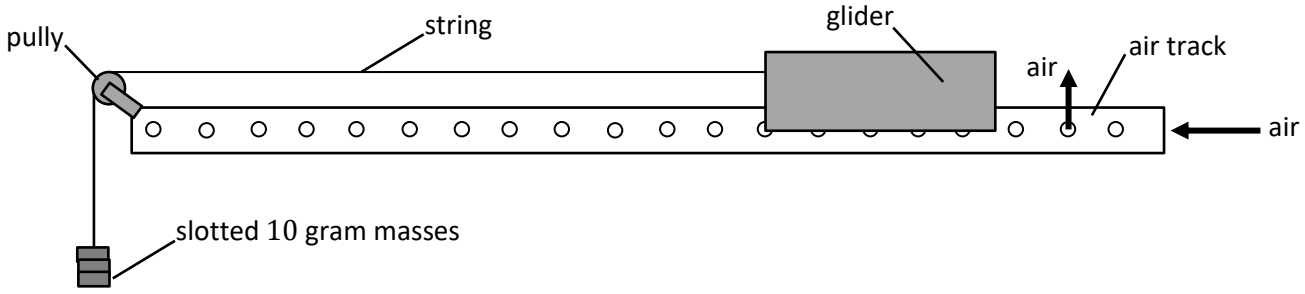

Figure 1

The air track consists of a long pipe with holes in it at regular intervals and one closed end. Air is blown in through the open end and comes out through the holes. The glider is lifted slightly by the air coming out through the holes.

(a) (i) What is the advantage of using a glider on an air track to carry out this experiment.

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[1 mark]

(ii) Suggest and explain an alternative way of carrying out the experiment if an air track is not available.

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[2 marks]

(b) A student used a motion sensor to measure the acceleration of the glider with different numbers of slotted masses suspended from the string.

The graph in **Figure 2** shows the results for the experiment.

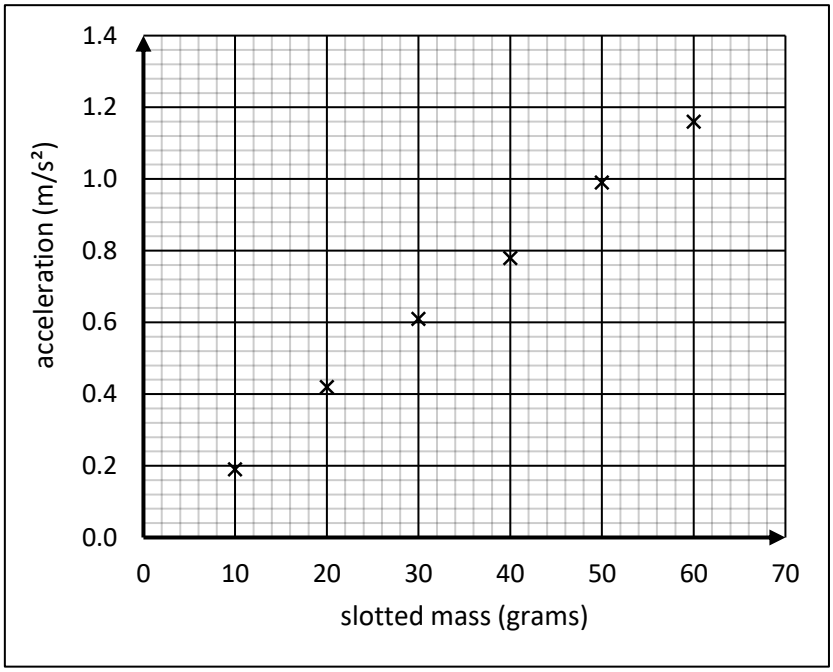

Figure 2

(i) Draw a line of best fit on the graph.

(ii) Explain whether the results support the hypothesis that the acceleration of an object is proportional to the resultant force acting on it.

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[4 marks]

Physics Only

Q5 **Figure 1** shows an experiment to investigate how the angle of refraction in a glass block varies with the angle of incidence.

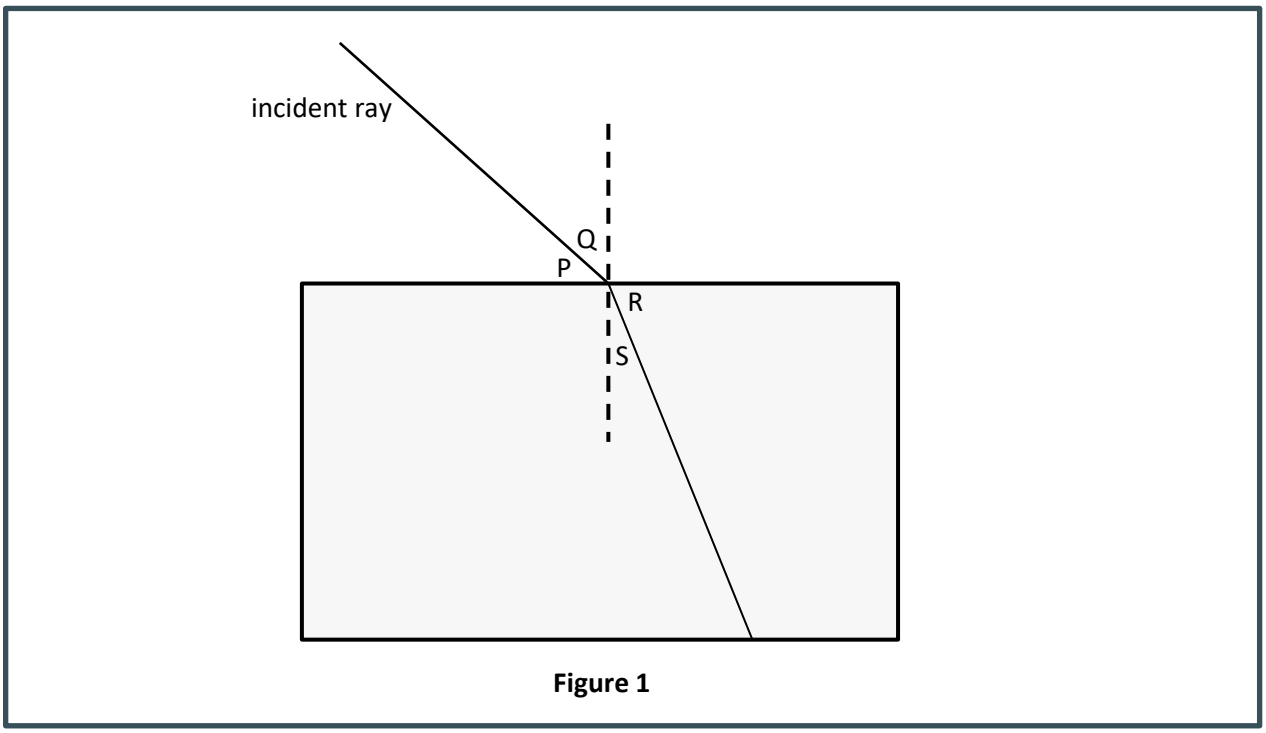

Figure 1

(a) Identify the angle of incidence and the angle refraction.

Draw a ring around one answer for each angle.

Angle of incidence:	P	Q	R	S
Angle of refraction:	P	Q	R	S

[1 mark]

(b) The graph in **Figure 2** shows the results for this experiment.

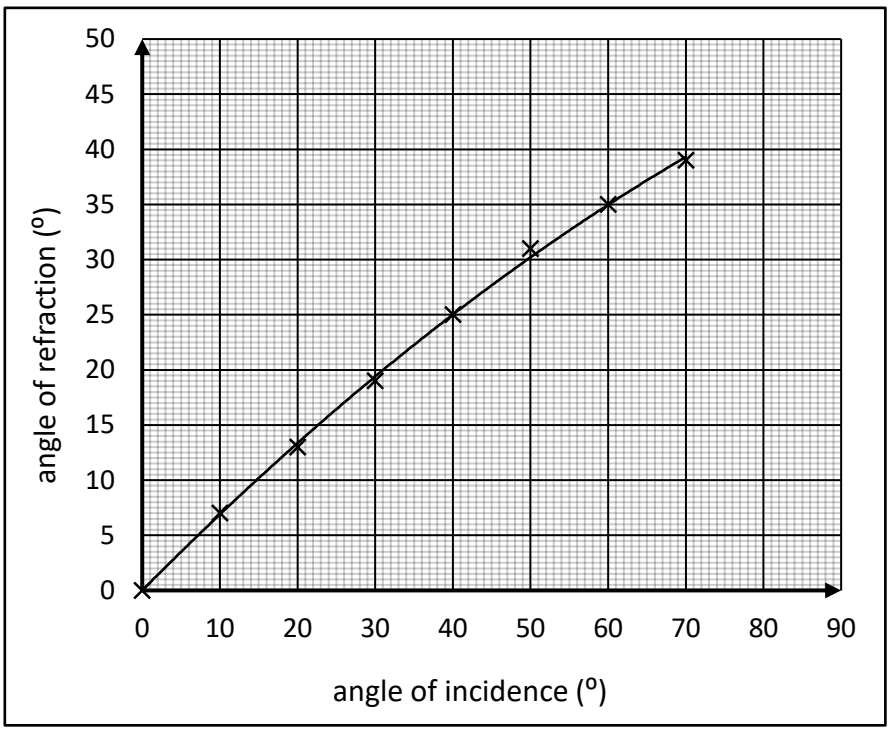

Figure 2

(i) Comment on the precision of these results.

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[2 marks]

(ii) Estimate the angle of refraction when the angle of incidence is 90°.

Angle of refraction = …… °

[1 mark]

Q1 Mark Scheme

	Answers	Extra guidance	Mark	AO/ Spec. Ref
a	Mass of cooking oil = 92.9 – 53.2 (= 39.7)	Award mark if 39.7 seen	1	AO1/2 P4.3.1.1
a	Density of cooking oil = 39.7/50	Award this mark for any use of D = m/V, even if incorrect values used	1	AO1/2 P4.3.1.1
a	0.794 or 0.79 or 0.8	NOT 0.790 or 0.80 Correct answer on its own scores all three marks	1	AO1/2 P4.3.1.1
b	Pour water into / half fill measuring cylinder **and** note volume	Do not award this mark if the idea of filling the measuring cylinder to the top of the scale is expressed.	1	AO1/2 P4.3.1.1
b	Lower stone into water **and** note the new volume		1	AO1/2 P4.3.1.1
b	Subtract the initial reading (volume) from the final reading (volume) on the measuring cylinder	Accept answers in the form of a diagram Accept $V = V_2 – V_1$ as long as symbols defined in some way (possibly on a diagram)	1	AO1/2 P4.3.1.1
c	The measurements of length will be too low	Accept 'measurement starts off the scale' or 'measurement does not start on the zero mark'	1	AO1/2 P4.3.1.1
c	Volume will be too small		1	AO1/2 P4.3.1.1
c	Dividing mass by a smaller volume will give a **higher** density	The idea of dividing by a smaller number to get a larger final value must be clear	1	AO1/2 P4.3.1.1

Q2 Mark Scheme

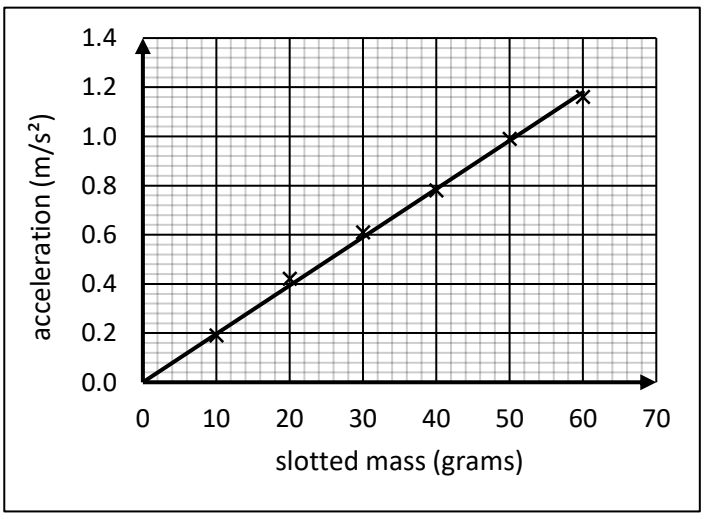
	Answers	Extra guidance	Mark	AO/ Spec. Ref
a	P = E/t or E = P x t	Accept this in any form, even in numerical form with t = 5	**1**	**AO1/2 P4.1.1.4**
a	50 = E/300 or E = 50 x 300	E = 50 x 300 on its own scores both marks. The correct conversion of minutes to seconds scores one mark even if used incorrectly	**1**	**AO1/2 P4.1.1.4**
b	15,000 = 1 x c x 12.5	Accept c = 15,000/12.5 BUT do not accept substitution into an equation that has been rearranged incorrectly	**1**	**AO1/2 P4.1.1.3**
b	c = 1200	Correct answer must be seen for this mark – no error carried forward	**1**	**AO1/2 P4.1.1.3**
c	Insulate block to reduce loss of heat (energy) / thermal energy to the surroundings	Improvement **and** reason must be seen.	**1**	**AO1/2 P4.1.1.3 WS2.7**
c	The temperature increase will rise to its expected value	Accept the idea that a larger temperature rise will occur	**1**	**AO1/2 P4.1.1.3 WS2.7**
c	c = E/mθ will be smaller	The idea that the energy is being divided by a smaller temperature rise must be clear.	**1**	**AO1/2 P4.1.1.3 WS2.7**

Q3 Mark Scheme

	Answers	Extra guidance	Mark	AO/ Spec. Ref
a	Voltmeter: 0.4 V Ammeter: 0.01 A	Accept 0.2 V – in this instance estimating the half way point between two marks is relatively easy Both must be correct for this mark	**1**	**AO1/2 WS2.3**
b	Independent: number of resistors Dependent: current	Accept 'ammeter reading' Both needed for this mark	**1**	**AO1/2 WS2.2**
b	Potential difference Resistance of resistors	Accept 'voltage' or 'voltmeter reading' Accept 'size' of resistors	**1**	**AO1/2 WS2.2**
c	random errors in this experiment are smaller	Accept 'no random errors in this experiment', 'less or no human error in this experiment', 'less human judgement needed in this experiment' Accept reverse argument – the timing experiment contains greater random errors/ human errors/ human reaction times	**1**	**AO1/2 WS3.4**
c	No need to calculate a mean value to cancel out random uncertainties		**1**	**AO1/2 WS3.4**

Q4 Mark Scheme

	Answers	Extra guidance	Mark	AO/ Spec. Ref
ai	To reduce friction **acting on the object**	Accept 'to reduce resistance forces on the object/glider' BUT not just to reduce friction / resistance forces	**1**	**AO1/2 P4.5.1.2**
aii	Carry out the experiment on a sloped surface OR Add a little extra mass to the slotted masses		**1**	**AO1/2 WS2.7**
aii	So that the (component of) weight acting down the slope balances the frictional force OR The weight of the extra mass balances the frictional force	Accept 'weight acting down slope OR weight of extra mass makes resultant force equal to the weight of the slotted masses	**1**	**AO1/2 WS2.7**
bi	Accept any straight line with a reasonable balance of points about it – not essential to pass through (0,0)		**1**	**AO1/2 WS3.1**
bii	Yes OR No	Yes if a straight line through (0,0) has been drawn; no if the straight line does not pass through (0,0) or if a curve has been drawn	**1**	**AO1/2 WS3.5**
bii	Because the graph is a straight line through (0, 0) OR Because the line does not pass through (0,0) OR Because the graph is not a straight line	The answer must match the line drawn on the graph If 'yes' is being explained the answer must contain both parts – straight line and (0, 0) Accept 'nearly proportional because the line is straight and passes close to (0,0)' for two marks	**1**	**AO1/2 WS3.5**
bii	Since the weight of the slotted masses is the pulling force on the glider	These marks can be scored only if 'yes' was given previously	**1**	**AO1/2 WS3.5**
bii	If the slotted mass is doubled the pulling force is doubled	Accept 'pulling force is proportional to slotted mass'	**1**	**AO1/2 WS3.5**



Q5 Mark Scheme

	Answers	Extra guidance	Mark	AO/ Spec. Ref
a	Angle of incidence – Q **and** Angle of refraction - S	If more than one answer ringed for each angle no mark awarded Accept underlining or any clear indication If corrections are made, the answer must be clear	**1**	**AO1/2** **P4.6.2.2** **WS1.2**
a				
bi	There is some scatter of the plotted points about the curve of best fit	The link between precision and the scatter on the graph is what is being looked for here – this mark is awarded regardless of the degree of scatter expressed	**1**	**AO1/2** **WS3.7**
bi	The results are precise (if degree of scatter has been described as low) OR The results are not precise (if degree of scatter has been described as high)	Some judgement needs to be seen for this mark.	**1**	**AO1/2** **WS3.7**
bii	Between 43^{o} and 48^{o}		**1**	**AO1/2** **WS3.3**