



## GCSE Science Specimen Papers

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### Set 4 New Style ISA and Marking Guidelines

### Revised Chemistry 1 – Viscosity of Oils

# Chemistry 1 ISA – *Viscosity of Oils (Specimen)*

## *Teachers' Notes*

This ISA relates to **Unit C1 Section 12.3**

### *Area of investigation*

This work should be carried out during the teaching of the section relating to:

**How do we get fuels from Crude Oil?**

### **RISK ASSESSMENT**

It is the responsibility of the centre to ensure that a risk assessment is carried out. Your attention is particularly drawn to the flammable nature of oils. Suitable precautions must be taken to ensure their safe use particularly when investigating their viscosities at different temperatures.

### **Part 1: The Practical Work**

**For this part of the investigation candidates may work individually or in groups.**

**Following an OFQUAL Scrutiny of the New Science specifications, AQA must make an adjustment to the assessment of the ISA papers. New ISAs from September 2009 will require candidates to use information from their own experiment to answer some of the questions in Section 2 of the ISA.**

**Consequently :**

- **Centres should ensure that candidates complete the practical task before attempting the ISA.**
- **As far as possible Centres should use tasks very similar to the ones detailed by the Teachers' Notes.**

Candidates should use a cup viscometer to investigate the viscosity of different oils.

A cup viscometer is a container (eg a yoghurt pot) with a small hole in the bottom through which a known volume of oil flows.

Candidates should be allowed to measure and record the time that it takes for the different oils to flow through the viscometer.

They should be given a range of different oils of different viscosities - at least three and preferably five different oils should be used.

Candidates must be instructed to take repeat readings and calculate a mean.

The teacher should complete the Explanation sheet. This should be included with the sample of candidates' work which will be sent to the moderator.

Instructions of a general nature may be given to candidates, but these must not be so prescriptive as to preclude the candidates from making their own decisions.

Candidates need to fill in the table they have produced prior to the practical, average their results and produce a graphical representation of their **averaged** results. (Refer to the Teachers' Guide for further clarification.)

### **Part 2: The Data Processing**

**For this part of the investigation candidates must work individually under direct supervision.**

Each candidate should draw up his or her own table of results and should process the data in an appropriate way eg charts, graphs, diagrams, line of best fit if appropriate.

The candidates' work should be collected by the teacher at the end of this session and only returned to the candidates when they undertake the subsequent ISA.

Candidates' work must not be annotated with additional information, either by the teacher or the candidate, which would give them an unfair advantage during the ISA – eg the use of the terms independent/dependent variable.

### **Part 3: The ISA**

**This is an example of the new style of ISA**

**Please note that the previous style ISAs can still be used until they reach their final date.**

**Further information is in the updated Teachers' Guide for use from 2009 which will be on the website soon.**

Surname						Other Names					
Centre Number						Candidate Number					
Candidate Signature											

For Examiner's Use
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General Certificate of Secondary Education  
June 20xx / June 20xx



**SCIENCE/CHEMISTRY**  
**ISA C1.x Viscosity of Oils - SPECIMEN**

**SCYC/CHYC / C1.x**

To be conducted before July 20xx  
For submission in May 20xx or May 20xx or May 20xx

**For this paper you must have:**

- results tables and charts or graphs from your own investigation.
- You may use a calculator.

Time allowed: 45 minutes

**Instructions**

- Use blue or black ink or ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions in **Section 1** and **Section 2**.
- Answer the questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want to be marked.

**Information**

- The maximum mark for this paper is 34.
- The marks for questions are shown in brackets.
- You are reminded of the need for good English and clear presentation in your answers.

For Teacher's Use	
Section	Mark
1	
2	
<b>Total</b> (max 34)	

Signature of teacher  
marking this ISA

Date



**SECTION 1**

These questions are about the investigation that you carried out on the viscosity of oils.

Answer **all** questions in the spaces provided.

- 1** In any investigation, the **independent** variable is the one that you deliberately change.

Which term best describes the independent variable in **your** investigation?

Draw a ring around the correct answer.

**categoric**

**continuous**

**discrete**

**ordered**

(1 mark)

- 2** In **your** investigation, what was the **dependent** variable?

.....  
(1 mark)

- 3** In your investigation:

- 3 (a)** state **one** variable that it was important to keep the same;

.....  
(1 mark)

- 3 (b)** it was important to keep this variable the same to make it a fair test.

Explain why.

.....  
.....  
.....  
(2 marks)

- 4** Suggest **one** change in the apparatus that you used which would improve the **precision** of your measurements.

.....  
.....

Explain how this change would improve the precision.

.....  
.....  
.....  
(2 marks)



**5** Write down **one** possible cause of error in your investigation.

.....  
.....

(1 mark)

**6 (a)** What conclusion can you make from your investigation about a link between the type of oil and its viscosity?

.....  
.....

(2 marks)

**6 (b)** Use your results to justify the conclusion that you have reached.

.....  
.....

(2 marks)

**7** Make sure that **your** results tables, and charts or graphs are handed in with this paper. You will be awarded up to 6 marks for these.

(6 marks)



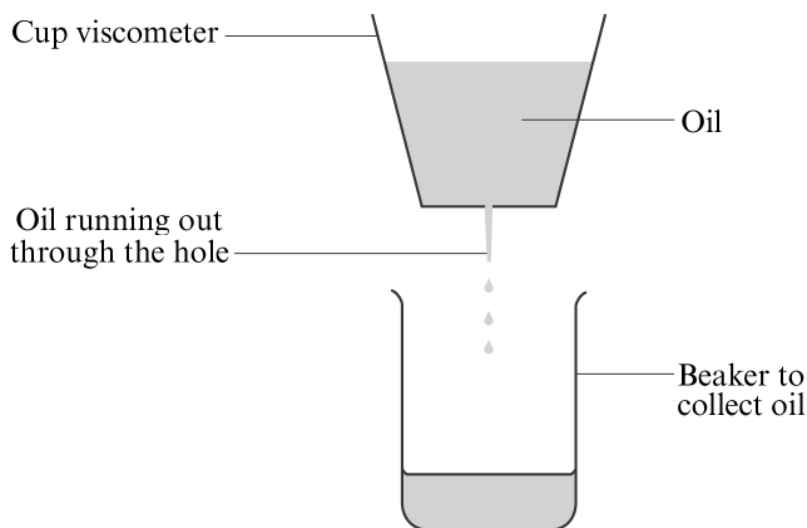
## SECTION 2

These questions are about an investigation that may be similar to the one that you carried out.

Answer all questions in the spaces provided

An oil company wanted to measure the viscosity of its motor oil over a range of temperatures. The company selected bottles of oil from its production line and tested the oils at different temperatures using a cup viscometer.

A cup viscometer is a small container with a hole in the bottom. A known volume of oil is put into the cup. The time it takes for the cup to empty is measured.



The table shows the results for one motor oil.

Look at the results and then answer the questions that follow.

Temperature of oil °C	Time to empty the cup viscometer in seconds			
	Test 1	Test 2	Test 3	Mean
20	22.3	23.7	29.0	23.0
30	15.2	22.1	15.8	15.5
40	12.5	12.7	12.9	12.7
50	10.2	10.2	10.5	10.3
60	9.1	9.6	9.2	9.3



- 8 What was the range of temperatures for the oil being tested?

The range was from ..... °C to ..... °C

(1 mark)

- 9 The company has calculated the mean values of the repeat tests.  
In your own investigation you were required to carry out several repeats and then calculate a mean.

- 9 (a) Why is this better than only recording the time once?

.....  
.....

(1 mark)

- 9 (b) Use ideas from your own investigation to explain how you should calculate a mean from the repeat values.

.....  
.....  
.....  
.....

(2 marks)

- 10 Which of the following would be the best way to present the results in the table?

Put a tick (✓) in the box next to your choice.

Bar chart ☐

Line graph ☐

Pie chart ☐

Scattergram ☐

(1 mark)

- 11 Using ideas from your own investigation, suggest how the company could have improved the **reliability** of the investigation.

.....  
.....  
.....

(1 mark)



- 12** The smallest scale division on the thermometer used to measure the temperature was  $0.1^{\circ}\text{C}$ .

Another thermometer has scale divisions of  $0.05^{\circ}\text{C}$ .

What effect would using this other thermometer have on the measurements?

Put a tick (✓) in the box next to your choice.

The measurements would have been more accurate ☐

The measurements would have been more precise ☐

The measurements would have been more reliable ☐

The measurements would have been more valid ☐

(1 mark)

- 13** What is the relationship between the viscosity of the oil and its temperature?

Use ideas from your own investigation to help you to answer this question.

.....

.....

(1 mark)

- 14** The company decided to that these test times were too short and wanted to increase the time that each test took.

Use ideas from your own investigation to explain how this could be done.

.....

.....

(1 mark)

- 15** Once a week the company tests a sample of 10 bottles of oil from its production line. Each week the company produces 100 000 bottles of oil.

- 15 (a)** Is 10 bottles of oil a suitable **number** of bottles to test?

Draw a ring around your answer.

**Yes / No**

Explain your answer.

.....

.....

(1 mark)



- 15 (b)** Is once a week a suitable **frequency** of test samples?

Draw a ring around your answer.

**Yes / No**

Explain your answer.

.....  
.....

(1 mark)

- 16** Suggest how the company should choose the sample of 10 bottles of oil from its production line to use for its tests.

.....  
.....

(1 mark)

- 17** The oil keeps its lubricating properties if the flow times are above 5 seconds and below 40 seconds. The company claimed the results in the table proved that the oil would last a long time and could be used in all climates.

Was the company justified in its claims? Explain your answer.

*To gain full marks in this question you should write your ideas in good English, and use the correct scientific words.*

.....  
.....  
.....  
.....  
.....  
.....

(3 marks)

- 18** A consumer group suggested that the company that manufactures the oils should not carry out the testing. Why would the consumer group suggest that an independent company should do the testing?

.....  
.....

(1 mark)

END OF QUESTIONS



## GCSE Science - Investigative Skills Assignment - Marking Guidelines

### Chemistry 1.2 Viscosity of Oils - Specimen

For use in May 20xx or May 20xx

Please mark in red ink, and use one tick for one mark. Each part of each question must show some red ink to indicate that it has been seen.

Subtotals for each part of each question should be written in the right-hand margin.

Enter the marks for **Section 1** and **Section 2** and the **total mark** on the front cover of the answer booklet.

The teacher must sign and date the front cover of the ISA.

The papers must be kept in a secure place and must **not** be returned to the candidates

Section 1			
Question	Answer	Additional guidance	Marks
1	categoric		1 mark
2	time taken (for oil to flow out of viscometer)		1 mark
3 (a)	Any <b>one</b> from, e.g.: <ul style="list-style-type: none"><li>• size of cup</li><li>• size of cup hole</li><li>• volume of oil</li></ul>	correct answer based on the method used	1 mark
3 (b)	Affects the timing measurement		1 mark
	Explanation of how it affects the timing measurement	eg the larger the hole the shorter the time it takes to empty the cup	1 mark
4	Suitable suggestion	eg uses pipette / burette / syringe (to measure volume) or digital watch (to measure time)	1 mark
	Explanation of this suggestion	idea that these instruments have smaller scale divisions	1 mark
5	Error correctly identified: this is most likely to be: <ul style="list-style-type: none"><li>• Measurement errors</li><li>• Method errors</li></ul>	Do not accept not just 'human error' unqualified  eg difficult to measure volume of oil exactly  eg timing difficulties / hard to judge exactly when the oil stops running out	1 mark

<b>6 (a)</b>	<p>Simple correct statement gains one mark only</p> <p>Amplified statement gains two marks</p>	<p>e.g. the different oils have different viscosities, for 1 mark only</p> <p>eg lists the different oils in the correct order of viscosity, or states which oil has the highest viscosity</p> <p>Accept any correct statement about their own investigation</p>	2 marks
<b>6 (b)</b>	<p>amplified quantitative statement gains <b>2</b> marks</p> <p>simple qualitative statement gains <b>1</b> mark only</p> <p>eg for <b>1</b> mark</p> <p>the bar chart shows that different oils took different times to run through</p> <p><b>or</b></p> <p>eg for <b>2</b> marks</p> <p>oil <i>p</i> took <i>x</i> seconds to run through but oil <i>q</i> took only <i>y</i> seconds</p>		2 marks

7	<p><b>Table:</b> Correct headings AND units all correct for all measured variables</p> <p>Table with incomplete headings or units for the measured variables = 1 mark</p>	<p>e.g. all headings present = 1 e.g. all units present = 1</p> <p>As a “rule of thumb”, add up the total number of headings and units that should be present, then:</p> <ul style="list-style-type: none"> <li>○ all present and correct = 2 marks</li> <li>○ some missing, but at least half present and correct = 1 mark</li> <li>○ fewer than half present and correct = 0 marks</li> </ul>	2 marks
7	<p><b>Graph/bar chart:</b></p> <ul style="list-style-type: none"> <li>• X axis: suitable scales chosen and labelled with quantity and units</li> <li>• Y axis: suitable scales chosen and labelled with quantity and units</li> <li>• Points or bars plotted correctly to within <math>\pm 1</math> mm</li> <li>• Suitable line drawn on graph or bars correctly labelled on bar chart</li> </ul>	<p>Accept axes reversed</p> <p>It may not always be necessary to show the origin</p> <p>Scale should be such that the plots occupy at least one third of each axis</p> <p>Allow one plotting error out of each 5 points plotted</p> <p>Allow error carried forward from incorrect points</p> <p>If wrong type of graph/chart, maximum 3 marks</p> <p>If the independent variable is:</p> <ul style="list-style-type: none"> <li>• continuous, should draw a best fit line graph.</li> </ul> <p>N.B. If no line possible because there is no correlation, candidates should state this on the graph</p> <ul style="list-style-type: none"> <li>• categoric, should draw a bar chart</li> <li>• discrete, you may allow either a bar chart or a line graph</li> </ul>	<p>1 mark</p> <p>1 mark</p> <p>1 mark</p> <p>1 mark</p>
	<b>Max 18 marks</b>		

## SECTION 2

<b>8</b>	20°C to 60°C		1 mark
<b>9 (a)</b>	idea of identifying anomalies/ being able to see spread of results		1 mark
<b>9 (b)</b>	ignore/discard any anomalous results add the repeat values together and divided by the number added together	These two marks maybe awarded independently of each other	1 mark 1 mark
<b>10</b>	Line graph		1 mark
<b>11</b>	Any <b>one</b> from, e.g. <ul style="list-style-type: none"> <li>• more repeats <b>and</b> calculate new mean</li> <li>• repeat using different equipment</li> <li>• repeat using different technique</li> <li>• compare results with those of others</li> </ul>		1 mark
<b>12</b>	The measurement would have been more precise		1 mark
<b>13</b>	The higher the temperature, the lower the viscosity	accept converse	1 mark
<b>14</b>	Use a larger viscometer cup / cup with a smaller hole / larger volume of oil if the cup was not completely filled		1 mark
<b>15 (a)</b>	An awareness that 10 bottles of oil out of 100 000 is too low a number to test	No mark for Yes or No. Mark is for an appropriate explanation	1 mark
<b>15 (b)</b>	An awareness that bottles of oil should be sampled more than once a week	No mark for Yes or No. Mark is for appropriate explanation	1 mark
<b>16</b>	Bottles should be chosen randomly	<b>accept</b> at a pre-set time on a given day	1 mark

17	<p>Any <b>two</b> from:</p> <ul style="list-style-type: none"><li>the company has not tested the oil below 20°C and does not know how the viscosity would change at low temperatures in cold climates</li><li>the company has not tested the oil above 60°C and does not know how the viscosity would change at high temperatures greater than 60°C when the engine is hot</li><li>the company has not tested oil in use and does not know how long the oil would maintain its lubrication properties when it is no longer new / there are impurities in the oil</li></ul> <p><i>Quality of written communication</i></p> <p>The mark is to be awarded for the correct use of at least <b>two</b> technical terms, e.g.:</p> <ul style="list-style-type: none"><li>viscosity</li><li>lubrication</li><li>temperature</li><li>impurities</li></ul>	<p>The marker should circle these terms. Annotate below candidate's answer with Q✓ for mark given or Qx for mark not given.</p>	<p>2 marks</p> <p>1 mark</p>
18	<p>Any suggestion about mistrust of the findings:</p> <p>eg suggestion that the consumer group might believe that there could be some pressure on the company testers to produce results that the company would like to see, rather than the accurate results</p> <p>eg an independent testing company would not be subject to pressure to report favourable results for the oil company</p>		<p>1 mark</p>
	Max 16 marks		
ISA Total 34 marks			