My ISA handbook

If you wish to answer on lined paper rather than printing the booklet please number your answers 1-44.

Activities and preparation for completing an ISA in science

2012-2013

What is an ISA?

An ISA is a controlled assessment. It tests your science skills.
You need to complete one for each GCSE in science that you do.

The ISA counts 1/4 towards that GCSE.

When do I do an ISA?

You do the ISA during your science lessons

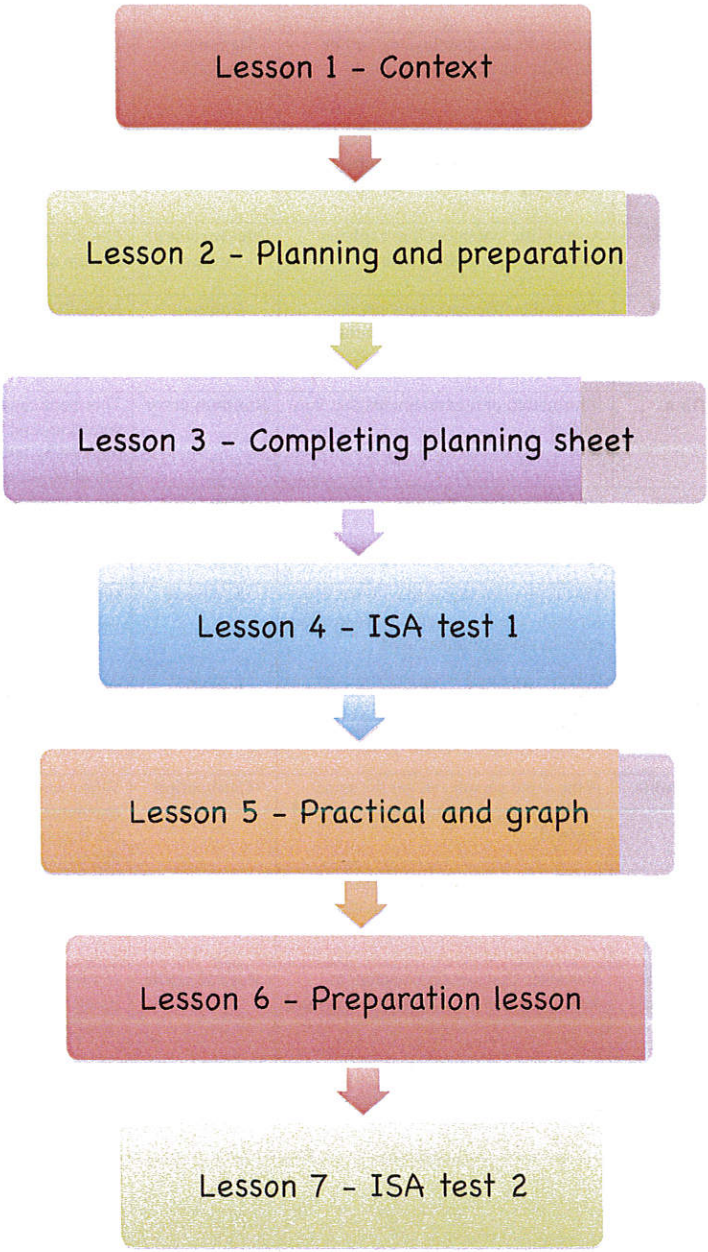
Can I re-sit the ISAs?

No we cannot guarantee a re-sit opportunity. It is very important that you prepare properly first time.

What is in an ISA?

Each ISA takes approximately 7 lessons to complete. It includes practical and written assessments in the form of two exam papers.

We will explain what happens when you do an ISA over the next few pages.


Lesson 1 - Context
Lesson 2 - Planning and preparation
Lesson 3 - Completing planning sheet
Lesson 4 - ISA test 1
Lesson 5 - Practical and graph
Lesson 6 - Preparation lesson
Lesson 7 - ISA test 2

	happen in an experiment	**variable**	numerical value
Valid	The results and conclusions will be this if the variables are correctly controlled	**Dependent variable**	This is the variable that changes as a result of a change in the independent variable
Fair test	This is where only the independent variable is changed and the others controlled	**Uncertainty**	The range around a true value. For example 20cm +/-2 cm
Hypothesis	A scientific statement that explains certain facts or observations	**Measurement error**	The difference between the real value and the measured value
Interval	This is the difference between the values of your independent variable	**Anomaly**	A result that does not fit the pattern
Data	Information or measurements that you collect	**Random error**	This error causes measurements to be spread around the true value – can be reduced by taking repeats and calculating a new mean
Datum	One piece of information	**Zero error**	When a piece of measuring equipment should be reading zero but it doesn't
Systematic error	This is an error that is always the same for each repeat – usually because of an error in the equipment used	**Accuracy**	How close the reading is to the true value
Resolution	The smallest change that can be read from a measuring device for example a ruler measured in mm or cm	**Precision**	This is determined by the scale on the measuring apparatus e.g. a ruler marked mm is more precise than one in cm
Repeatable	If the same person can get the same reading using the same equipment and method	**Calibration**	When we make sure that measuring apparatus is making correct readings e.g. the temperature of melting ice is 0 degrees celsius
Categoric variable	A variable that can be described by a label or category such as colour or surface	**True value**	This is the real value of a measurement in an experiment
Control variable	Variables that remain constant, to make sure that an investigation is valid	**Reproducible**	If another person can get the same result using the same method and equipment or with different method or equipment.
Independent variable	This is the variable that is changed during an investigation. There should only be one of these.	**Range**	The maximum and minimum values of the independent or dependent variables e.g. 'from 10cm to 50cm'

Variables

A **variable** is something that can change

Match up the type of variable to the description

Control Variable	The variable that changes as a result of changing the independent variable. This is the one you measure.
Independent variable	A variable that is kept constant (ie not changed) during an experiment.
Dependent variable	The one thing that you decide to change.

Below are descriptions of some investigations, for each investigation write down;

- The independent variable
- The dependant variable
- At least two control variables
- Are the independent and dependant variables categoric or continuous

Investigation	Independent variable	Dependent variable	Control variable(s)
John wants to find out which ball bounces highest, a football, a netball and a basket ball.	1.	2	3
Michelle wants to find out if at what temperature salt dissolves easiest in water.	4	5	6
Tyler is investigating what concentration of acid reacts quickest when dissolving calcium carbonate. To do this he is going to measure the amount of gas given off	7	8	9

Categoric variable A variable than can be described by a label i.e. a **word** such as blue or brown for eye colour.

Continuous variable A variable that can be measured and can therefore have any value. Eg Temperature can be measured and can have any value.

Hypothesis

A **hypothesis** is a scientific statement that explains certain observations.

It has the form:

"If I change the independent variable this will cause a change in dependent variable."

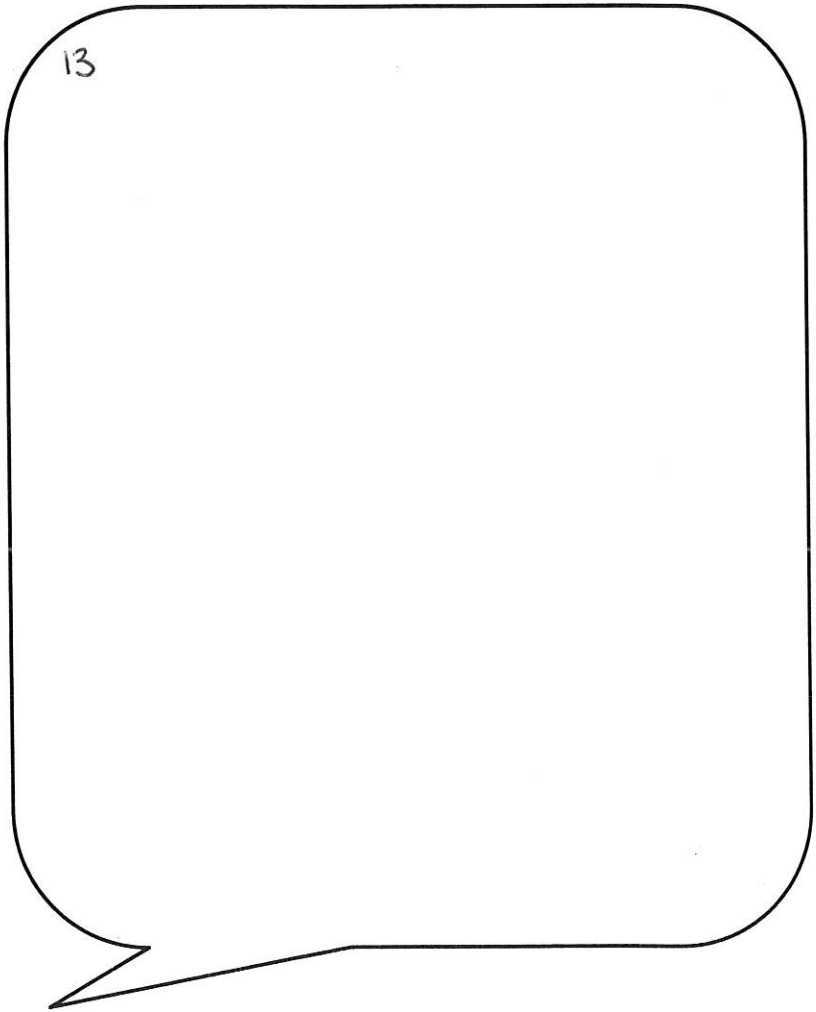
Can you use this format to write a hypothesis for each of the investigations we have already considered?

Investigation	Independent variable	Dependent variable	Hypothesis
John wants to find out which ball bounces highest, a football, a netball and a basket-ball.	1	2	10
Michelle wants to find out if at what temperature salt dissolves easiest in water.	4	5	11
Tyler is investigating what concentration of acid reacts quickest when dissolving calcium carbonate. To do this he is going to measure the amount of gas given off	7	8	12

Research

During your ISA we will give you a description of the context of the experiment AND a hypothesis.

Your first task will be to research the science behind the context and hypothesis and to find additional information about the hypothesis that would explain it in terms of the science.



What is scientific research and what sources could you use?

Name ..... Class ..... Date .....

Candidate research notes

You will be allowed to use one side of A4 research notes when completing Sections 1 and 2 of the ISA.

Hypothesis

E.g. Some types of hand wash are better at reducing the risk of bacterial infection than others.

Research sources

List all of the sources you used to carry out your research, such as books, websites or CD-ROMs.

Which source was the most useful and why?

Method(s)

Briefly outline a possible method that could be used to collect useful data to investigate the hypothesis. Think about what you will change, what you will control and what you will measure.

Equipment

List all the equipment you would need for your method. Think about how you will set your investigation up and what you will need to measure. Select the most suitable equipment to do this.

You may want to draw a diagram.

Risk assessment issues

Record any possible hazards in each method, and the risks they present. Explain how you will reduce these.

E.g. acid is an irritant and can cause holes in clothes. To reduce this risk I will wear goggles, wipe up spills and wash my hands.

Relating the investigation to the context

Your teacher will describe the context in which the investigation is set.
You must research this context and write down how the results of your investigation might be useful, e.g. health and safety developments, energy efficiency, in industry, etc.

What is a good source?

Which of these sources would you expect to get more accurate information from AND why?

14

What information would you need to give to identify a source?

15

Preliminary investigations

Your source could give you some good ideas about what method to use.

How will we tell whether this experiment can actually work?

We have to do a preliminary investigation.

In a dictionary look up what preliminary means and write your answer below:

16

Often the preliminary investigation will help us to decide how to control our controlled variables.

I want to measure speed of reaction at different concentrations. How could I control the temperature of a reaction to make sure this does not affect the results?

17

How will your preliminary investigation help you to decide on the best value for the temperature?

18

Preliminary investigations

This is a popular ISA test 1 question for 3 marks

"Describe briefly how you would carry out a preliminary investigation to find a suitable value to use for this variable. You should also explain how the results of this preliminary investigation will help you to decide on the best value for this variable"

A perfect answer is

I will need to keep the temperature the same so it does not affect the speed of the reaction. I will test a lower and upper range of 20-35°C using a waterbath.

I will measure the time taken for the reaction at both temperatures and pick a value where the speed is not too slow or too fast.

Common mistakes include:

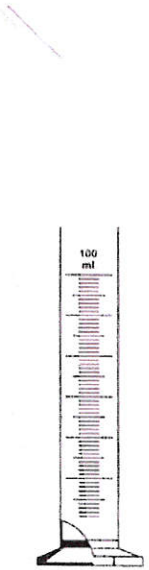
Not mentioning a suitable control variable
Not mentioning a range
Not saying how that you will measure the dependent variable.

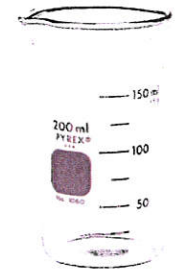
Method - you are always asked to write one of these

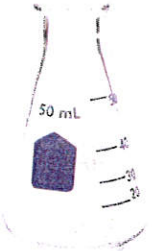
When we describe a method in an ISA we need to include:

1. A list of equipment
2. Measurements you would take
3. How you would take the measurements
4. What you will do to make it a fair test
5. Risk assessment

Can you write an equipment list for this equipment?







Method writing... ISA Test 1 - 9 mark question

Tyler is investigating what concentration of acid reacts quickest when dissolving calcium carbonate. To do this he is going to measure the amount of gas given off in 10 seconds with different concentrations of acid.

What measurements is Tyler going to make?

19

Identify the variables (IV and DV)

20

How will Tyler make sure it is a fair test - control variables

21

Can you write a risk assessment in the form

22 Hazard Risk Precaution

23 Step by step method

1.

2.

3.

4.

5.

6.

Table of results

Tables of results must include titles and units and they should be headed with the dependent variable and independent variable.

Can you fill in the headings for Tyler's experiment?

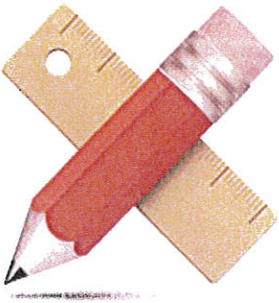
24	25
0.1	5.0
0.2	10.0
0.3	13.0
0.4	16.0
0.5	18.0
0.6	19.0
0.7	20.0
0.8	20.0
0.9	20.0
1.0	20.0

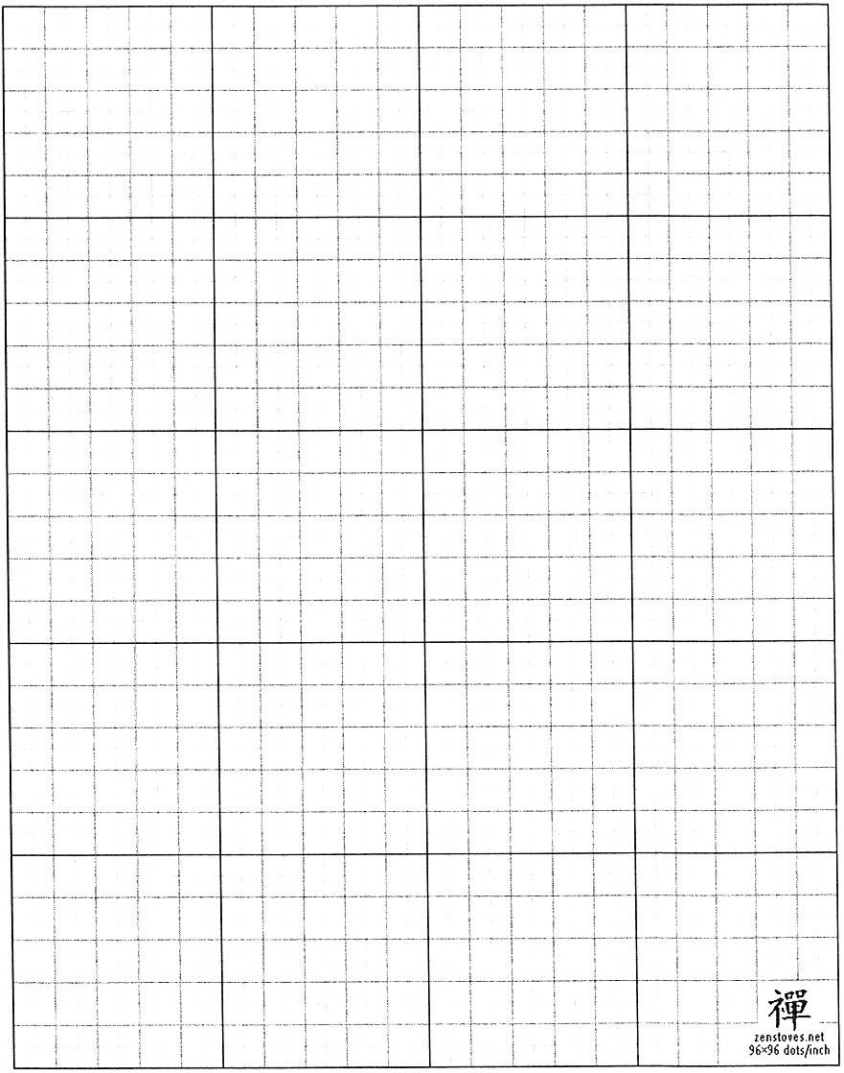
Drawing a graph

You need to include

1) Axes titles and units
2) All points plotted to within +/- 1mm
3) Line of best fit (could be curved or straight)
4) Appropriate scale (fill at least 1/3 of your axes)

Tip: Use a sharp pencil and ruler. Try and keep your scale simple and use a cross to mark each point.

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zenstones.net
96×96 dots/inch

Spot the difference

The definitions for repeatable and reproducible are very similar.

Repeatable

A measurement is repeatable if the original experimenter repeats the investigation using the same method and equipment and gets the same results

Reproducible

A measurement is reproducible if the investigation is repeated by another person or by using different equipment or techniques and the same results are obtained.

Can you spot the difference?

27 _____

_____

_____

Which is which?

I repeat my results three times and each time I get similar results. All my results follow the same pattern. Does this make my results:

28 Repeatable or Reproducible

People in my class do a similar experiment and obtain the similar values and the same pattern as me. Does this make my results:

29 Repeatable or Reproducible

Sharing results

When you have completed your experimental work you will be asked to share your results with others.

When we share our results with others are we can see whether there are similarities and differences. When comparing results with others are we showing:

30 Reproducibility OR Repeatability?

When we have more data points what effect will this have on our mean?

31

What type of error is reduced when a mean is calculated?

32

Use these ideas to explain the advantages of sharing your results with others.

33

Model Answer

Enables you to compare your results with those of others to see if there are any similarities or differences.

With more data you are able to calculate a more accurate mean and minimise the effect of random errors.

Enables reproducibility to be confirmed.

ISA test 2

You need to get familiar with all the words on your glossary. Lets practice with some here...

Accuracy
A measurement is accurate if it is close to the real value.

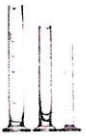
Resolution
This is the smallest change that a measuring instrument can measure.

Instruments with a higher resolution are more likely to give a value close to the true value. In other words they would give you a more accurate measurement

Test your understanding:

I want to measure out 25cm^3 of water. Which piece of equipment do you think would get me a volume closest to 25cm^3 (circle your answer)?

34 A measuring cylinder which measures to +/- 0.1cm^3



A 25cm^3 pipette which measures to +/- 0.005cm^3

35 Explain your choice_____

_____

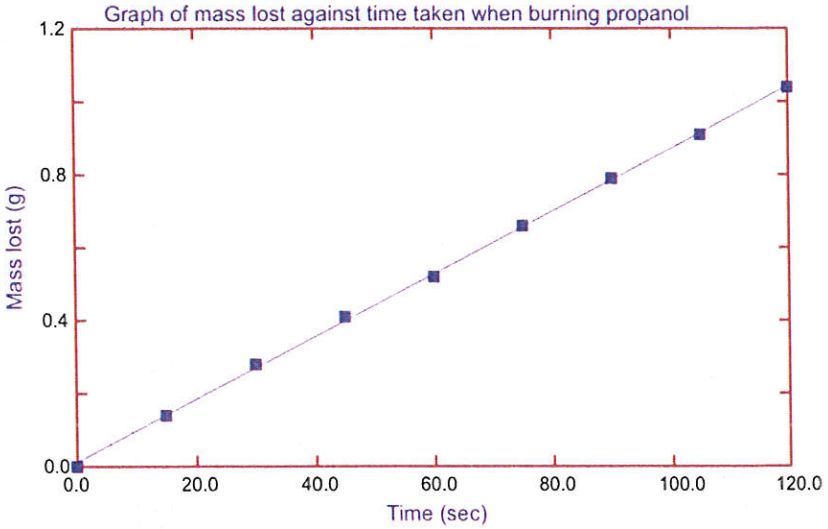
_____

Do your results support your hypothesis?

This is a popular test 2 question for three marks

You need to look at your graph and table and see whether there is a pattern or trend.

Look at this graph.



Does it support the hypothesis that a fuel loses mass when it is burned?

36

It is ALWAYS really important to give some values from your table. In my table it shows that at 15 seconds 0.14g has been lost but at 60 seconds 0.52 g has been lost. This supports my hypothesis.

If your results show a clear pattern why do you think this could be?

1) Discuss your range
2) Discuss your repeats
3) Discuss your equipment

For example my results show a clear pattern because:

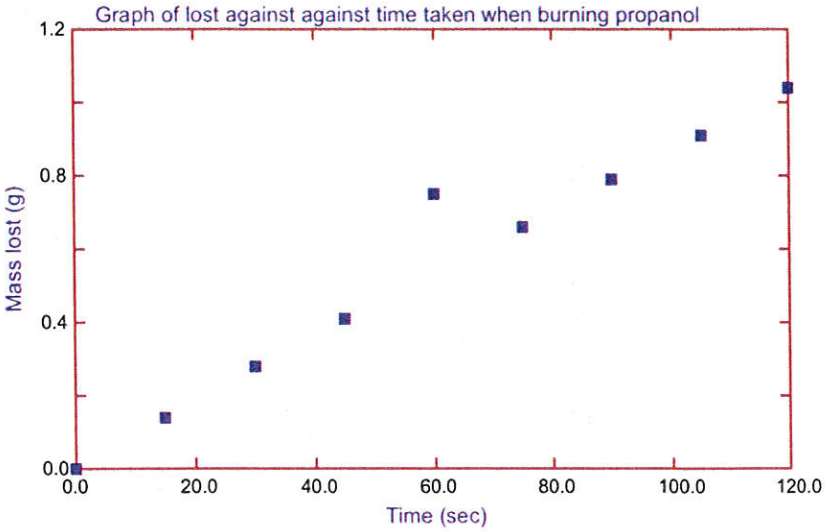
I chose a suitable range (0-120s) of my independent variable, time in seconds and a suitable interval (every 30s) to record the change in mass.

I repeated my results three times and calculated a mean. This also meant I could remove anomalous results.

I used a balance that had a high resolution (measured to 3dp).

Anomalous results

Look at another version of my graph:



Use your glossary to answer the following questions

What is an anomalous result?

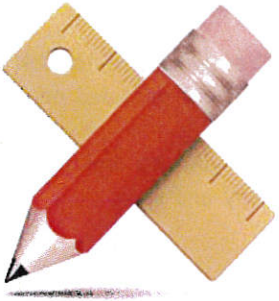
37

How does my graph show me that I have an anomalous result?

38

You should also give the value for any anomalous results. Here my anomalous result is at 60 seconds and is 0.75g which is well above the line of best fit.

Sketching a graph



You will need to sketch a graph

1) Write axes titles
2) Sketch a suitable shape as a line

Can you use the following data to sketch the graph for methanol

Time (sec)	Mass lost (g)
0	0.1
15	0.2
30	0.3
45	0.4
60	0.5

Case Studies

You will need to look at four case studies provided on a separate sheet.

As you are looking at the case studies try and spot:

1) Does the data show the same trend?
2) Are the IV and DV the same?
3) Are there and anomalous results?
4) Have the anomalous results been included in the calculations.

ALWAYS GIVE NUMERICAL EXAMPLES FROM EVERY CASE STUDY

Take a look at the case studies on the following pages.

The hypothesis is:

It is suggested that there is a link between the mass of mustard powder added and the time it takes for an oil/water emulsion to separate.

Does the data in case study 1 support the hypothesis?

40

Does the data in case study 2 support the hypothesis?

41

Does the data in case study 3 support the hypothesis?

42

Remember to ALWAYS include numerical examples.
Look at Case study 4

What is the relationship between the percentage of emulsifier used and the time taken for the ice cream to separate?

Explain how well the data supports your answer.

43

Name ..... Class ..... Date .....

Data sheet

Case Study 1

A group of students carried out an investigation similar to the one you have done to test the hypothesis that there is a link between the mass of mustard powder added and the time it takes for oil and water to separate.

They carried out the investigation three times. In each test they used the same volumes of oil and water and shook the mixture 20 times.

These are their results:

Mass of mustard powder added to oil (g)	Time for mixture to separate (s)			
	Test 1	Test 2	Test 3	Mean time
0.10	22	26	24	24
0.15	64	65	64	64
0.20	87	85	86	86
0.25	104	104	105	104
0.30	117	116	115	116

Case Study 2

A group of students carried out an investigation similar to the one you have done to test the hypothesis that there is a link between the mass of mustard powder added and the time it takes for oil and water to separate.

They carried out the investigation three times. In each test they used the same volumes of oil and water and shook the mixture 20 times.

These are their results:

Mass of mustard powder added to oil (g)	Time for mixture to separate (s)			
	Test 1	Test 2	Test 3	Mean time (s)
0.10	10	12	15	12
0.15	32	33	32	32
0.20	46	32	45	41
0.25	56	55	57	56
0.30	62	63	62	62

Name ..... Class ..... Date .....

Case Study 3

Students in a laboratory carried out tests to find the time it took for an oil/water emulsion to separate when 1 g of an emulsifier was added to it. In each test they used the same volumes of oil and water and shook the mixture 20 times.

These are their results:

Emulsifier	Time for mixture to separate (s)				
	Test 1	Test 2	Test 3	Test 4	Mean
Chilli powder	67	68	67	70	68
Egg white	4	6	5	5	5
Egg yolk	94	72	90	92	87
Mustard	76	77	70	73	74

Case Study 4

An ice-cream company is testing different amounts of two emulsifiers.

The company will use the results to find out which emulsifier and percentage might be best to use in the ice cream.

They added the emulsifier to the same volume of ice cream mix and shook the mixture for the same length of time. They timed how long it took for the ice cream to separate.

These are their results:

Emulsifier	Time for mixture to separate (minutes)			
	Test 1	Test 2	Test 3	Mean time
0.2% egg yolk	13	15	17	15
0.4% egg yolk	36	22	37	37
0.6% egg yolk	51	53	55	53
0.2% emulsifier E433	39	40	41	40
0.4% emulsifier E433	92	93	92	92
0.4% emulsifier E433	122	122	116	120

Context

The point of the final question on the ISA test paper 2 is to see whether you can link your results to the initial context of the investigation. You must give as much detail as you can how you can solve the original problem.

Here is an example context:

A mayonnaise producer wants to add mustard powder to his mayonnaise to increase shelf life and stop the mustard from separating out. However, he does not want the mayonnaise to taste strongly of mustard or it will put customers off.

In your investigation (see case studies) you have investigated how the effect of mustard on the time taken to separate.

Explain how this will help the producer of mustard to determine how much to add to his product: