GCSE to A-Level Biology Transition

Lesson 8

Keywords and Tables

Lesson 8 Key words and Tables

Learning objectives

- Recall and explain How Science Works (HSW) vocabulary
- Recall and explain how to draw tables
- Evaluate some methods and data

Table showing the amount of time taken for the pink colour of the potassium permanganate solution to disappear

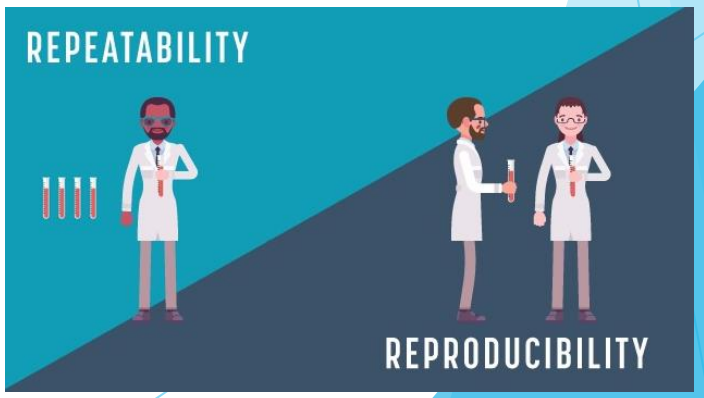
	Time for $KMnO_4$ colouration to disappear / s ± 0.05s											
	Banana				Rice				Control			
Day	1	3	5	7	1	3	5	7	1	3	5	7
Trial 1	76.23	52.37	47.00	33.03	76.23	56.09	30.57	56.78	76.23	54.33	47.13	36.96
		52.98	48.87	34.31		54.59	31.00	57.23		54.67	46.98	36.78
		52.66	47.96	35.97		54.35	30.76	57.13		55.13	47.96	35.98
Trial 2		54.34	48.28	44.53		50.50	30.19	25.19		54.78	46.56	37.23
		55.65	47.88	45.66		49.86	28.20	26.63		54.65	46.78	37.65
		54.23	48.53	45.17		50.06	29.37	24.78		55.07	46.99	37.98
Trial 3		54.75	47.76	44.27		48.98	29.22	26.78		55.02	47.12	36.87
		54.17	48.22	43.18		49.43	30.45	25.87		55.34	47.56	36.45
		54.23	47.89	44.73		49.56	30.76	26.98		54.69	47.32	36.22
Trial 4		53.98	45.66	38.97		56.33	28.25	57.43		54.79	46.98	36.87
		54.37	46.76	39.24		57.19	27.91	56.91		54.99	47.51	36.98
		54.21	46.23	39.58		56.74	27.65	56.50		55.34	47.35	36.56
Mean	**76.23**	**54.00**	**47.59**	**40.72**	**76.23**	**52.81**	**29.53**	**41.52**	**76.23**	**54.90**	**47.19**	**36.88**
St Dev	**0.00**	**0.91**	**0.97**	**4.50**	**0.00**	**3.32**	**1.25**	**16.18**	**0.00**	**0.30**	**0.38**	**0.56**

An: Relevant quantitative data collected

Comm: Concise, unambiguous & conventions respected

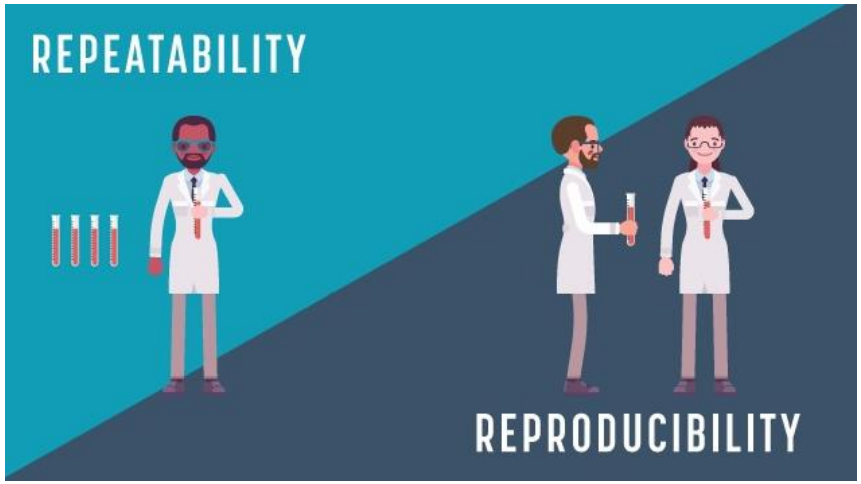
An: Appropriate, successful processing. Uncertainties considered

Comm: Processing can be followed. Correct notation and conventions used.



Starter

Write down definitions for **repeatable** and **reproducible**

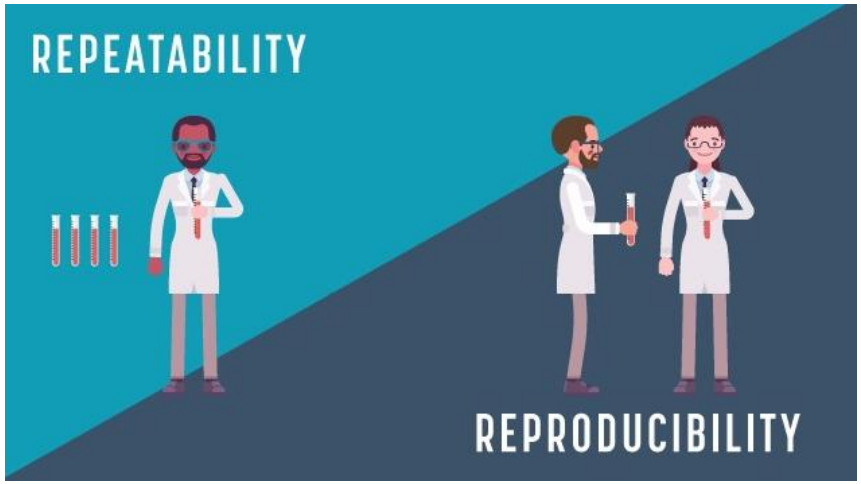


Repeatable – click to reveal definition

Reproducible – click to reveal definition

Starter

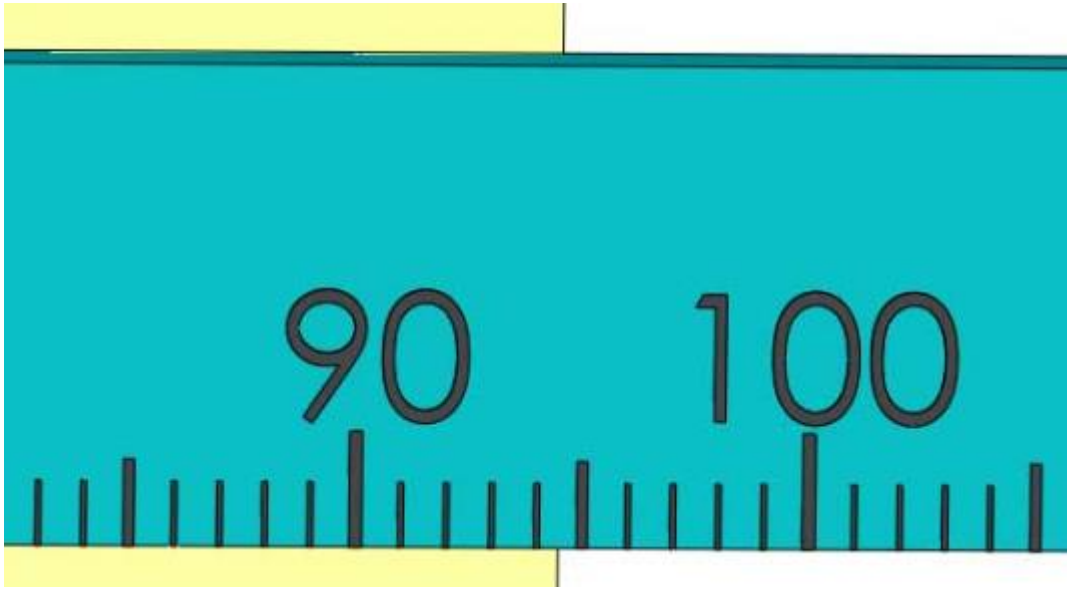
Write down definitions for **repeatable** and **reproducible**



Repeatable – if the original experimenter repeats the investigation using the same method and equipment and obtains very similar results

Reproducible – if another experimenter repeats the investigation using the same method but their own equipment and obtains very similar results

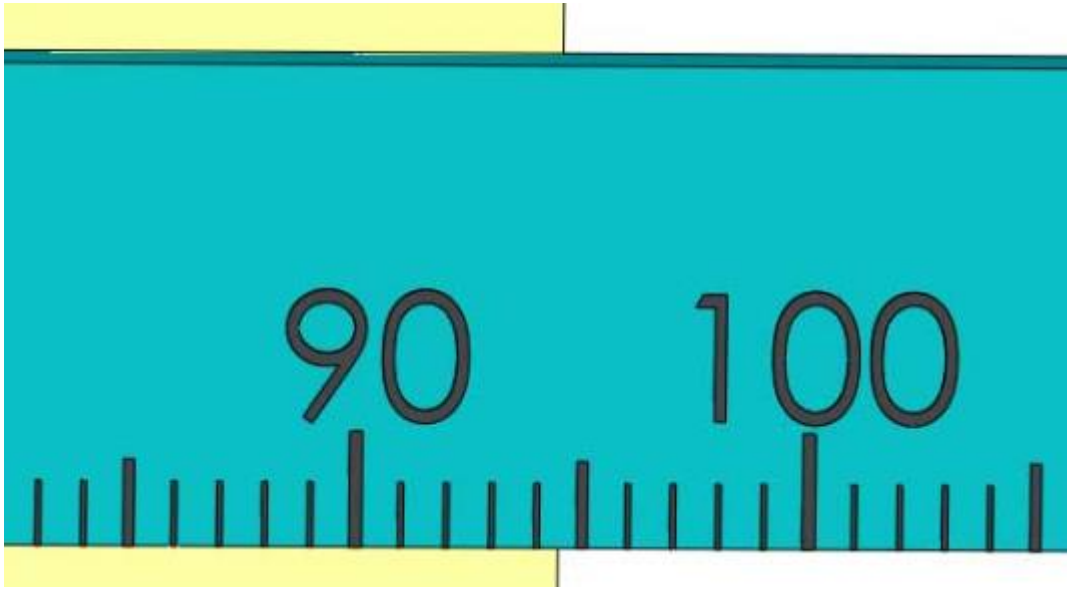
What is resolution?



What would it be for this instrument?

Resolution – click to reveal definition

What is resolution?



What would it be for this instrument?

0.5

The smallest change in the quantity being measured (input) of a measuring instrument that gives a perceptible change in the reading

How do we know a measurement is valid?

- We already discussed the measurements need to be **repeatable** and **reproducible**
- What does validity mean?

Validity – click to reveal definition

How do we know a measurement is valid?

- We already discussed the measurements need to be **repeatable** and **reproducible**
- What does validity mean?

Validity – suitability of the investigative procedure to answer the question being asked

So, what do we need to think about before doing any experiment? Can you list a few ideas?

What to think about before doing an experiment

- Write down some things you can think about!

What to think about before doing an experiment

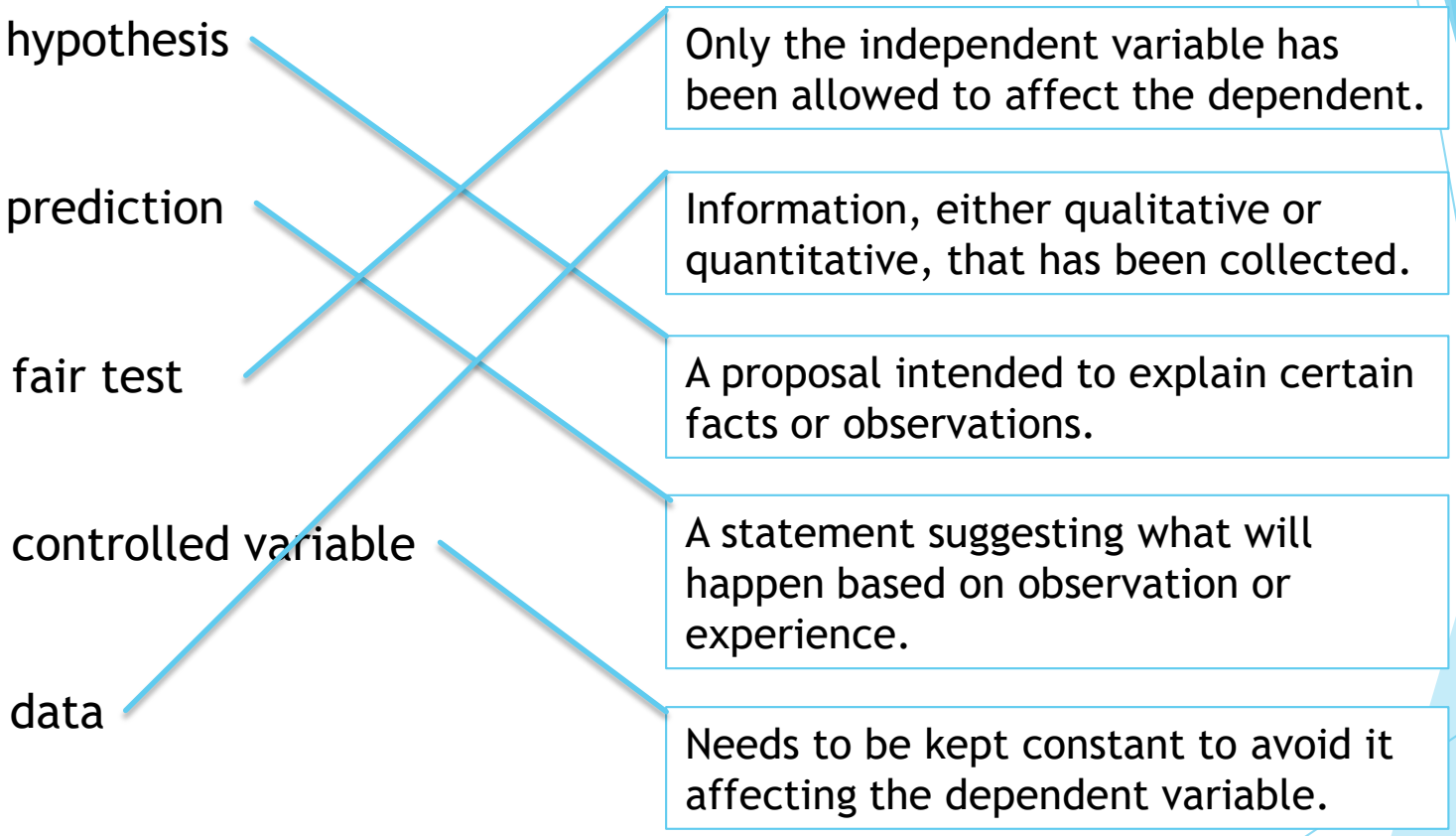
- Do we have a hypothesis?
- Can we make a prediction?
- Is it going to be a fair test?
- What are the controlled variables?
- How are we going to collect data?
- Is the equipment calibrated properly?
- How close will the data be to the true value?
  - What can we say about the accuracy?
  - What about precision?
  - How do we deal with anomalies?

How many of these keywords did you use. Write definitions for each of them.

Can you now link the keyword to right text? (1)

hypothesis	Only the independent variable has been allowed to affect the dependent.
prediction	Information, either qualitative or quantitative, that has been collected.
fair test	A proposal intended to explain certain facts or observations.
controlled variable	A statement suggesting what will happen based on observation or experience.
data	Needs to be kept constant to avoid it affecting the dependent variable.

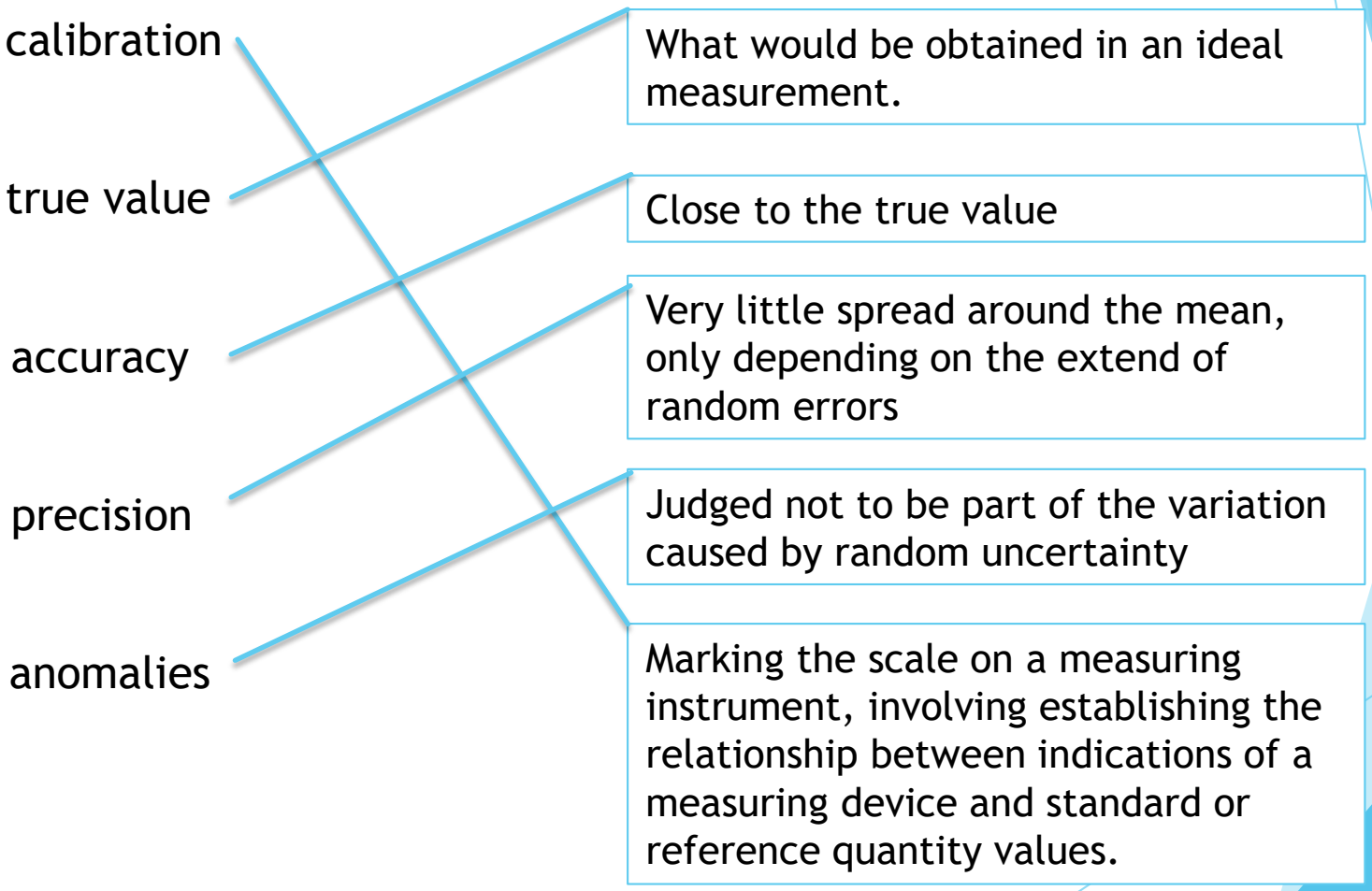
Can you now link the keyword to right text? (1)



Can you now link the keyword to right text? (2)

calibration	What would be obtained in an ideal measurement.
true value	Close to the true value
accuracy	Very little spread around the mean, only depending on the extend of random errors
precision	Judged not to be part of the variation caused by random uncertainty
anomalies	Marking the scale on a measuring instrument, involving establishing the relationship between indications of a measuring device and standard or reference quantity values.

Can you now link the keyword to right text? (2)



What about uncertainties and errors?

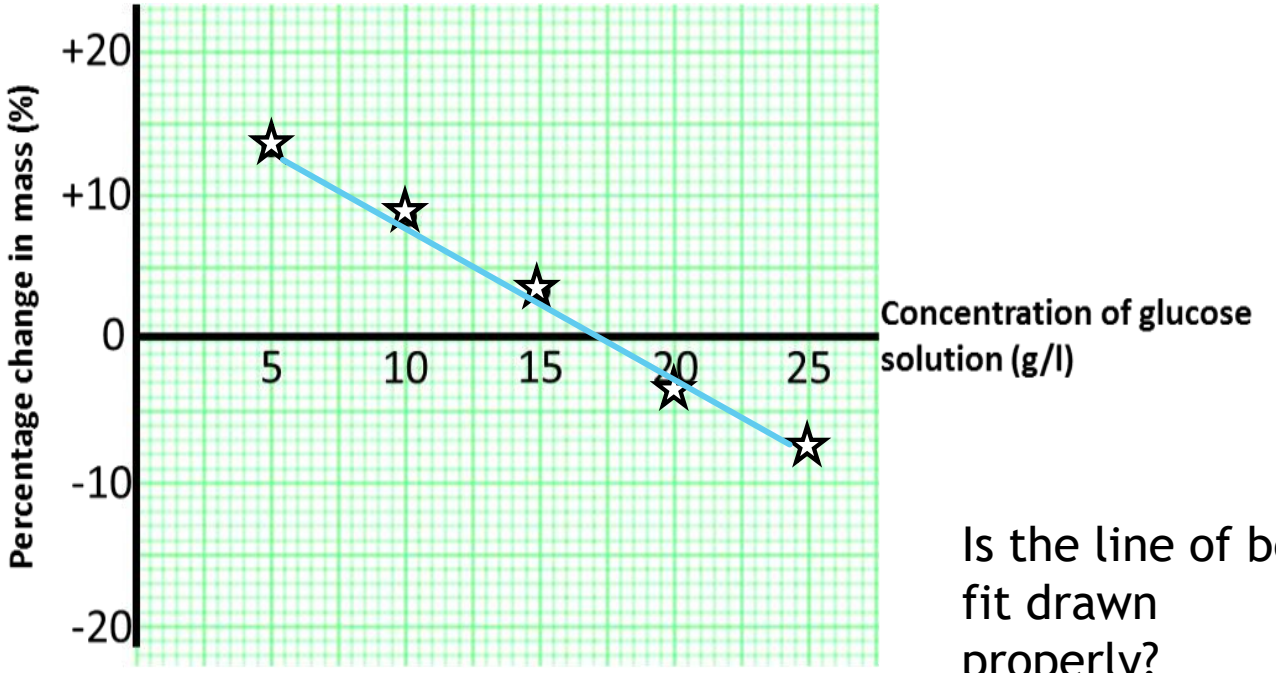
Error/uncertainty	Meaning
uncertainty	Click to reveal
measurement error	
anomalies	
random error	
systematic error	
zero error	

What about uncertainties and errors?

Error/uncertainty	Meaning
uncertainty	Interval within which the true value can be expected to lie, with a given level of confidence or probability.
measurement error	Difference between the measured value and the true value.
anomalies	Values not fitting the pattern caused by random uncertainty.
random error	Readings spread about the true value due to unpredictability between measurements.
systematic error	Readings differ from the true value by a consistent amount each time. Different techniques or equipment is needed to compare results.
zero error	Measurement gives a false reading when the true value should be zero.

Valid conclusion

Are the data valid? Was it the appropriate experimental design? Is the reasoning sound?

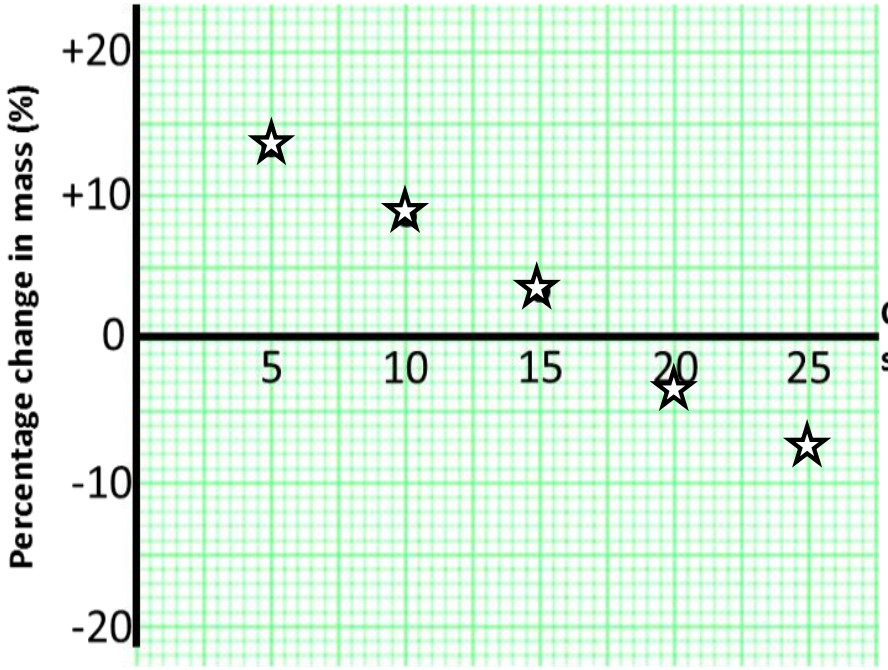


Is the line of best fit drawn properly?

Are the points means of repeat experiments? If so, what is the spread around the mean? What is the range?

Valid conclusion

What is the change of the dependent variable because of the independent variable?

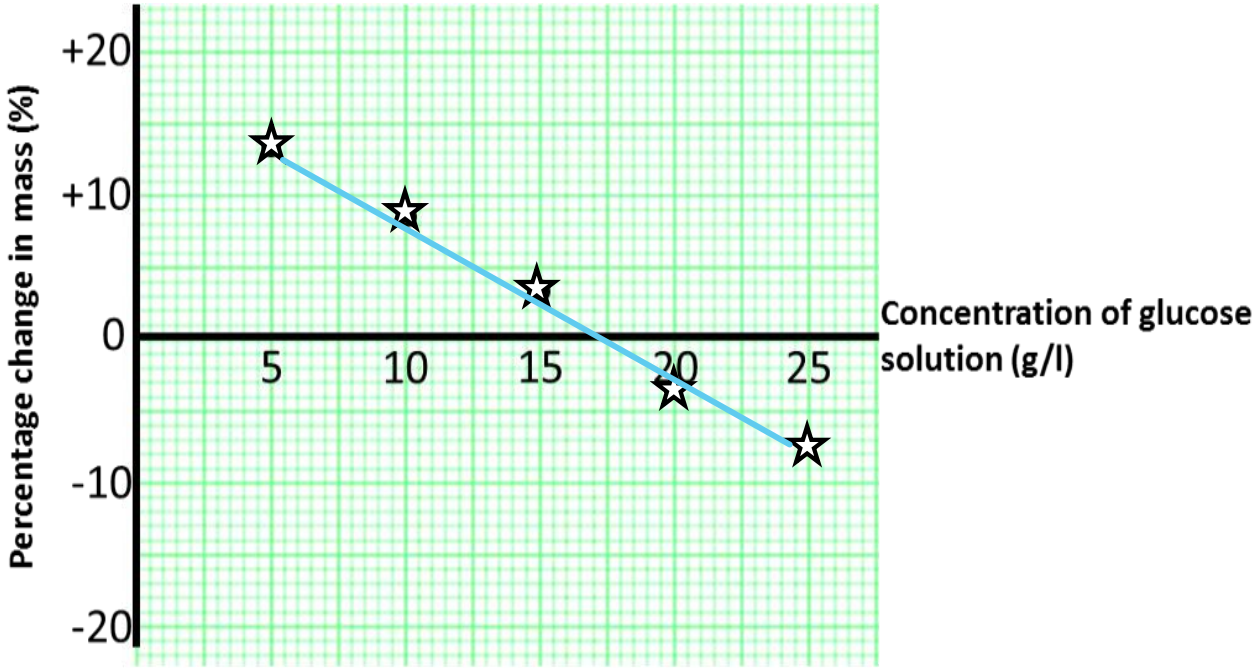


independent variable (what you change)

As the concentration of the glucose solution increases the percentage change in mass decreases

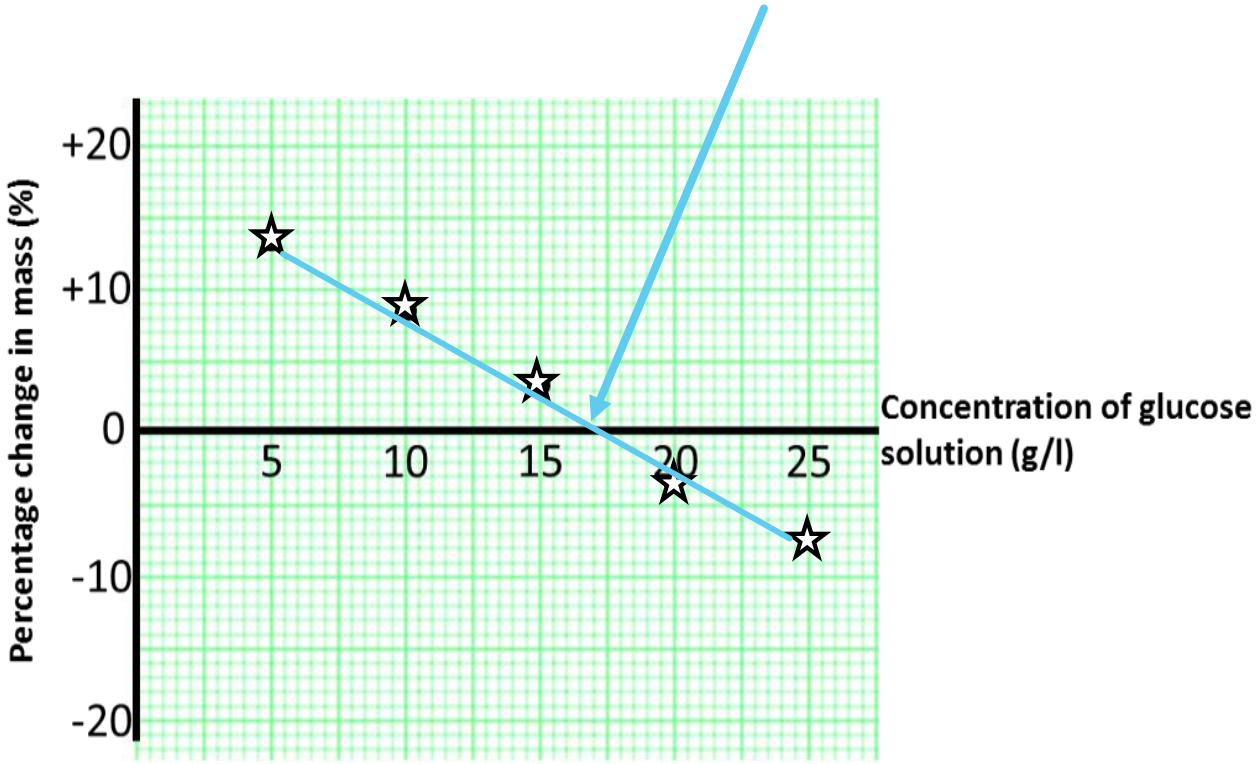
Valid conclusion

Where is the net movement of water zero?



Valid conclusion

Where is the net movement of water zero?



Are intervals of 5 g/l enough or do you need smaller intervals?

Tables

How is a table generally set up?

- Independent variable (what you change) on the left
- The unit should be in the heading
- The different quantities at which you measure down the column (the intervals can be larger or smaller or exponential)
- The dependent variable (what you measure) on the right
- The unit should be in the heading
- Often the experiment is repeated and a mean is given

Independent variable (unit)	Dependent variable (unit)			
	Test 1	Test 2	Test 3	mean
0				
10				
15				
20				
25				

What can be improved on this method?

- Use a borer to make potato chips of 0.5cm
- Record the mass of the chips before putting them in different concentrations of sucrose solution (0.0 - 0.1 – 0.4 – 0.6 – 0.8 – 1.0 moles/litre)
- Leave them in the solution for 15 minutes
- Remove the chips and record the mass
- Calculate the change in mass, draw a graph and determine what the concentration of sucrose in the potato is

What can be improved on this method?

- Use a borer to make potato chips of 0.5cm To make it a valid experiment we need to make sure we use the same potato for the experiment
- Record the mass of the chips before putting them in different concentrations of sucrose solution (0.0 - 0.1 – 0.4 – 0.6 – 0.8 – 1.0 moles/litre) We need to blot the potato chips to remove excess liquid before weighing to get a fair mass; we need to use equal intervals and may choose smaller intervals around a critical value in a next experiment; we may need to be clear about the accuracy and precision of the scales and measure up to the nearest 0.01 g
- Leave them in the solution for 15 minutes To measure a significant change in mass we need to leave them for longer so that enough water has moved in or out of the chip because of osmosis

What can be improved on this method?

- Remove the chips and record the mass Obviously you need to blot the chips again to remove any outside liquid which will differ frim chip to chip and effect the mass of the chip. You want to have a fair comparison of before and after
- Calculate the change in mass, draw a graph and determine what the concentration of sucrose in the potato is It would be better to look at percentage change in mass here, because the starting mass of the different potato chips will be slightly different.

What is wrong with this table?

	0	0.1	0.4	0.6	0.8	1	
before	1	0.98	0.94	1.04	1.02	0.98	
after	1.25	1.15	0.1	1.00	1.20	0.88	
change	0.25	0.23	0.06	-0.04	0.18	-0.1	

What is wrong with this table?

No headings or units

Not all numbers have the same decimals

There is a possible anomalous result which could be highlighted

	0.0	0.1	0.4	0.6	0.8	1.0	
before	1.00	0.98	0.94	1.04	1.02	0.98	
after	1.25	1.15	0.10	1.00	1.20	0.88	
change	0.25	0.23	0.06	-0.04	0.18	-0.10	

Anomalous result

It looks like the independent variable is set out in the first row rather than the left column