# FIA1
# DATA TEST

# DATA TEST SKILLS

# LEARNING OBJECTIVES

**By the end of the lesson, you should be able to:**

- ❑ **Conduct** a simulation investigating the relationship between intensity and distance from a radioactive source.
- ❑ **Identify** the relationship between the independent variable and dependent variable
- ❑ **Predict** or **infer** a value, using the relationship between the IV and DV
- ❑ **Calculate** the mean of a set of provided values

# DATA TEST SKILLS

Data may be presented in a table or in a graph:

| Skills | Table Dataset Skills | Graph Dataset Skills |
|---|---|---|
| Identify the relationship | ✓ | ✓ |
| Predict / Infer a value | ✓ | ✓ |
| Calculate the mean | ✓ | |
| Identify a value | ✓ | ✓ |
| Identify the uncertainty | ✓ | ✓ |
| Contrast the uncertainty | ✓ | ✓ |
| Draw a conclusion to evaluate a statement | ✓ | |
| Identify the mathematical relationship | | ✓ |
| Draw a conclusion that quantifies a parameter | | ✓ |
| Predict a change to the relationship | | ✓ |

# IDENTIFYING RELATIONSHIPS

**Thoroughly analyse the data**

If analysing a graph

- consider the line of best fit and look for outliers.

If analysing a table

- consider each data point in order to find the most accurate measure of change – don't just take the first two data points!

## In the exam

**Respond with three parts:**

1. **State** the type of relationship *(linear, inverse squared, exponential decay, .....)*
2. **Describe** the relationship *(when x ....., y .... – be sure to use the actual variables provided by the data)*
3. **Support** with evidence *(as seen when ... and when .....) – there must be **two steps** stated to prove the relationship.*

# LINEAR RELATIONSHIP

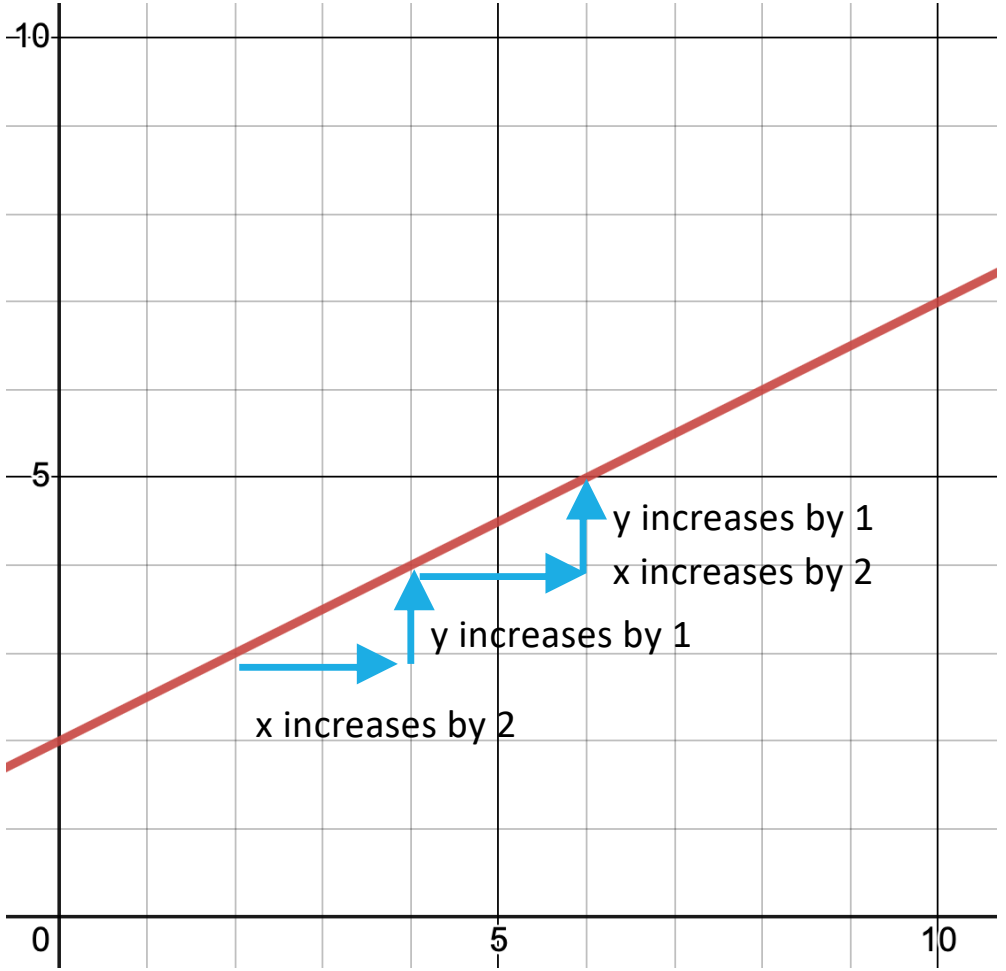
$$y \propto x$$

As x increases, y increases proportionally.

| x | y |
|---|---|
| 2 | 3 |
| 4 | 4 |
| 6 | 5 |
| 8 | 6 |

+2 +1

+2 +1



# INVERSE SQUARED RELATIONSHIP

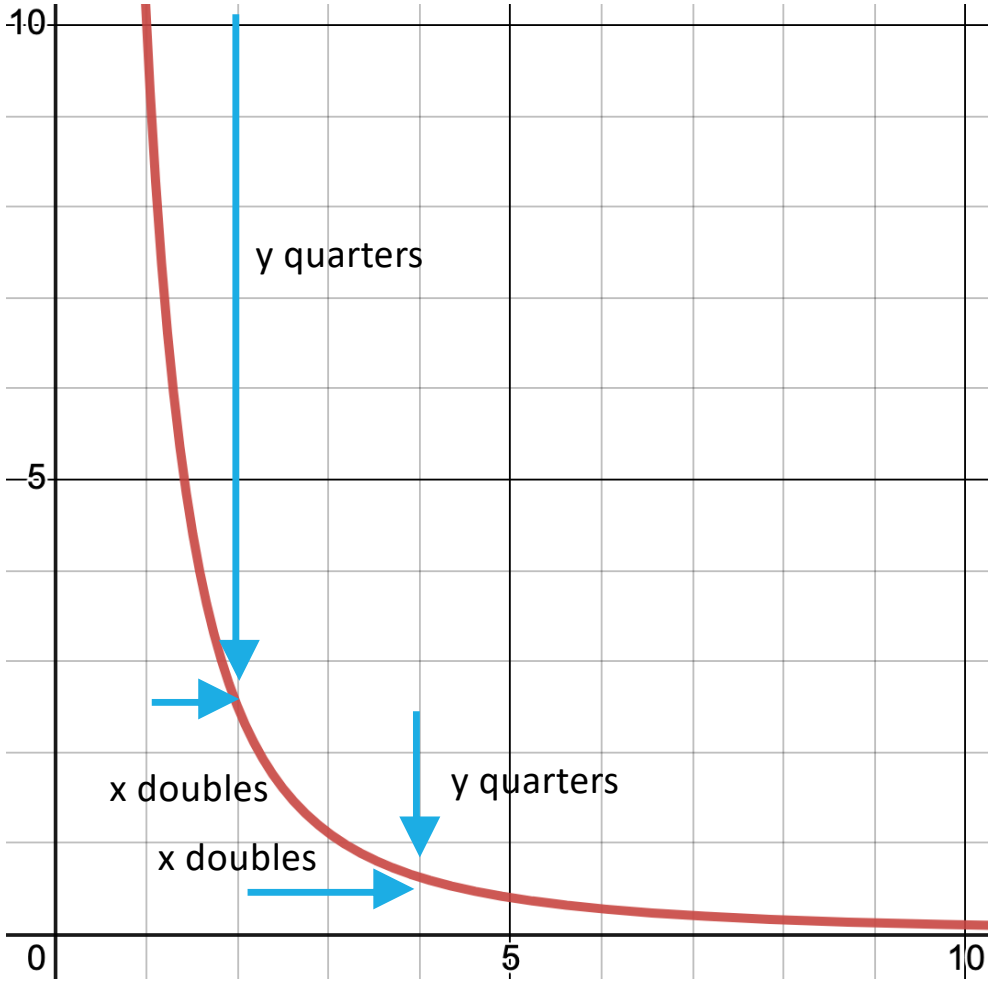
$$y \propto \frac{1}{x^2}$$

As x doubles, y quarters.

| x | y |
|---|---|
| 2 | 100.0 |
| 4 | 25.0 |
| 6 | 11.1 |
| 8 | 6.3 |

x2 ÷4

x2 ÷4



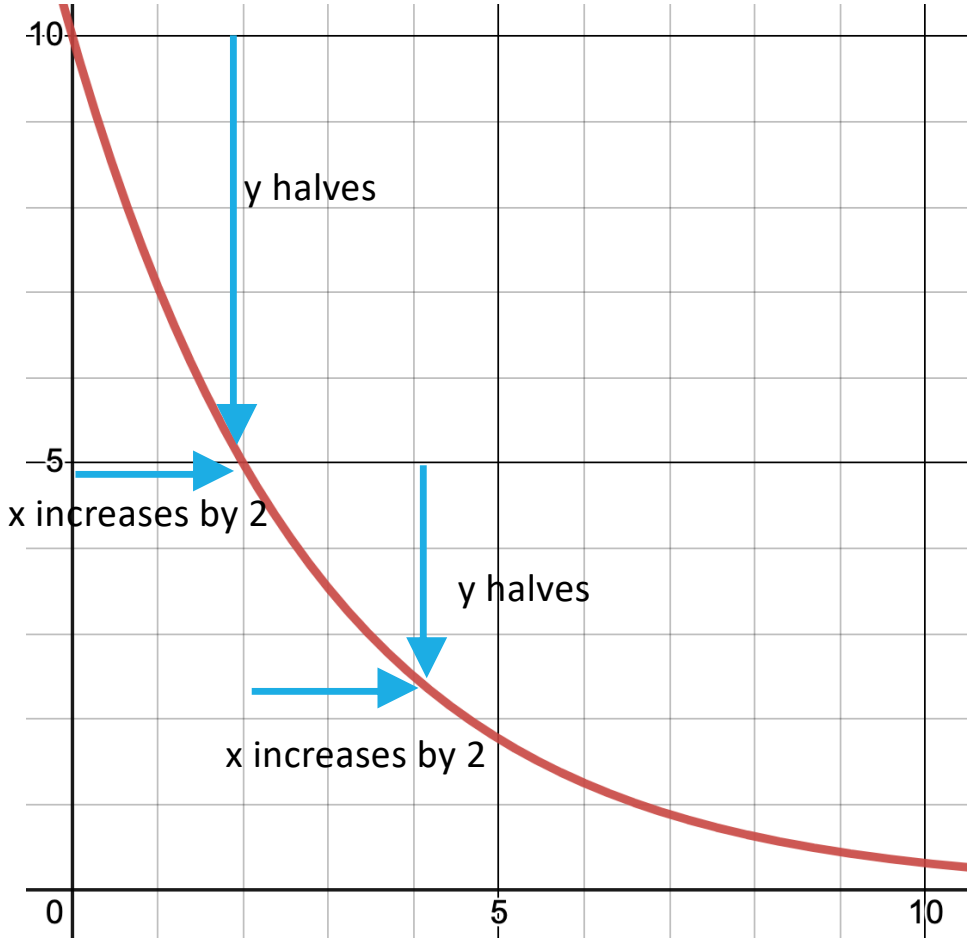
# EXPONENTIAL DECAY RELATIONSHIP

$$y \propto \left(\frac{1}{2}\right)^{x}$$

As x increases by a constant interval, y halves.

| | x | y | |
|---|---|---|---|
| | 2 | 50.0 | |
| +2 | | | ÷2 |
| | 4 | 25.0 | |
| +2 | | | ÷2 |
| | 6 | 12.5 | |
| | 8 | 6.3 | |

Note: this is just one example of an exponential decay relationship – this is an example where the **halving time** is constant.



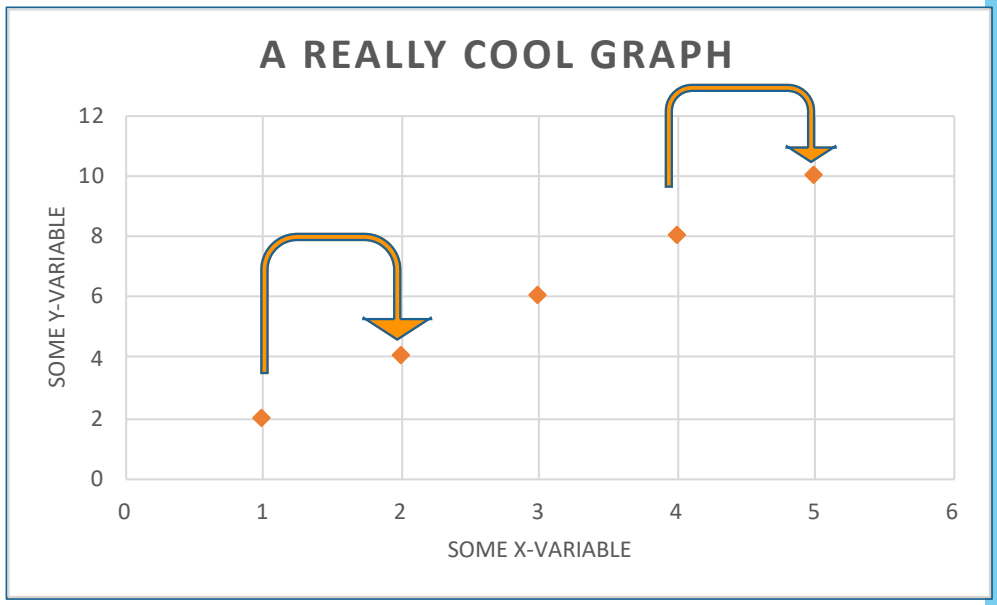
# IDENTIFYING THE RELATIONSHIP (PART 2)

When proving a relationship from either tabulated or graphical data, you need to ensure you show "two steps". That is, you need to justify that the given relationship exists from a → b , and from c → d. For example:

| Some x variable | Some y variable |
|---|---|
| 1 | 2 |
| 2 | 4 |
| 3 | 6 |
| 4 | 8 |
| 5 | 10 |

1st Step

2nd Step




There is a linear relationship between x and y. It can be seen that as x increases from 1 to 2, y increases from 2 to 4. Similarly, As x increases from 4 to 5, y increases from 8 to 10. In both cases, as x increases by 1, y increases by two.

# WORKED EXAMPLE – IDENTIFY THE RELATIONSHIP

Identify the relationship between time gaming and Physics exam results. Use evidence from the table to support your response. [2 marks]

| Time gaming (hr) | Physics results (%) |
|---|---|
| 2 | 80 |
| 4 | 19 |
| 6 | 9 |
| 8 | 5 |

*The relationship between time gaming and Physics exam results is inverse squared. As the time spend gaming doubles, the Physics exam results quarters.* ✓

*This can be seen when the time spent gaming doubles from 2hr to 4hr, the Physics results approximately quarter from 80% to 19%, and when time spent gaming doubles again from 4hr to 8hr, the Physics results approximately quarter from 19% to 5%.* ✓

# YOU TRY – IDENTIFY THE RELATIONSHIP

3 minutes

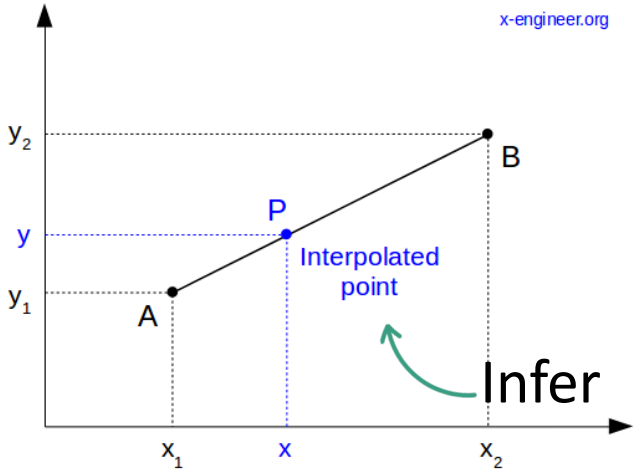
Identify the relationship between car value and age of car. Use evidence from the table to support your response. [2 marks]

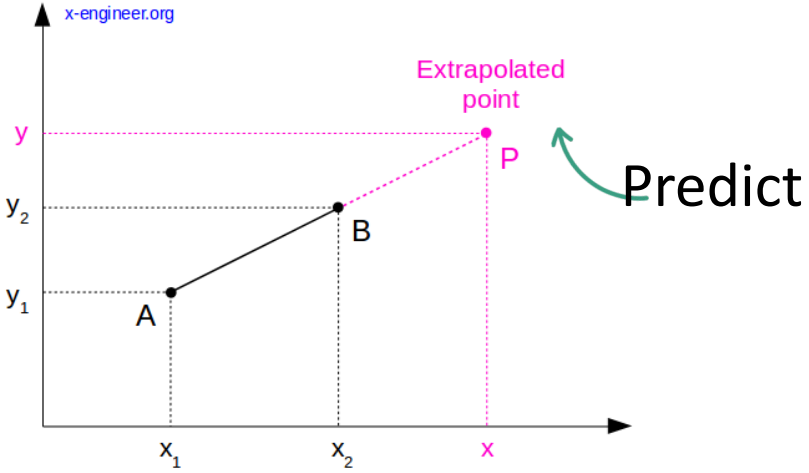
| Age of car (years) | Value of car ($) |
|---|---|
| 0 | 80 000 |
| 1 | 40 000 |
| 2 | 20 000 |
| 3 | 10 000 |
| 4 | 5 000 |
| 5 | 2 500 |

# PREDICTING / INFERRING A VALUE

We can **use** identified relationships to predict / infer possible values from tabular and graphical evidence.

- Predict – extrapolate (beyond the given data set)
- Infer – interpolate (within the given data set or between given data points)

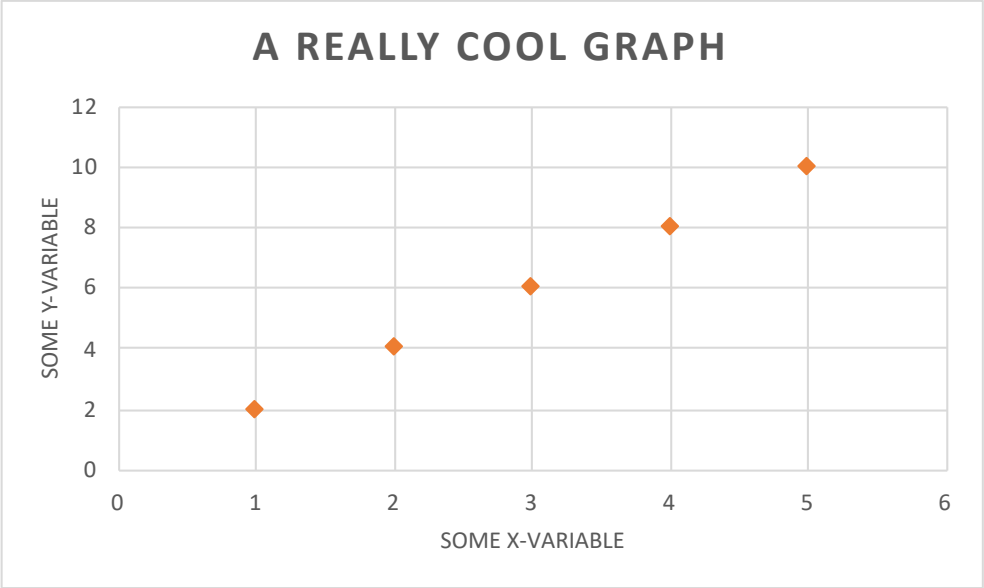


# PREDICTING / INFERRING A VALUE

When predicting a value that doesn't lie in your data set, you can either apply a mathematical relationship (if it's linear) or use a table to figure out the results.

| Some x variable | Some y variable |
|---|---|
| 1 | 2 |
| 2 | 4 |
| 3 | 6 |
| 4 | 8 |
| 5 | 10 |




| Some x variable | Some y variable |
|---|---|
| 5 | 10 |
| 6 | 12 |
| 7 | 14 |
| 8 | 16 |
| 9 | 18 |

**Mathematical Relationship**

The value of the y variable when the x value is 9 is 18. This is due to the fact that y=2x

**Use a table**

The value of the y variable when the x value is 9 is 18. This can be seen from the following table:

# WORKED EXAMPLE – PREDICT THE VALUE

Predict what the physics result would be if the time spent gaming was 12 hours.
Use evidence from the table to support your answer. [2 marks]

| Time gaming (hr) | Physics results (%) |
|---|---|
| 2 | 80 |
| 4 | 19 |
| 6 | 9 |
| 8 | 5 |

*As the relationship between time gaming and Physics exam results is inverse squared, the time spend gaming doubles, the Physics exam results quarters.*

$$6 \times 2 = 12$$
$$9 \div 4 = 2.25\%$$ ✓

*Physics result would be 2%* ✓

# YOU TRY – PREDICT THE VALUE

3 minutes

Predict the value of the car after 8 years. Use evidence from the table to support your answer. [2 marks]

| Age of car (years) | Value of car ($) |
|---|---|
| 0 | 80 000 |
| 1 | 40 000 |
| 2 | 20 000 |
| 3 | 10 000 |
| 4 | 5 000 |
| 5 | 2 500 |

# CALCULATE A MEAN

$$\bar{x} = \frac{\sum x}{n} \qquad \text{mean} = \frac{\text{sum of terms}}{\text{number of terms}}$$

**Thoroughly review the data:**

- Make sure you substitute in the correct data points.
- Present your answer with the correct:
  - **decimal points** or
  - **significant figures**

## In the exam

**Respond with three parts:**

1. **Substitute** the data values into the mean formula.
2. **Calculate** the mean.
3. **Present** your answer in the answer box – **with the correct number of decimal places or significant figures**.

# WORKED EXAMPLE - CALCULATE A MEAN

**Calculate** the mean heart rate after a running time of 15 minutes. Present your answer to 1 decimal place. [2 marks]

| Running time (minutes) | Heart Rate (bpm) | | | |
|---|---|---|---|---|
| | Trial 1 | Trial 2 | Trial 3 | Mean |
| 5 | 72.1 | 73.1 | 74.5 | 73.2 |
| 10 | 82.1 | 88.3 | 84.9 | 85.1 |
| 15 | 97.3 | 98.8 | 102.5 | |
| 20 | 115.7 | 119.2 | 110.4 | 115.1 |

$$\text{mean} = \frac{\text{sum of terms}}{\text{number of terms}}$$

$$\text{mean} = \frac{97.3 + 98.8 + 102.5}{3}$$ ✓

$$\text{mean} = \frac{298.6}{3}$$

$$\text{mean} = 99.533$$

$$\text{mean} = 99.5$$ ✓

# LEARNING OBJECTIVES

**By the end of the lesson, you should be able to:**

- ❑ **Identify** a value from a provided dataset
- ❑ **Identify** the uncertainty from a provided dataset
- ❑ **Contrast** the uncertainty from a provided dataset

# DATA TEST SKILLS

Data may be presented in a table or in a graph:

| Skills | Table Dataset Skills | Graph Dataset Skills |
|---|---|---|
| Identify the relationship | ✓ | ✓ |
| Predict / Infer a value | ✓ | ✓ |
| Calculate the mean | ✓ | |
| Identify a value | ✓ | ✓ |
| Identify the uncertainty | ✓ | ✓ |
| Contrast the uncertainty | ✓ | ✓ |
| Draw a conclusion to evaluate a statement | ✓ | |
| Identify the mathematical relationship | | ✓ |
| Draw a conclusion that quantifies a parameter | | ✓ |
| Predict a change to the relationship | | ✓ |

# IDENTIFY A VALUE - TABLE

When you are asked to **identify** a value from a graph, you are being asked to read and analyse the tabular data provided.

This question stem requires you to identify a specific data point, it may be the Dependent Variable or the Independent Variable

| Distance (m) | Radioactivity (Bq) | | | |
|---|---|---|---|---|
| | Trial 1 | Trial 2 | Trial 3 | Mean |
| 0.1 | 147.7 | 150.38 | 154.52 | 150.87 |
| 0.2 | 38.84 | 36.30 | 38.38 | |
| 0.3 | 16.16 | 16.88 | 16.58 | 16.54 |
| 0.4 | 8.88 | 10.02 | 9.64 | 9.51 |
| 0.5 | 6.46 | 5.68 | 5.2 | 5.78 |

## For example

Identify the average radioactivity at a distance of 0.3m.

radioactivity = 16.54Bq ✓

## For example

Identify the distance that produces an average radioactivity of 9.51Bq.

distance = 0.4m ✓

# IDENTIFY A VALUE - GRAPH

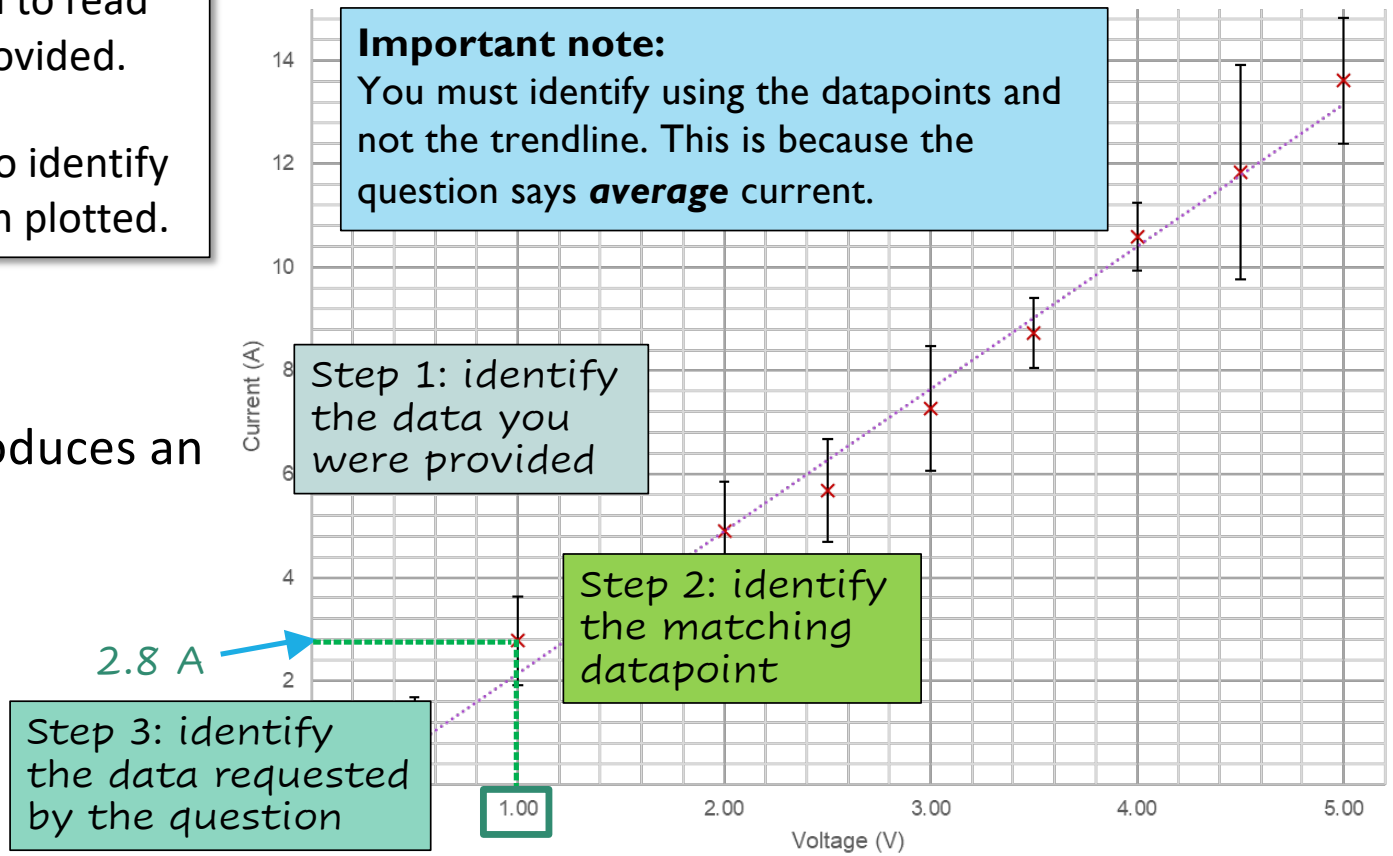
When you are asked to **identify** a value from a graph, you are being asked to read and analyse the graphical data provided.

This question stem requires you to identify a specific data point that has been plotted.

## For example

Identify the voltage that produces an average current of 2.8 A.

**V = 1.00 Volts** ✓



# YOU TRY - IDENTIFY A VALUE

3 minutes

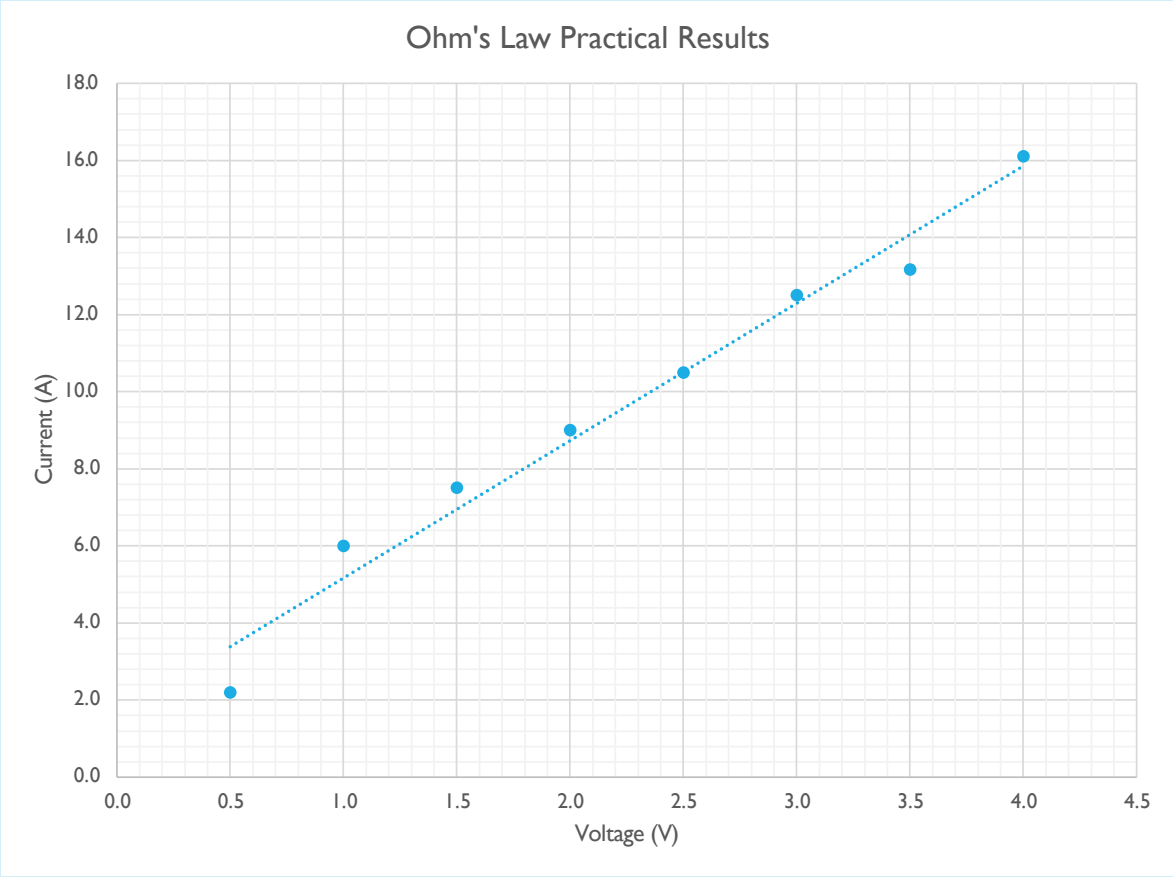
**Identify** the running time when the mean heart rate is 143.8 bpm. [1 mark]

| Running time (minutes) | Heart Rate (bpm) | | | |
|---|---|---|---|---|
| | Trial 1 | Trial 2 | Trial 3 | Mean |
| 5 | 72.1 | 73.1 | 74.5 | 73.2 |
| 10 | 82.1 | 88.3 | 84.9 | 85.1 |
| 15 | 97.3 | 98.8 | 102.5 | |
| 20 | 115.7 | 119.2 | 110.4 | 115.1 |
| 25 | 128.4 | 132.1 | 129.4 | 130.0 |
| 30 | 142.2 | 144.7 | 144.6 | 143.8 |
| 35 | 162.7 | 158.1 | 159.4 | 160.1 |

Click to show answer

# YOU TRY - IDENTIFY A VALUE

3 minutes




**Identify** the average current (I) when the applied voltage was 1.0V.

[1 mark]

Click to show answer

# IDENTIFY THE UNCERTAINTY

When you are asked to **identify** the uncertainty of the mean, you will be provided the formula $\pm\frac{x_{max}-x_{min}}{2}$.

This question stem requires you to identify the maximum and the minimum values and calculate the uncertainty.

| Distance (m) | Radioactivity (Bq) | | | |
|---|---|---|---|---|
| | Trial 1 | Trial 2 | Trial 3 | Mean |
| 0.1 | 147.7 | 150.38 | 154.52 | 150.87 |
| 0.2 | 38.84 | 36.30 | 38.38 | |
| 0.3 | 16.16 | 16.88 | 16.58 | 16.54 |
| 0.4 | 8.88 | 10.02 | 9.64 | 9.51 |
| 0.5 | 6.46 | 5.68 | 5.2 | 5.78 |

## For example

Identify the uncertainty of the mean when the distance is 0.4m. Use the formula $\pm\frac{x_{max}-x_{min}}{2}$.

$$\pm\frac{x_{max}-x_{min}}{2}$$

$$\pm\frac{10.02-8.88}{2}$$

$$\pm\frac{1.14}{2}$$

$$\pm 0.57$$ ✓

# YOU TRY – IDENTIFY THE UNCERTAINTY

3 minutes

**Identify** the uncertainty of the mean when the distance is 0.2m. Use the formula $\pm \frac{x_{max}-x_{min}}{2}$. [1 mark]

| Distance (m) | Radioactivity (Bq) | | | |
|---|---|---|---|---|
| | Trial 1 | Trial 2 | Trial 3 | Mean |
| 0.1 | 147.7 | 150.38 | 154.52 | 150.87 |
| 0.2 | 38.84 | 36.30 | 38.38 | |
| 0.3 | 16.16 | 16.88 | 16.58 | 16.54 |
| 0.4 | 8.88 | 10.02 | 9.64 | 9.51 |
| 0.5 | 6.46 | 5.68 | 5.2 | 5.78 |

Click to show answer

# CONTRAST THE UNCERTAINTY

## Contrast

display recognition of **differences** by deliberate juxtaposition of contrary elements; show how things are different or opposite; give an account of the differences between two or more items or situations, referring to both or all of them throughout. (QCAA)

**Be sure to thoroughly analyse the data!**

If analysing a graph – review the error bars on the graph, use the scale on the axis!

If analysing a table – read the absolute error values carefully.

## In the exam

**Respond with two parts:**

1. **State** the uncertainty of the values

   *(when …. the uncertainty is ±….. and when … the uncertainty is ±…..)*

2. **Contrast** the uncertainties with contrasting language

   *(the uncertainty when …… is **larger / smaller / double** the uncertainty when ….)*

# EXAMPLE - CONTRAST THE UNCERTAINTY

**Contrast** the absolute uncertainty of the time measured at displacements of 10m and 40m.

| Displacement (m) | Average Time (s) | Uncertainty |
|---|---|---|
| 10 | 3.48 | ±0.03 |
| 20 | 4.97 | ±0.02 |
| 30 | 6.12 | ±0.05 |
| 40 | 6.95 | ±0.06 |
| 50 | 7.84 | ±0.01 |

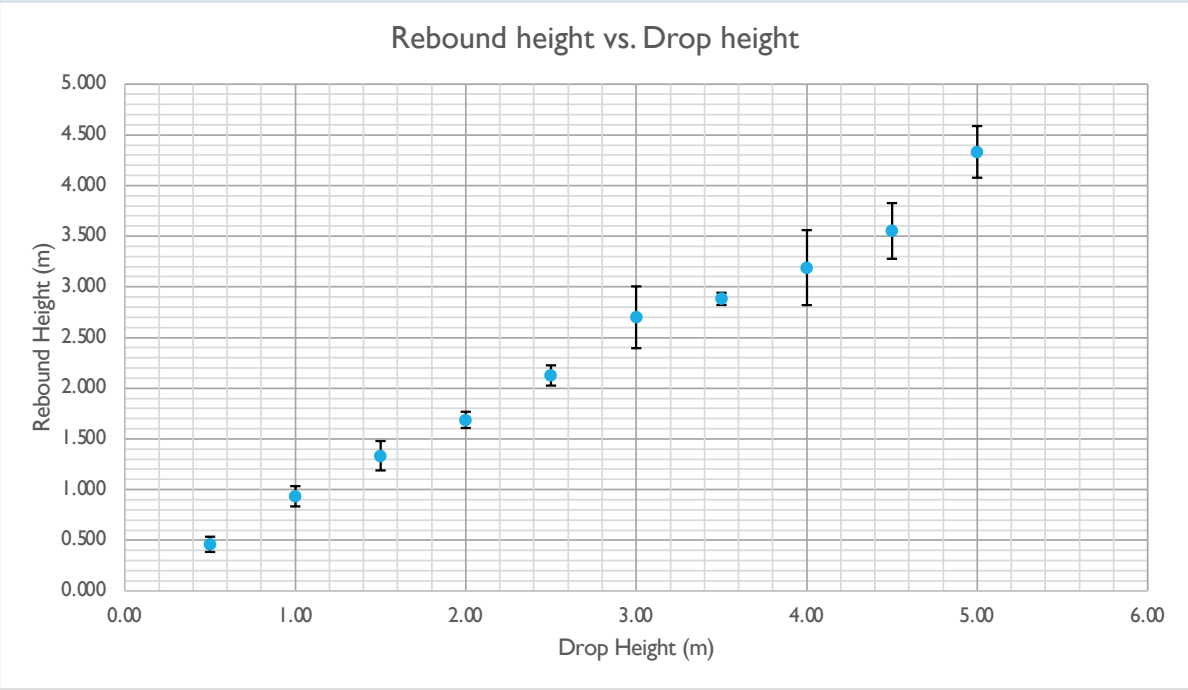
*For a displacement of 10m, the absolute uncertainty of the time is ±0.03s. For a drop height of 40m, the absolute uncertainty of the time is ±0.06s.* ✓

*The uncertainty in the measured time when the displacement is 40m, is double the uncertainty when the displacement is 10m.* ✓

# YOU TRY - CONTRAST THE UNCERTAINTY

3 minutes

**Contrast** the absolute uncertainty of the rebound height measured at drop heights of 4.00m and 3.00m.

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# LET'S CHECK

**Can you:**

- ✓ **Identify** a value from a provided dataset
- ✓ **Identify** the uncertainty from a provided dataset
- ✓ **Contrast** the uncertainty from a provided dataset

# DATA TEST SKILLS

Data may be presented in a table or in a graph:

| Skills | Table Dataset Skills | Graph Dataset Skills |
|---|---|---|
| Identify the relationship | ✓ | ✓ |
| Predict / Infer a value | ✓ | ✓ |
| Calculate the mean | ✓ | |
| Identify a value | ✓ | ✓ |
| Identify the uncertainty | ✓ | ✓ |
| Contrast the uncertainty | ✓ | ✓ |
| Draw a conclusion to evaluate a statement | ✓ | |
| Identify the mathematical relationship | | ✓ |
| Draw a conclusion that quantifies a parameter | | ✓ |
| Predict a change to the relationship | | ✓ |

# IDENTIFY THE MATHMATICAL RELATIONSHIP

When you are asked to **identify** the mathematical relationship and include the uncertainties for the gradient and intercept, you are being asked to read and analyse data provided on the graph.

This question stem requires you utilise the provided trendlines.

**Be sure to present your answer with the correct physical symbols!**

## In the exam

**Respond with three parts:**

1. **Calculate** the uncertainty of the gradient

$$\Delta m = \frac{m_{max} - m_{min}}{2}$$

2. **Calculate** the uncertainty of the y-intercept

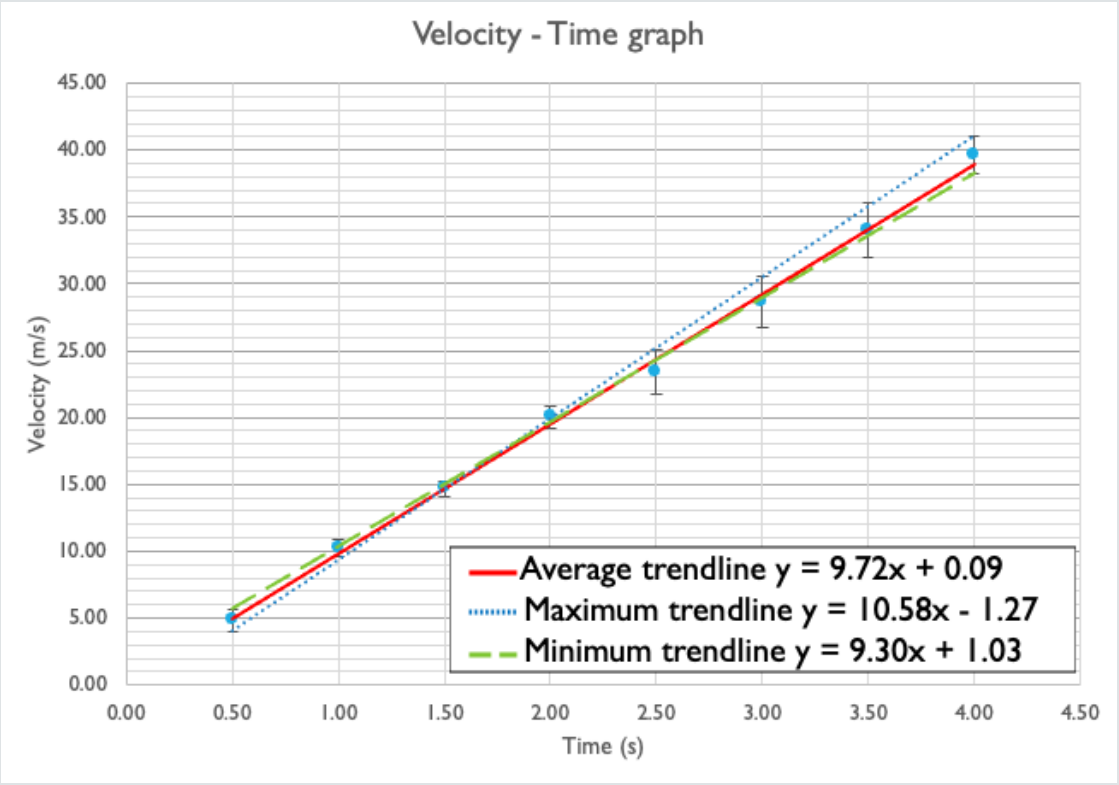
$$\Delta c = \frac{c_{max} - c_{min}}{2}$$

3. **Substitute** the gradient and intercept of the average trendline and calculated uncertainties into the formula $DV = (m \pm \Delta m)IV + c \pm \Delta c$

# IDENTIFY THE MATHEMATICAL RELATIONSHIP

**Identify** the mathematical relationship between velocity, v, and time, t. Include the uncertainties for the gradient and intercept.

[3 marks]




$$\Delta m = \frac{m_{max} - m_{min}}{2} \qquad \Delta c = \frac{c_{max} - c_{min}}{2}$$

$$\Delta m = \frac{10.52 - 9.30}{2} \qquad \Delta c = \frac{1.03 - -1.27}{2}$$

$$\Delta m = 0.61 \checkmark \qquad \Delta c = 1.15 \checkmark$$

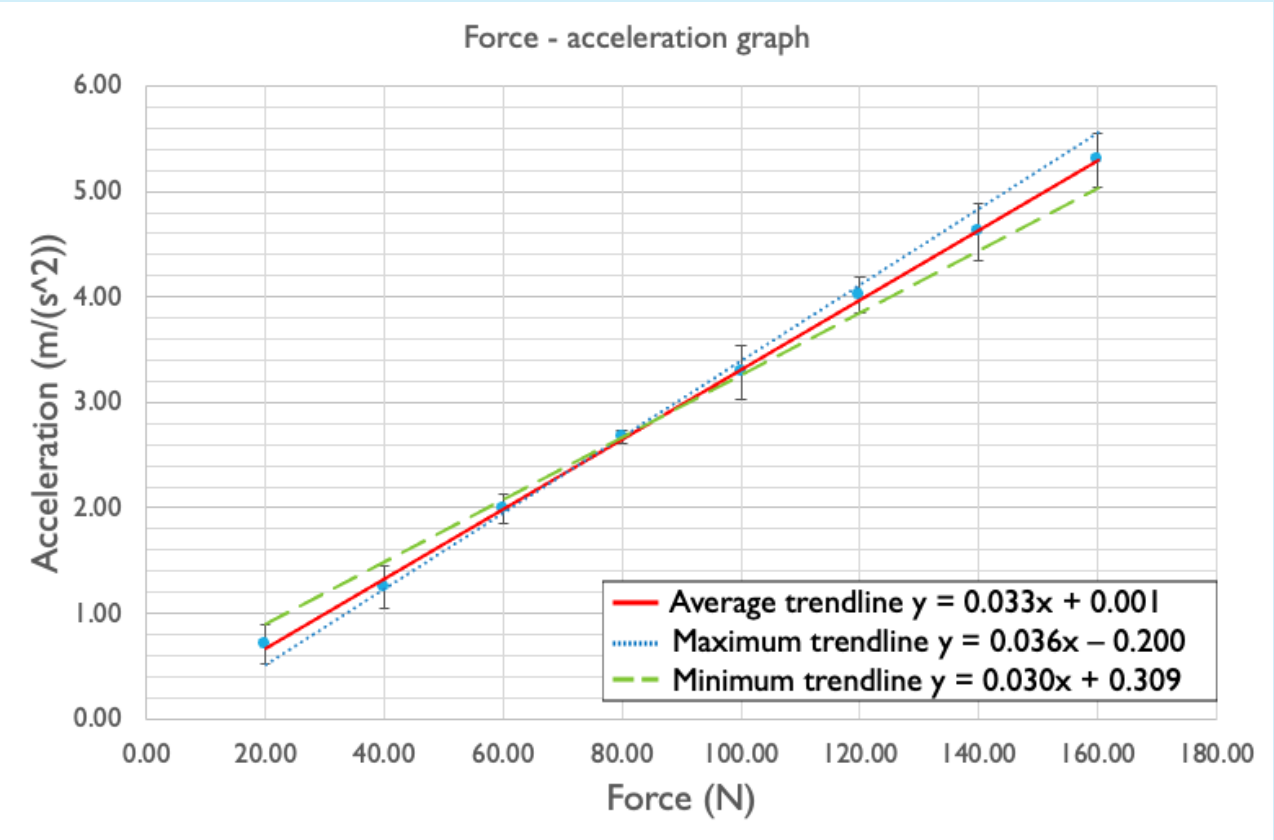
$$v = (9.72 \pm 0.61)t + 0.09 \pm 1.15 \checkmark$$

# IDENTIFY THE MATHEMATICAL RELATIONSHIP

5 minutes

**Identify** the mathematical relationship between acceleration, a, and force, F. Include the uncertainties for the gradient and intercept.

[3 marks]




Click to show answer

# DRAW A CONCLUSION THAT QUANTIFIES A PARAMETER

When you are asked to **draw a conclusion** about a physical quantity from a graph, you are being asked to interpret the physical meaning of a feature of the graph (gradient, area or intercept).

***HOW TO DRAW A CONCLUSION INCLUDING THE PERCENTAGE UNCERTAINTY***

Step 1: Write out your theoretical relationship in linear form.

Step 2: Compare your theoretical relationship to the linear mathematical relationship ($y = mx + c$).

Step 3: **Explicitly** identify how the gradient/intercept of your graph relates to the requested quantity.

Step 4: Solve for the quantity required by the question.

Step 5: Present your solution to the required decimal places or significant figures.

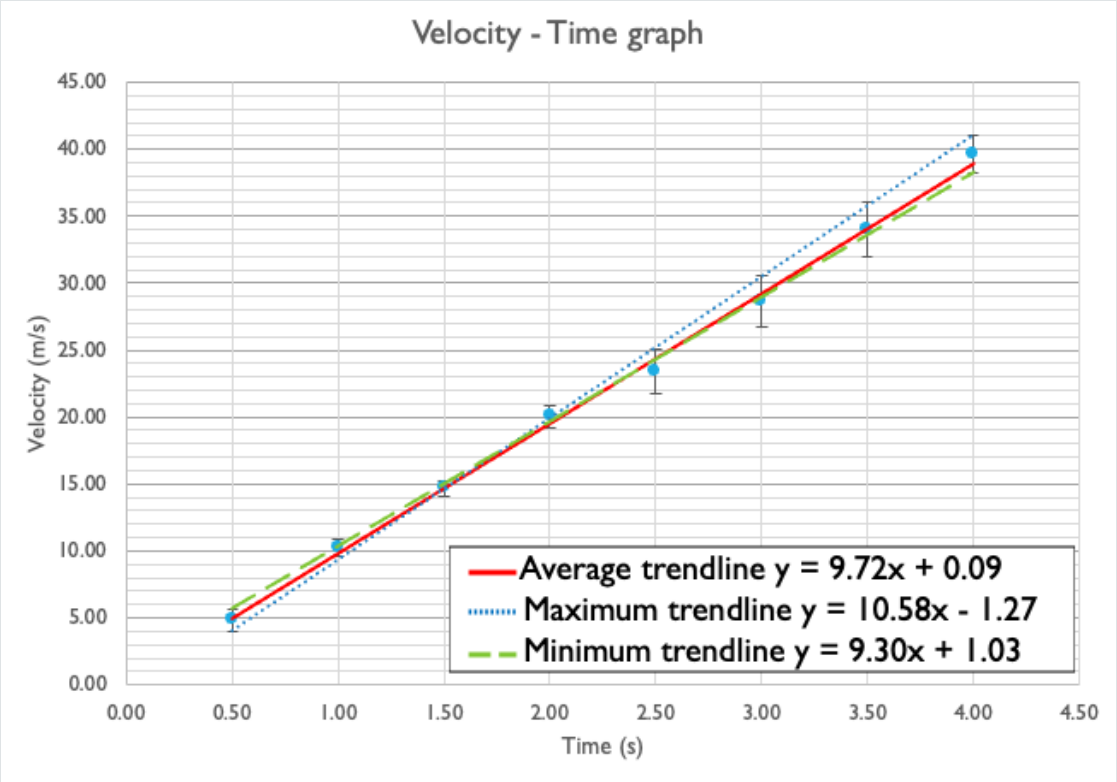
## In the exam

**Respond with three parts:**

1. **State** the physical meaning of the gradient / intercept / area of the graph that relates to the requested quantity
   *(gradient = ……)*
2. **Present** your solution for the quantity

# DRAW A CONCLUSION

Using the graph, **draw a conclusion** that quantifies the value of acceleration of the object. Show all working. [2 marks]




$v = u + at$

$v = at + u$

$y = mx + c$

$\therefore gradient = a$ ✓

$v = (9.72 \pm 0.61)t + 0.09 \pm 1.15$

$gradient = 9.72$

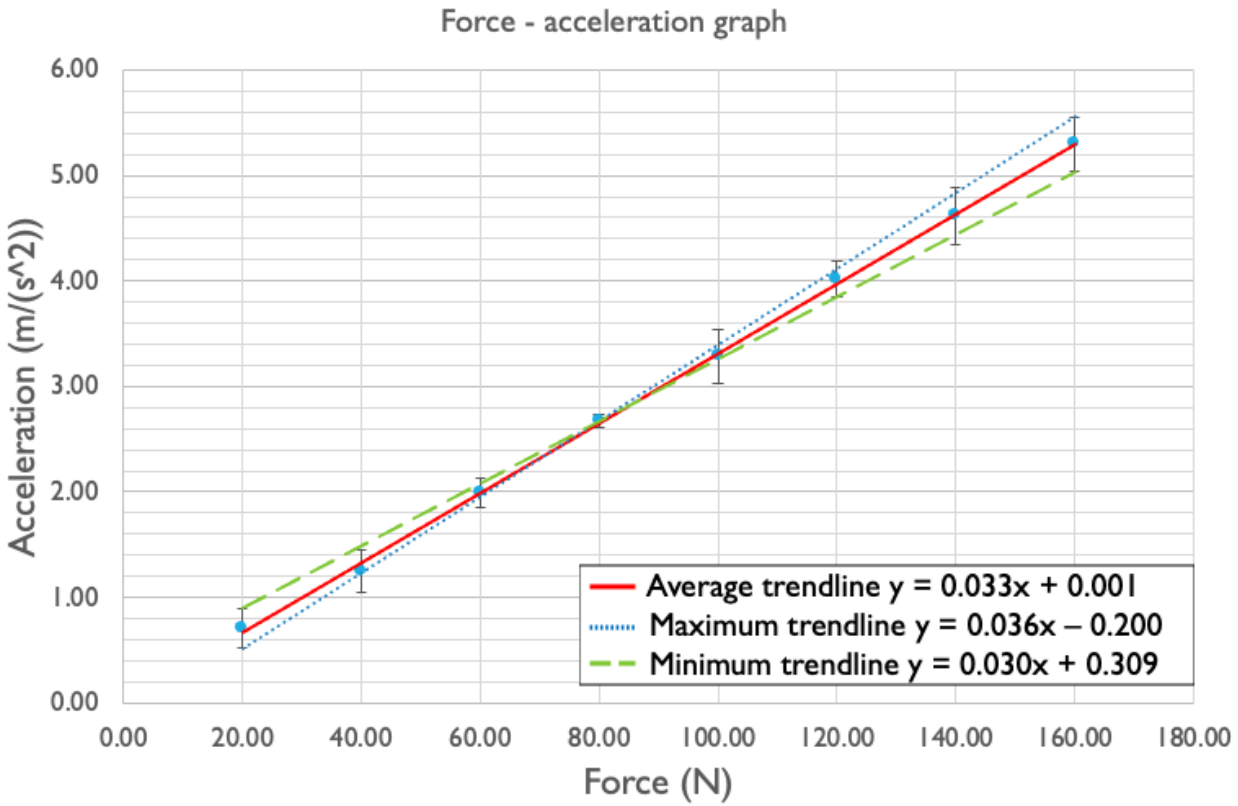
$a = 9.72ms^{-2}$

✓

# YOU TRY: DRAW A CONCLUSION

5 minutes

Using the graph, **draw a conclusion** that quantifies the value of the mass of the object. Show all working. Present all values to 3 d.p. [2 marks]

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# DRAW A CONCLUSION TO ADDRESS A STATEMENT

When you are asked to **draw a conclusion to address a statement** you are being asked to use evidence from a table to either support or refute a given proportionality statement of the form:

*Draw a conclusion to evaluate the statement "doubling/halving/tripling/etc. [the IV] doubles/halves/triples/etc. [the DV] when [the CVs] are kept constant" Use evidence from table X to justify your answer.*

***Remember***
***Two*** *steps of evidence to support your answer*

## In the exam

**Respond with two parts:**

1. **Identify** and present two steps of relevant evidence from the table
2. **State** whether the evidence supports or refutes the statement

# DRAW A CONCLUSION TO ADDRESS A STATEMENT

Draw a conclusion to address the statement "As distance doubles, intensity halves when the material is kept constant." Use evidence from the table to justify your answer. [2 marks]

| Distance (m) | Intensity ($W/m^2$) | | | | |
|---|---|---|---|---|---|
| | Trial 1 | Trial 2 | Trial 3 | Trial 4 | Mean |
| 0.1 | 304.50 | 306.90 | 281.70 | 311.40 | 301.13 |
| 0.2 | 82.05 | 80.55 | 77.70 | 75.83 | 79.03 |
| 0.3 | 33.40 | 33.53 | 31.10 | 34.03 | 33.02 |
| 0.4 | 19.61 | 17.79 | 19.11 | 19.16 | 18.92 |
| 0.5 | 11.64 | 11.48 | 12.20 | 12.44 | 11.94 |

When the distance doubles from 0.1 m to 0.2 m, intensity does not halve – it decreases from 301.13 $W/m^2$ to 79.03 $W/m^2$ $\left(\neq \frac{301.13}{2}\right)$, again when distance doubles from 0.2 m to 0.4 m, intensity does not halve – it decreases from 79.03 $W/m^2$ to 18.92 $W/m^2$ $\left(\neq \frac{79.03}{2}\right)$ ✓

The statement "doubling the distance halves the intensity" is refuted by table 1 ✓

# YOU TRY: DRAW A CONCLUSION TO ADDRESS A STATEMEN

7 minutes

Draw a conclusion to address the statement "As voltage doubles, current doubles when the resistance is kept constant." Use evidence from table 2 to justify your answer. [2 marks]

| Voltage (V) | Current (mA) | | | | |
|---|---|---|---|---|---|
| | Trial 1 | Trial 2 | Trial 3 | Trial 4 | Mean |
| 2 | 138.0 | 142.7 | 143.4 | 137.6 | 140.4 |
| 3 | 223.5 | 212.8 | 213.9 | 213.0 | 215.8 |
| 4 | 272.9 | 278.6 | 281.7 | 287.7 | 280.2 |
| 5 | 366.1 | 342.5 | 352.5 | 366.1 | 356.8 |
| 6 | 422.6 | 433.3 | 418.3 | 445.3 | 429.9 |

Click to show answer

# LEARNING OBJECTIVES

**By the end of the lesson, you should be able to:**

- ❑ **Examine** exponential decay graphs and use these graphs to estimate half-lives
- ❑ **Predict** a change to the relationship.
- ❑ **Calculate** the error of a parameter.

# DATA TEST SKILLS

Data may be presented in a table or in a graph:

| Skills | Table Dataset Skills | Graph Dataset Skills |
|---|---|---|
| Identify the relationship | ✓ | ✓ |
| Predict / Infer a value | ✓ | ✓ |
| Calculate the mean | ✓ | |
| Identify a value | ✓ | ✓ |
| Identify the uncertainty | ✓ | ✓ |
| Contrast the uncertainty | ✓ | ✓ |
| Draw a conclusion to evaluate a statement | ✓ | |
| Identify the mathematical relationship | | ✓ |
| Draw a conclusion that quantifies a parameter | | ✓ |
| Predict a change to the relationship | | ✓ |

# PREDICT A CHANGE IN THE RELATIONSHIP

When you are asked to **predict a change in the relationship**, the question stem will be "*If [CV]* doubled/halved/tripled/etc , predict the *DV when the IV is xxx* ".

***THERE ARE TWO METHODS TO ANSWER THIS QUESTION STEM***

METHOD A

Step 1: Identify the value of the DV that corresponds with required IV value.

Step 2: Write out your theoretical relationship in linear form.

Step 3: **Explicitly** identify the proportionality statement for the changed variable and the DV.

Step 4: Calculate the new value of the DV

Step 5: Present your answer

METHOD B

Step 1: Write out your theoretical relationship in linear form.

Step 3: **Explicitly** identify the proportionality statement for the changed variable and a feature of the mathematical relationship.

Step 4: Calculate the new value of the DV using a "new" mathematical relationship

Step 5: Present your answer

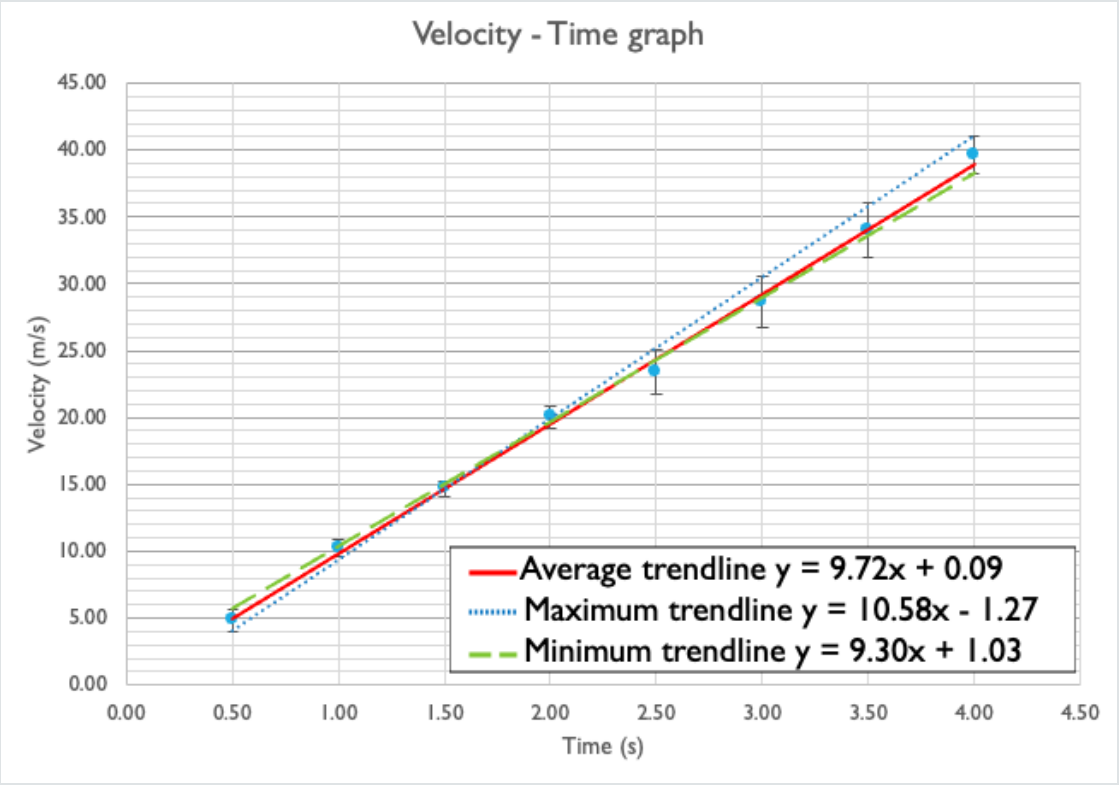
## In the exam

**Respond with two parts:**

1. **Demonstrate** mathematical reasoning *(use the proportionality statement to help)*
2. **Present** the correct answer

# PREDICT A CHANGE IN THE RELATIONSHIP (METHOD A)

If the acceleration doubled, **predict** the velocity after a time of 2.50 seconds. Use evidence from the graph to support your answer. [2 marks]




From the graph:

When t = 2.5 s

$v \approx 23.5 ms^{-1}$

$v = u + at$

$v = at + u$

$\therefore v \propto a$

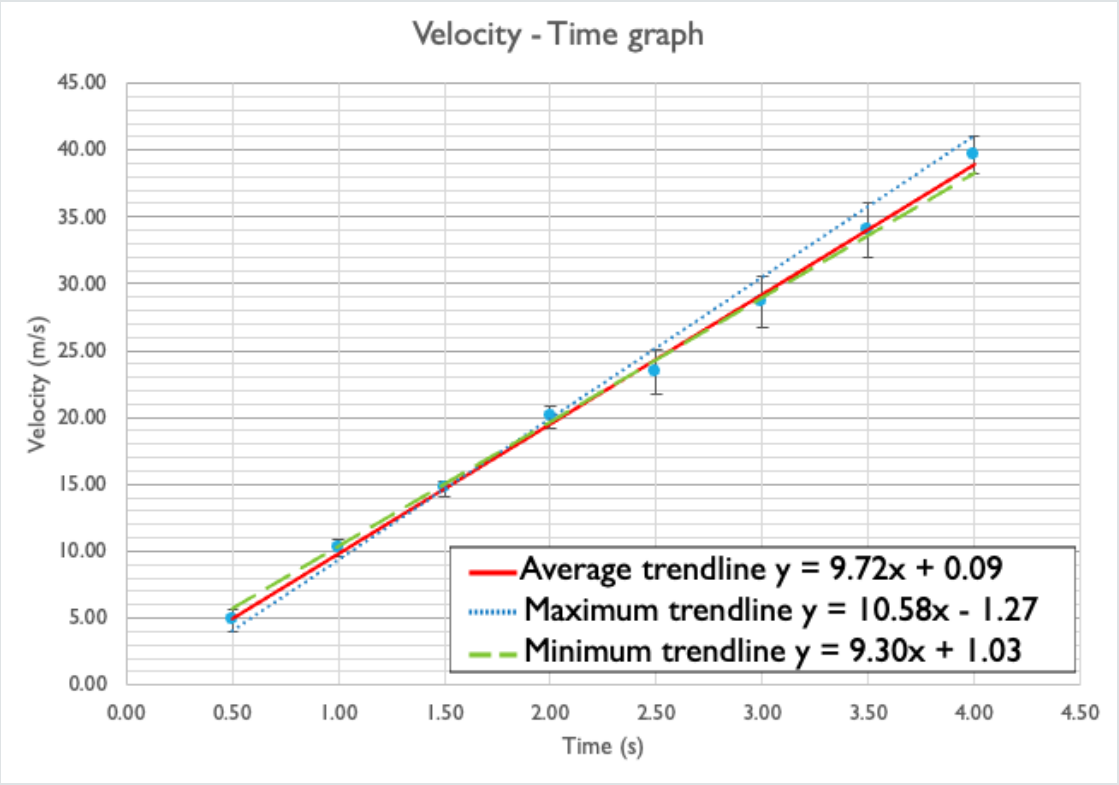
Therefore, if acceleration is doubled, velocity will also double. ✓

$v = 2 \times 23.5$

$v = 47.0 ms^{-1}$ ✓

# PREDICT A CHANGE IN THE RELATIONSHIP (METHOD B)

If the acceleration doubled, **predict** the velocity after a time of 2.50 seconds. Use evidence from the graph to support your answer. [2 marks]




$v = u + at$

$v = at + u$

$y = mx + c$

$\therefore \text{gradient} \propto a$

Therefore, if acceleration is doubled, the gradient will double. ✓

$v = (2 \times 9.72)t + 0.09$ is the new relationship

$v = (2 \times 9.72)(2.5) + 0.09$

$v = 48.6 + 0.09$

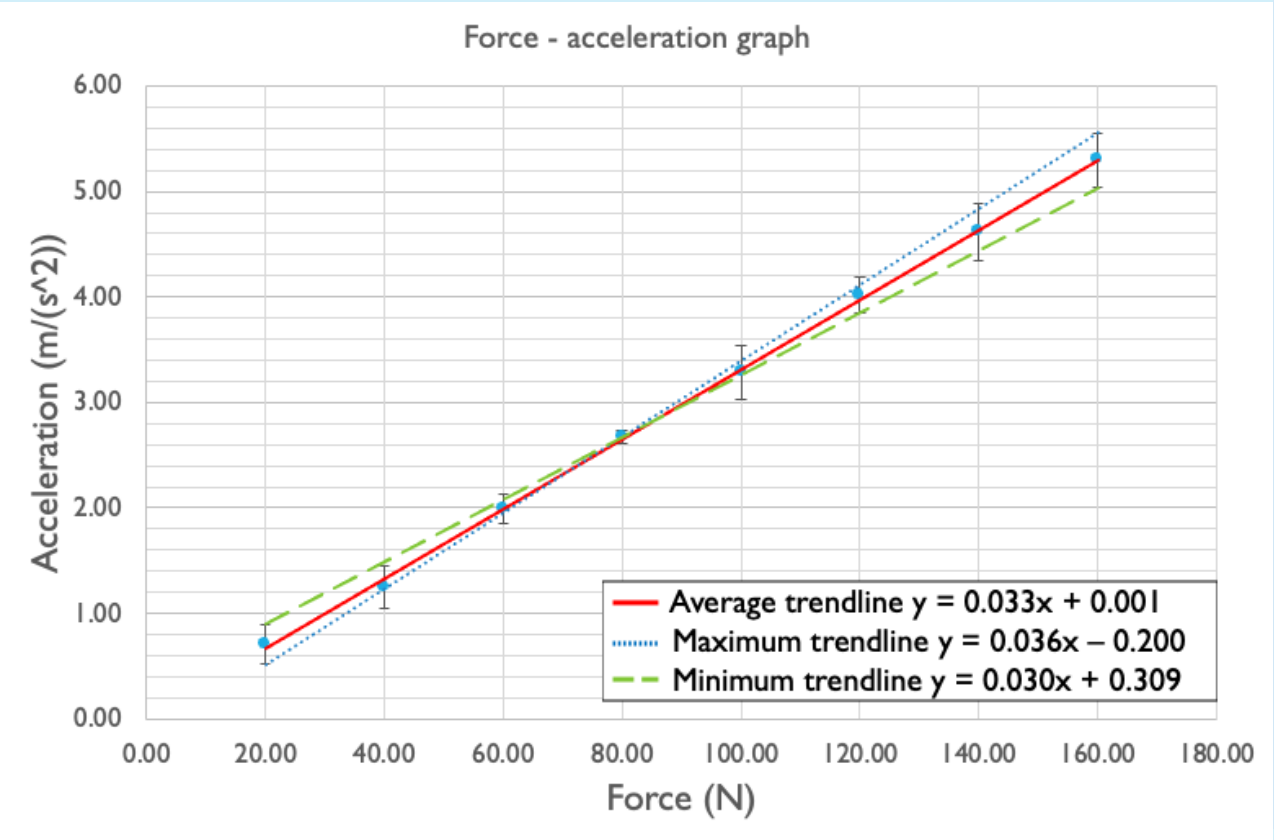
$v = 48.7\ \text{ms}^{-1}$ ✓

NOTE: the answer for Method A is not the same answer for Method B

# YOU TRY: PREDICT A CHANGE IN THE RELATIONSHIP

5 minutes

If the mass is doubled, **predict** the acceleration when a force of 100.0 N is applied. Use evidence from the graph to support your answer. [2 marks]

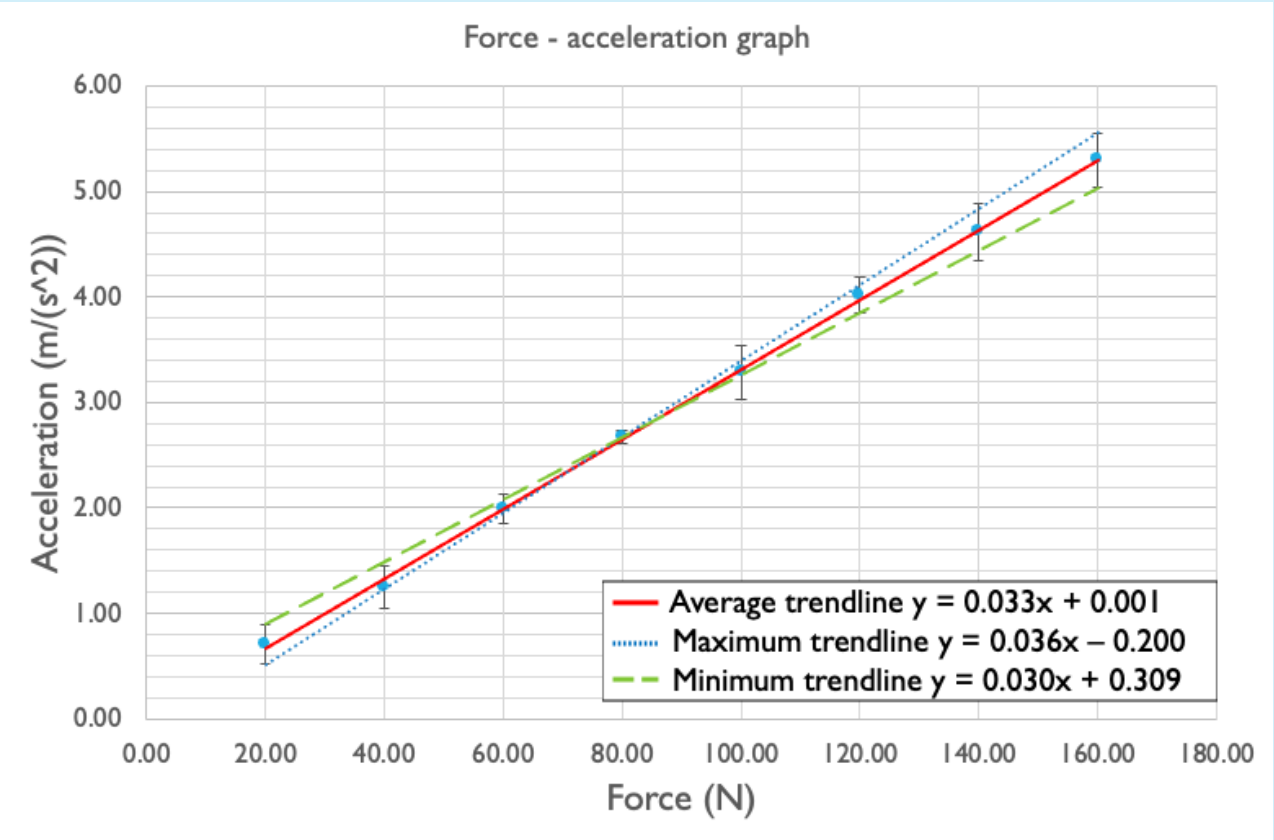



Click to show method A

# YOU TRY: PREDICT A CHANGE IN THE RELATIONSHIP

7 minutes

If the mass is doubled, **predict** the acceleration when a force of 100.0 N is applied. Use evidence from the graph to support your answer. [2 marks]




Click to show method B

# RADIOACTIVITY VS DISTANCE

# RETRIEVAL

1. **Calculate** the mean radioactivity at a distance of 0.2m. *[2 marks]*
2. **Identify** the relationship between radioactivity and distance. Use evidence from the table to support your response. *[2 marks]*
3. **Predict** the radioactivity at 1.2m. Use evidence from the table to support your response.

*[2 marks]*

| Distance (m) | Radioactivity (Bq) | | | |
|---|---|---|---|---|
| | Trial 1 | Trial 2 | Trial 3 | Mean |
| 0.1 | 147.7 | 150.38 | 154.52 | 150.87 |
| 0.2 | 38.84 | 36.30 | 38.38 | |
| 0.3 | 16.16 | 16.88 | 16.58 | 16.54 |
| 0.4 | 8.88 | 10.02 | 9.64 | 9.51 |
| 0.5 | 6.46 | 5.68 | 5.2 | 5.78 |

# LEARNING OBJECTIVES

**By the end of the lesson, you should be able to:**

- ❑ **Conduct** a simulation investigating the relationship between intensity and distance from a radioactive source.

# PRAC: RADIOACTIVITY VS DISTANCE

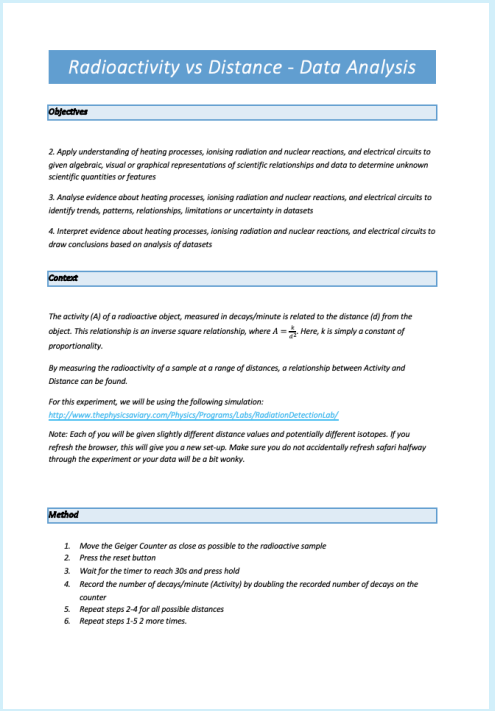
Step 1: Download the worksheet

*WS 1: PRAC Radioactivity vs Distance* from QLearn

Step 2: Complete the practical

Step 3: Complete the analysis questions in the primary data section

Step 4: Get started on the data test style questions in the secondary data section

*Radioactivity vs Distance - Data Analysis*

***Objectives***

*2. Apply understanding of heating processes, ionising radiation and nuclear reactions, and electrical circuits to given algebraic, visual or graphical representations of scientific relationships and data to determine unknown scientific quantities or features*

*3. Analyse evidence about heating processes, ionising radiation and nuclear reactions, and electrical circuits to identify trends, patterns, relationships, limitations or uncertainty in datasets*

*4. Interpret evidence about heating processes, ionising radiation and nuclear reactions, and electrical circuits to draw conclusions based on analysis of datasets*

***Context***

*The activity (A) of a radioactive object, measured in decays/minute is related to the distance (d) from the object. This relationship is an inverse square relationship, where* $A = \frac{k}{d^2}$*. Here, k is simply a constant of proportionality.*

*By measuring the radioactivity of a sample at a range of distances, a relationship between Activity and Distance can be found.*

*For this experiment, we will be using the following simulation:*
*http://www.thephysicsaviary.com/Physics/Programs/Labs/RadiationDetectionLab/*

*Note: Each of you will be given slightly different distance values and potentially different isotopes. If you refresh the browser, this will give you a new set-up. Make sure you do not accidentally refresh safari halfway through the experiment or your data will be a bit wonky.*

***Method***

1. *Move the Geiger Counter as close as possible to the radioactive sample*
2. *Press the reset button*
3. *Wait for the timer to reach 30s and press hold*
4. *Record the number of decays/minute (Activity) by doubling the recorded number of decays on the counter*
5. *Repeat steps 2-4 for all possible distances*
6. *Repeat steps 1-5 2 more times.*

# LET'S CHECK

**Can you:**

- ✓ **Conduct** a simulation investigating the relationship between intensity and distance from a radioactive source.

# HOMEWORK

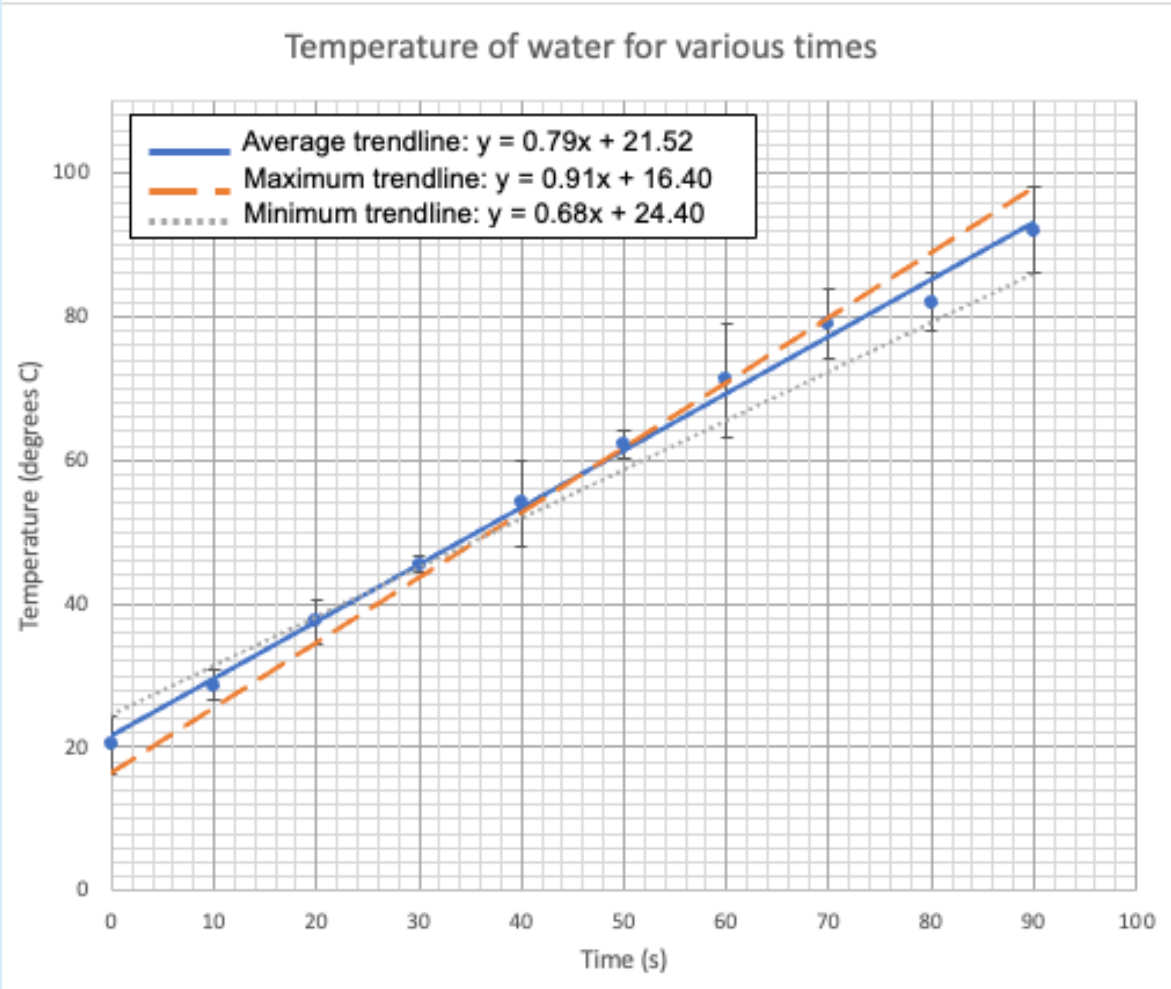
Complete WS 1: PRAC Radioactivity vs Distance

# HALF-LIFE PRAC

# RETRIEVAL

**An experiment was completed to answer the question "What is the relationship between temperature and time when 0.50 kg of water is heated with a 1750 W power source?"**

1. Identify the mathematical relationship between temperature, T and time, t. Include the uncertainty of the gradient and intercept. *[3 marks]*
2. Identify the uncertainty in the mean temperature after 50 s. *[1 mark]*
3. Using the graph, draw a conclusion that quantifies the value of the specific heat capacity of water. *[2 marks]*



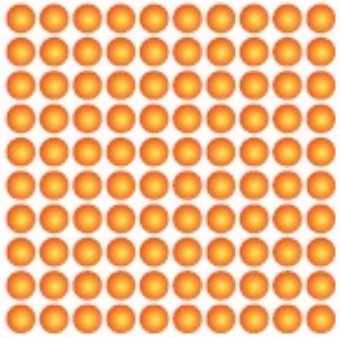
# LEARNING OBJECTIVES

**By the end of the lesson, you should be able to:**

- ❑ **Examine** exponential decay graphs and use these graphs to estimate half-lives

# HALF-LIFE EXAMPLE

DAY 0



÷2

DAY 4

÷2

DAY 8

100 radon-222 atoms in the sample

50 radon-222 atoms in the sample. The rest have been converted into polonium-218

25 radon-222 atoms in the sample. The rest have been converted into polonium-218

Every four days, half the number of radon-222 atoms decay into polonium-218.

Thus, the half-life of the isotope radon-222 is of 4 days.

# REPRESENTING NUCLEAR DECAY

We can also mathematically determine the number of nuclides remaining after a period of time using the following:

$$N = N_0 \left(\frac{1}{2}\right)^n$$

Where:

$N$ = Number of unstable nuclides remaining

$N_0$ = Initial number of unstable nuclides

$n$ = number of elapsed half lives = $\frac{t}{t_{\frac{1}{2}}}$

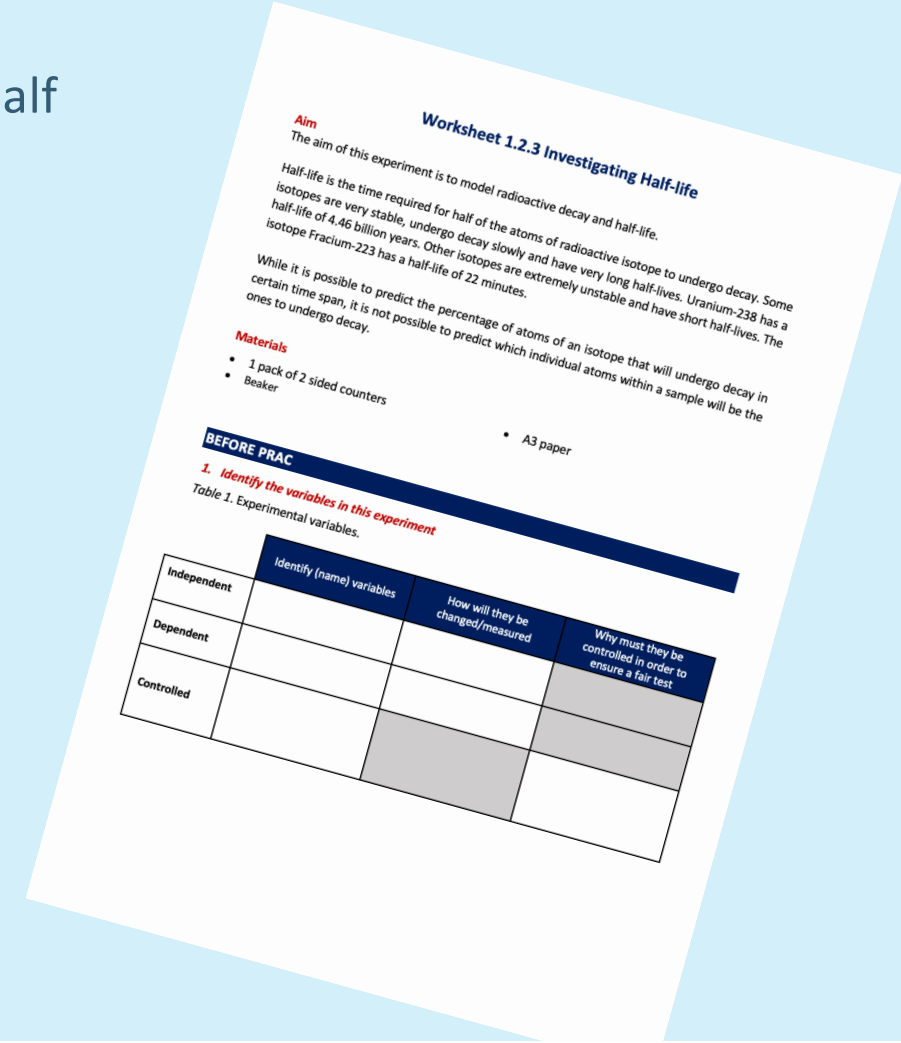
where $t$ = elapsed time, and $t_{\frac{1}{2}}$ = time of one half-life

Note: our syllabus specifies that you only need to solve for WHOLE numbers of half-lives, so the table method works just fine!

# PRAC – HALF-LIFE

STEP 1: **Complete** the prac analysis from the half life prac

STEP 2: **Complete** WS 3 – Data test practice



**Worksheet 1.2.3 Investigating Half-life**

**Aim**

The aim of this experiment is to model radioactive decay and half-life.

Half-life is the time required for half of the atoms of radioactive isotope to undergo decay. Some isotopes are very stable, undergo decay slowly and have very long half-lives. Uranium-238 has a half-life of 4.46 billion years. Other isotopes are extremely unstable and have short half-lives. The isotope Fracium-223 has a half-life of 22 minutes.

While it is possible to predict the percentage of atoms of an isotope that will undergo decay in certain time span, it is not possible to predict which individual atoms within a sample will be the ones to undergo decay.

**Materials**

- 1 pack of 2 sided counters
- Beaker
- A3 paper

**BEFORE PRAC**

1. *Identify the variables in this experiment*

*Table 1.* Experimental variables.

| | Identify (name) variables | How will they be changed/measured | Why must they be controlled in order to ensure a fair test |
|---|---|---|---|
| Independent | | | |
| Dependent | | | |
| Controlled | | | |

# LEARNING OBJECTIVES

**By the end of the lesson, you should be able to:**

- ✓ **Examine exponential decay graphs and use these graphs to estimate half-lives**

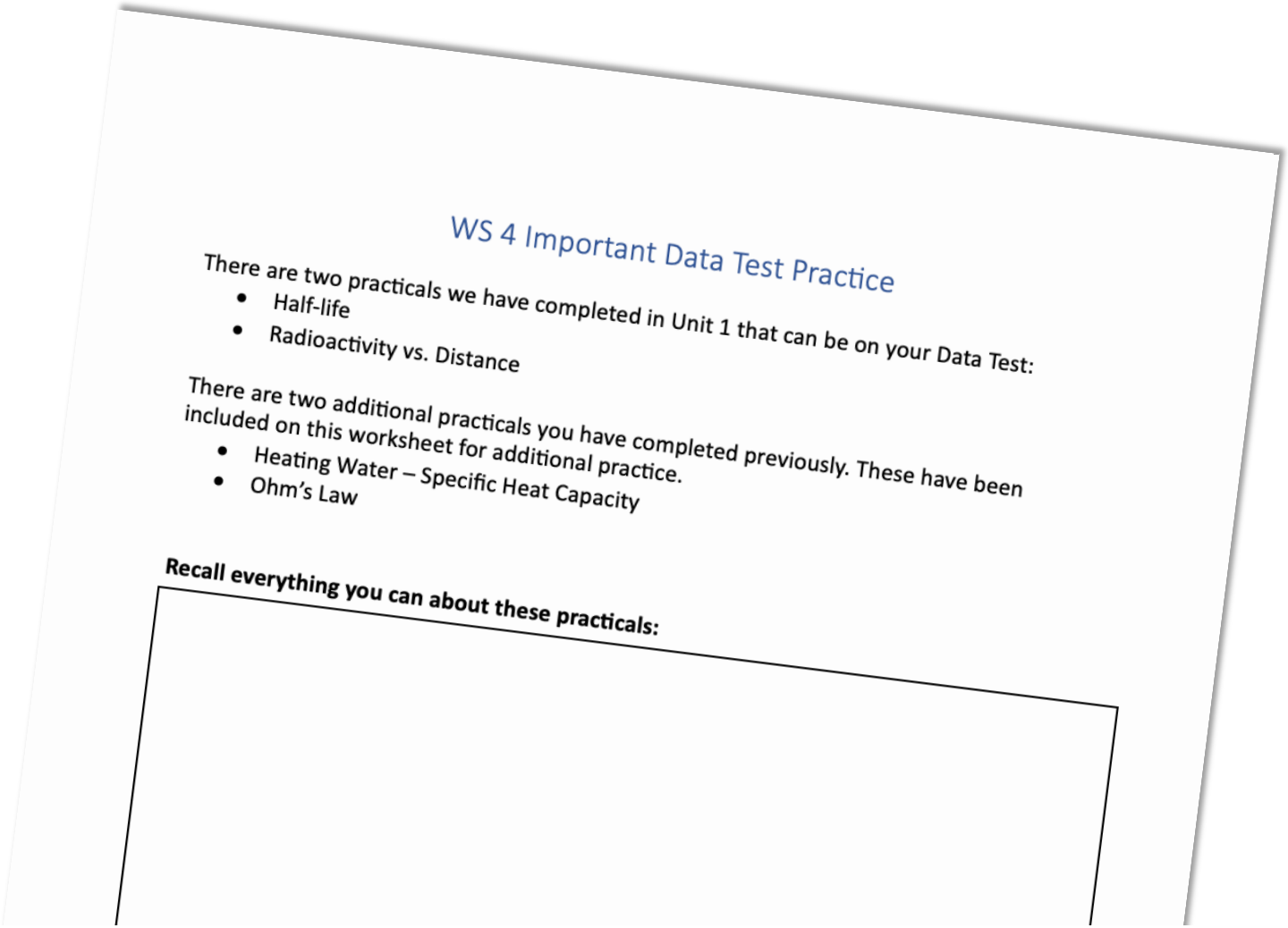
# HOMEWORK

**Complete:** WS 2 Half-life PRAC

**Complete** WS 3 – Data test practice

# DATA TEST REVISION

# GET STARTED ON THE WORKSHEET



WS 4 Important Data Test Practice

There are two practicals we have completed in Unit 1 that can be on your Data Test:

- Half-life
- Radioactivity vs. Distance

There are two additional practicals you have completed previously. These have been included on this worksheet for additional practice.

- Heating Water – Specific Heat Capacity
- Ohm's Law

**Recall everything you can about these practicals:**


DATA TEST

# LEARNING OBJECTIVES

**By the end of the lesson, you should be able to:**

- ❑ **Calculate** binding energy for fission and fusion reactions.
- ❑ **Solve** problems involving Einstein's mass-energy equivalence relationship.

# TOPIC



**Content**

- Sub-section

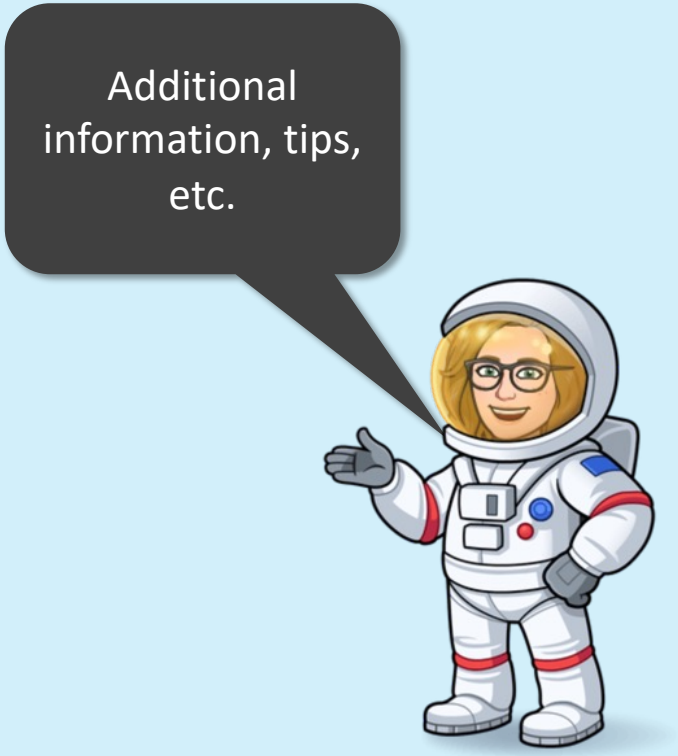
# WORKED EXAMPLE

# TASK


Worksheet Name

**Task instructions**

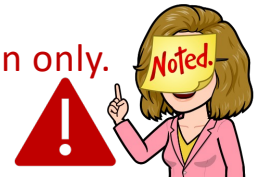
- Step 1
- Step 2
- Step 3



# ICONS

15 minutes

This is for your information only.
It won't be on the exam.



# LEARNING CHECK

Question

A • Answer A

B • Answer B

C • Answer C

D • Answer D

# WATCH

Short Description of what the video is about.

Title of video (Duration)
Hyperlink