RET Mathematics INSET

30th October 2017

Teresa Robinson, Maths Adviser

Maths and Science

Common Questions to be completed in pairs

1 maths teacher & 1 science teacher

- Complete both questions
- Discuss:
  - Similarities and differences
  - Any issues for teaching

Science

1. (a.) What is the median number of stomata on the upper surface of the leaf?

[1 mark]

(b.) Calculate the value of X in the table.
Give your answer to 2 significant figures.

[2 marks]

Leaf area	Number of stomata	
	Upper surface	Lower surface
1	3	44
2	0	41
3	1	40
4	5	42
5	1	39
Mean	**2**	**X**

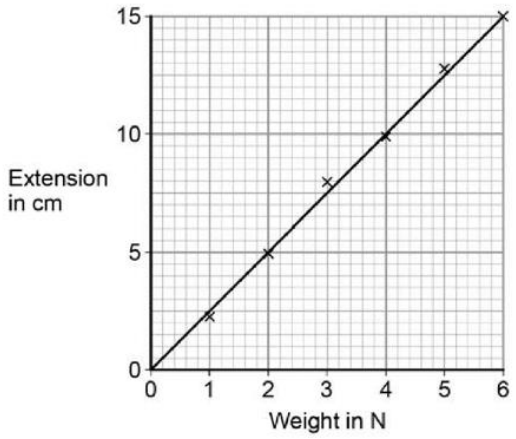
2. The student measured the extension of the spring using a range of weights.

The student's data is shown plotted as a graph in Figure 3.

What range of weight did the student use?

[1 mark]

Figure 3



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Science - Answers

1. (a.) What is the median number of stomata on the upper surface of the leaf? 1

[1 mark]

(b.) Calculate the value of X in the table.
Give your answer to 2 significant figures.

[2 marks]

$$\frac{44 + 41 + 40 + 42 + 39}{5} = \frac{206}{5} = 41.2 = 41\ (to\ 2sf)$$

Leaf area	Number of stomata	
	Upper surface	Lower surface
1	3	44
2	0	41
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Mean	**2**	**X**

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The student's data is shown plotted as a graph in Figure 3.

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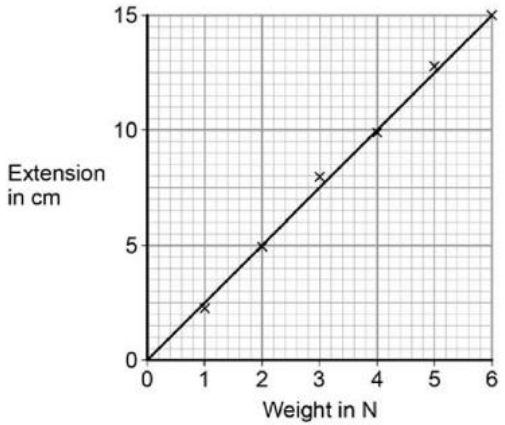
[1 mark]

1 - 6

Figure 3



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Maths

1. The table shows information about the marks of 30 students in a test.

   Students who scored less than the mean mark have to retake the test.

   (a.) How many students have to retake the test?

   You must show your working.

Mark	Frequency
14	2
15	10
16	2
17	3
18	13
	Total = 30

.....[3 marks]

(b.) What is the range of marks?

.....[1 mark]

Maths - Answers

1. The table shows information about the marks of 30 students in a test.

Mark	Frequency
14	2
15	10
16	2
17	3
18	13
	Total = 30

Students who scored less than the mean mark have to retake the test.

(a.) How many students have to retake the test?

You must show your working.

Mean = $\frac{28+150+32+51+234}{30} = \frac{495}{30} = 16.5$

14 people had to resit the test.

.....[3 marks]

(b.) What is the range of marks? 18 – 14 = 4

.....[1 mark]

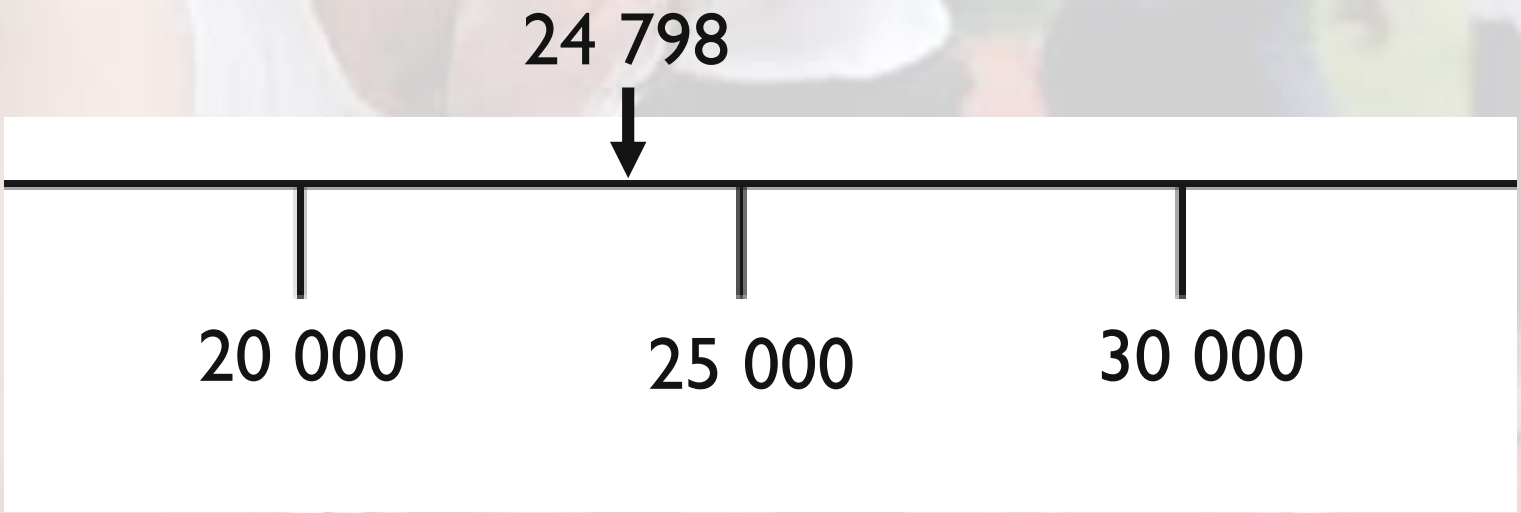
Finding the mean, median and mode from a table

- Encourage students to take time to understand what the table is actually showing.
- Maths – Is it a frequency table? Is it a grouped frequency table?
- The range:
  - Science – given as the minimum and maximum values
  - Maths – the difference between the greatest and least values
- Students must be able to round: dp and sf

Common maths and science questions

Significant Figures – pictorial representation

- Round 24 798 to 1sf



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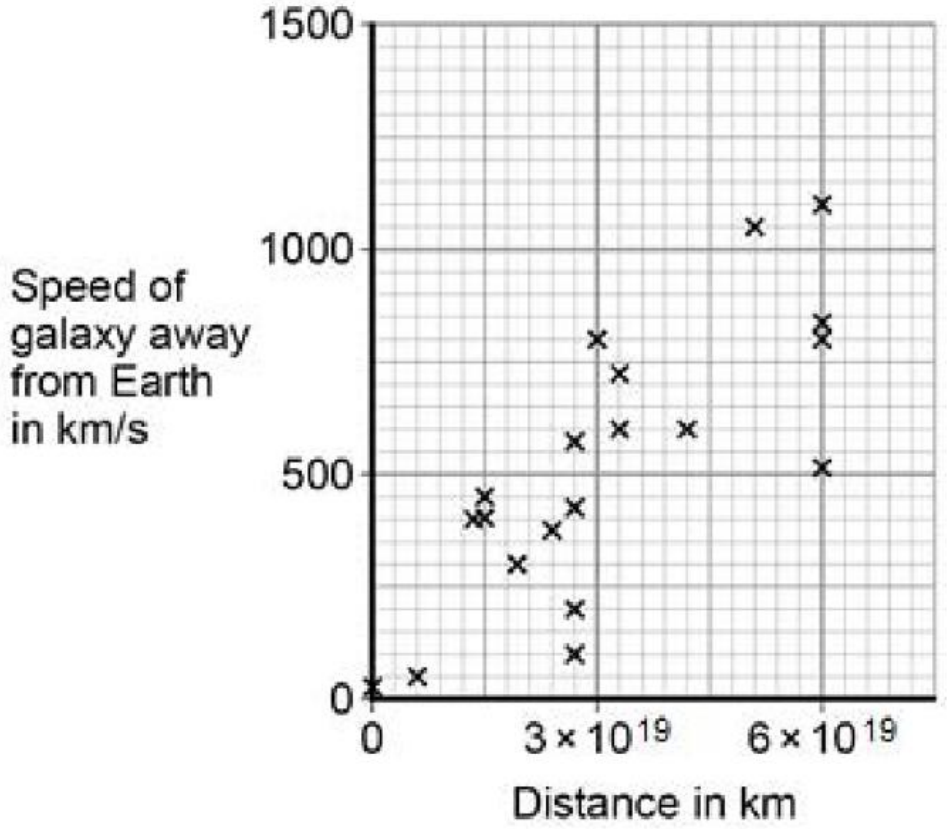
3. From his observations, Hubble was able to calculate the speed of a galaxy and the distance of the galaxy from the Earth.
Figure 5 shows the results of Hubble's calculations.

Figure 5



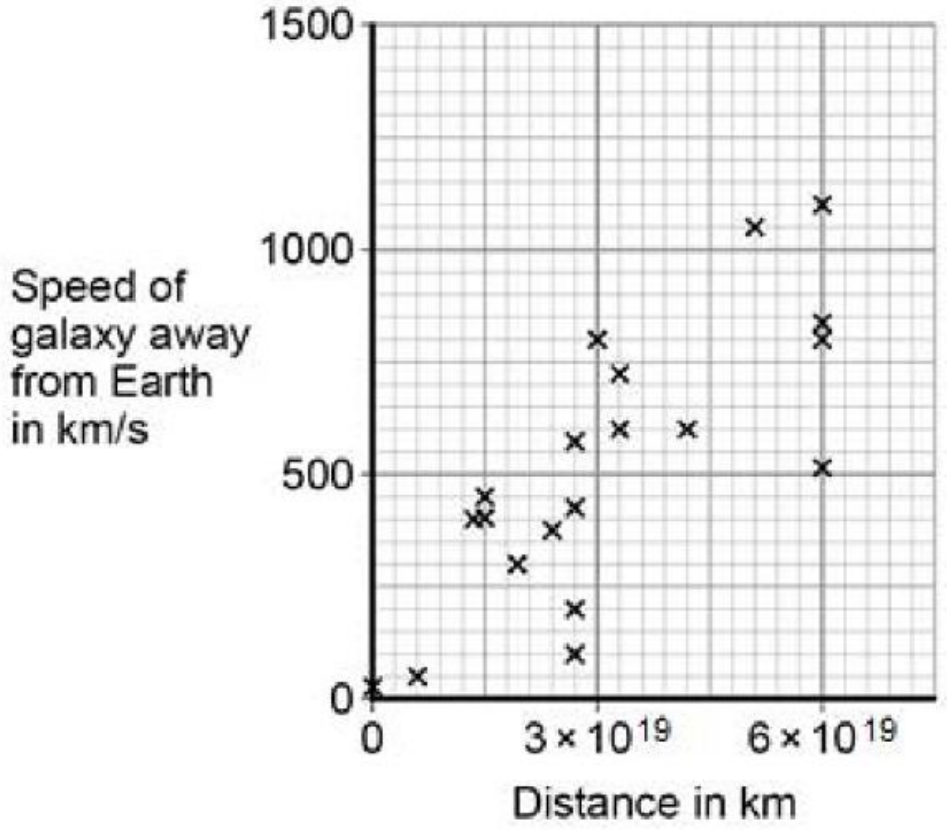
What relationship between the speed of a galaxy and the distance is suggested by Hubble's results?

[1 mark]

Science - Answers

3. From his observations, Hubble was able to calculate the speed of a galaxy and the distance of the galaxy from the Earth.
Figure 5 shows the results of Hubble's calculations.

Figure 5



What relationship between the speed of a galaxy and the distance is suggested by Hubble's results?

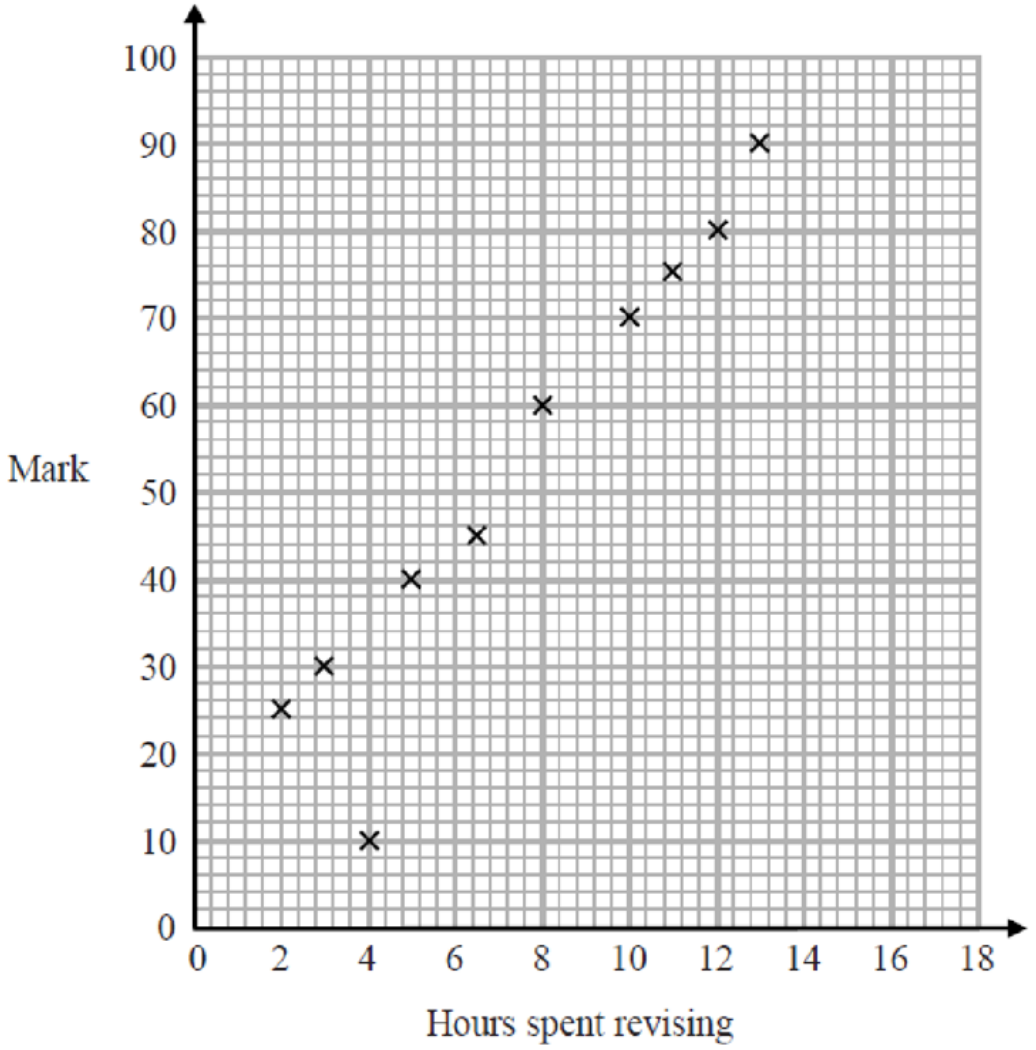
As the distance increases so does the speed

[1 mark]

Maths

3. The scatter diagram shows information about 10 students.

For each student, it shows the number of hours spent revising and the mark the student achieved in a Spanish test.



One of the points is an outlier.

(a) Write down the coordinates of the outlier.

.....

[1 mark]

(b) For all the other points

(i) draw the line of best fit,

(ii) describe the correlation.

..... [2 marks]

Maths - Answers

3. The scatter diagram shows information about 10 students.

For each student, it shows the number of hours spent revising and the mark the student achieved in a Spanish test.

One of the points is an outlier.

(a) Write down the coordinates of the outlier.

.....(4, 10).....

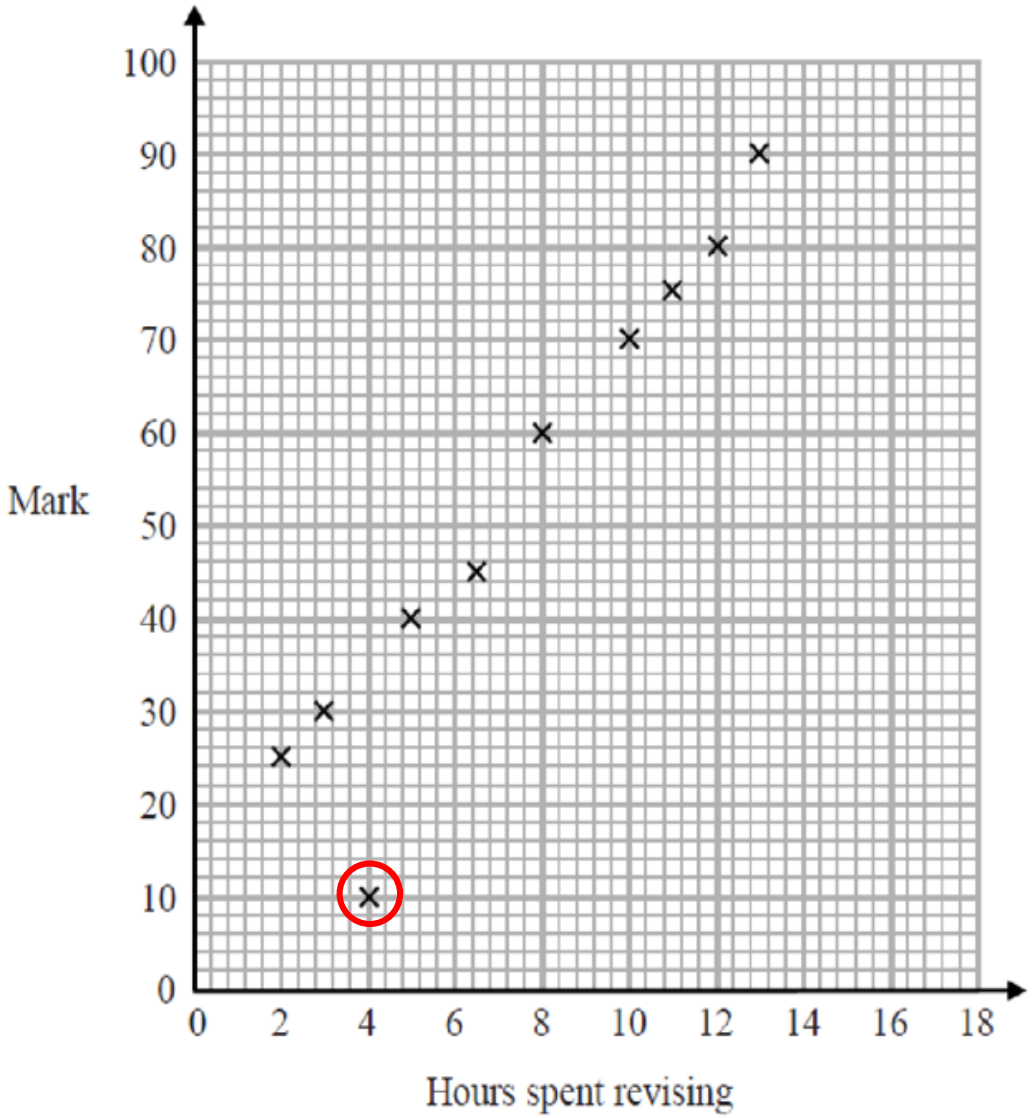
[1 mark]

(b) For all the other points

(i) draw the line of best fit,

(ii) describe the correlation.

.....positive..... [2 marks]



Scatter graphs and correlation

Relationship/correlation

- Describe the relationship:
  - As … increases … increases
  - As … increases … decreases
- State the type of correlation: positive or negative

Line of best fit

A line of best fit does not have to pass through the origin

Maths – points should be evenly distributed along the line

Science – the line should pass through as many points as possible. Science also use curves of best fit.

Outliers

- In science outliers are sometimes referred to as anomalies
- In maths students may be asked to provide a reason for the outlier e.g. an error in the measurement

Science & Maths

4. Calculate the percentage (%) decrease in the number of seals caught from 2004 to 2010.

Year	Number of seals caught in thousands
2004	362
2005	316
2006	348
2007	224
2008	215
2009	91
2010	67

Decrease in seals = ...%

[2 marks]

4. In 1999 the minimum wage for adults was £3.60 per hour. In 2013 it was £6.31 per hour.

Work out the percentage increase in the minimum wage.

_____% [3 marks]

Maths & Science - Answers

4. Calculate the percentage (%) decrease in the number of seals caught from 2004 to 2010.

$$\frac{362 - 67}{362} \times 100 = 81.49\%$$

Decrease in seals = ...%

[2 marks]

Year	Number of seals caught in thousands
2004	362
2005	316
2006	348
2007	224
2008	215
2009	91
2010	67

4. In 1999 the minimum wage for adults was £3.60 per hour. In 2013 it was £6.31 per hour.

Work out the percentage increase in the minimum wage.

$$\frac{6.31-3.60}{3.60} \times 100 = 75\%$$

_____% [3 marks]

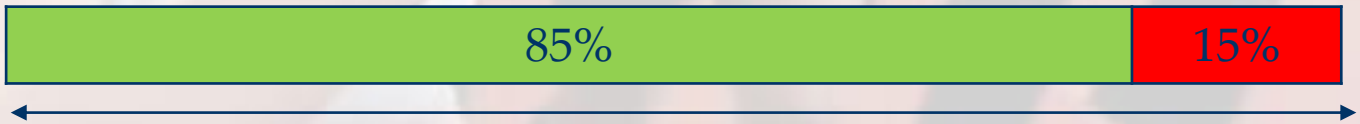
Percentage increase

- Really important in science. Regularly assessed.
- In maths more able students are encouraged to use % multipliers.

Increase by 10%

$110\% = \frac{110}{100} = 1.1$ Percentage multiplier is 1.1

Decrease by 15%



$85\% = \frac{85}{100} = 0.85$ Percentage multiplier is 0.85

5. A coarse particle has a diameter of 1×10^{-6} m.
A nanoparticle has a diameter of 1.6×10^{-9} m.
Calculate how many times bigger the diameter of the coarse particle is than the diameter of the nanoparticle.

[2 marks]

5. During an experiment, a scientist notices that the number of bacteria halves every second.

There were $2{\cdot}3 \times 10^{30}$ bacteria at the start of the experiment.

Calculate how many bacteria were left after 5 seconds.

Give your answer in standard form correct to two significant figures.

[2 marks]

Maths & Science - Answers

5. A coarse particle has a diameter of 1×10^{-6} m.
A nanoparticle has a diameter of 1.6×10^{-9} m.
Calculate how many times bigger the diameter of the coarse particle is than the diameter of the nanoparticle.

$$\frac{1 \times 10^{-6}}{1.6 \times 10^{-9}} = 625$$

[2 marks]

5. During an experiment, a scientist notices that the number of bacteria halves every second.

There were $2{\cdot}3 \times 10^{30}$ bacteria at the start of the experiment.

Calculate how many bacteria were left after 5 seconds.

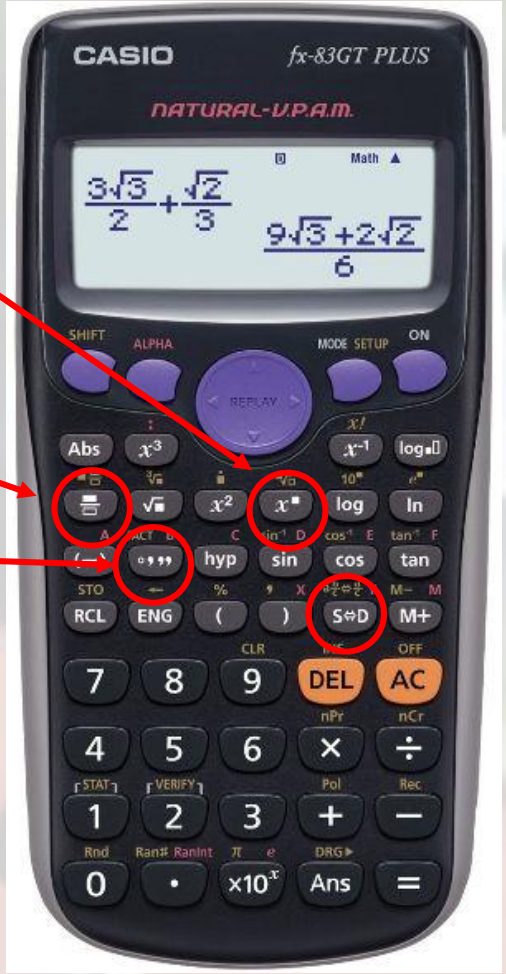
Give your answer in standard form correct to two significant figures.

$2{\cdot}3 \times 10^{30} \times 2^5 = 7.36 \times 10^{31} = 7.4 \times 10^{31}$ *to* $2sf$

[2 marks]

Standard form

- Students should use the power key when inputting numbers in standard form into their calculators.
- The fraction key is also useful.
- S-D key
- ° ’ ” key for time



- The calculation on the calculator should look exactly the same as the calculation on the exam paper.

6. Figure 15 shows how the velocity of the train changes with time as the train travels along a straight section of the journey.

Estimate the distance travelled by the train along the section of the journey shown in Figure 15.
To gain full marks you must show how you worked out your answer.

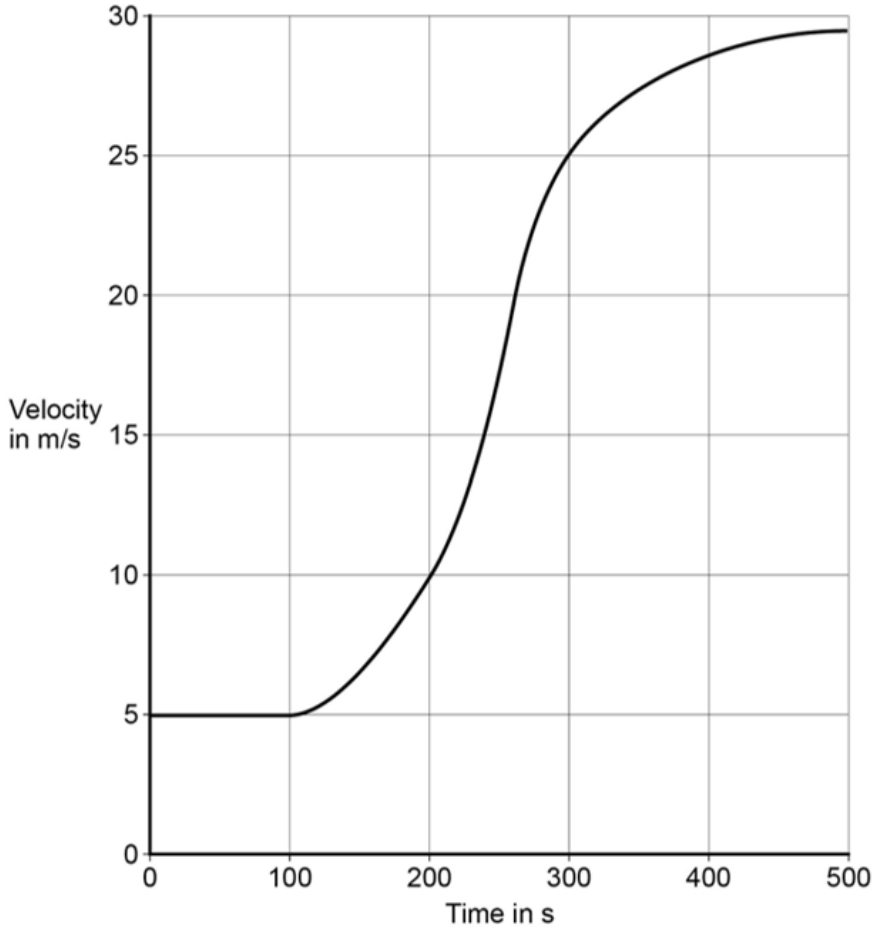


Figure 15

[3 marks]

Science - Answers

6. Figure 15 shows how the velocity of the train changes with time as the train travels along a straight section of the journey.

Estimate the distance travelled by the train along the section of the journey shown in Figure 15.
To gain full marks you must show how you worked out your answer.

Number of squares below the curve = 17

Distance = 17 ×500 = 8500m

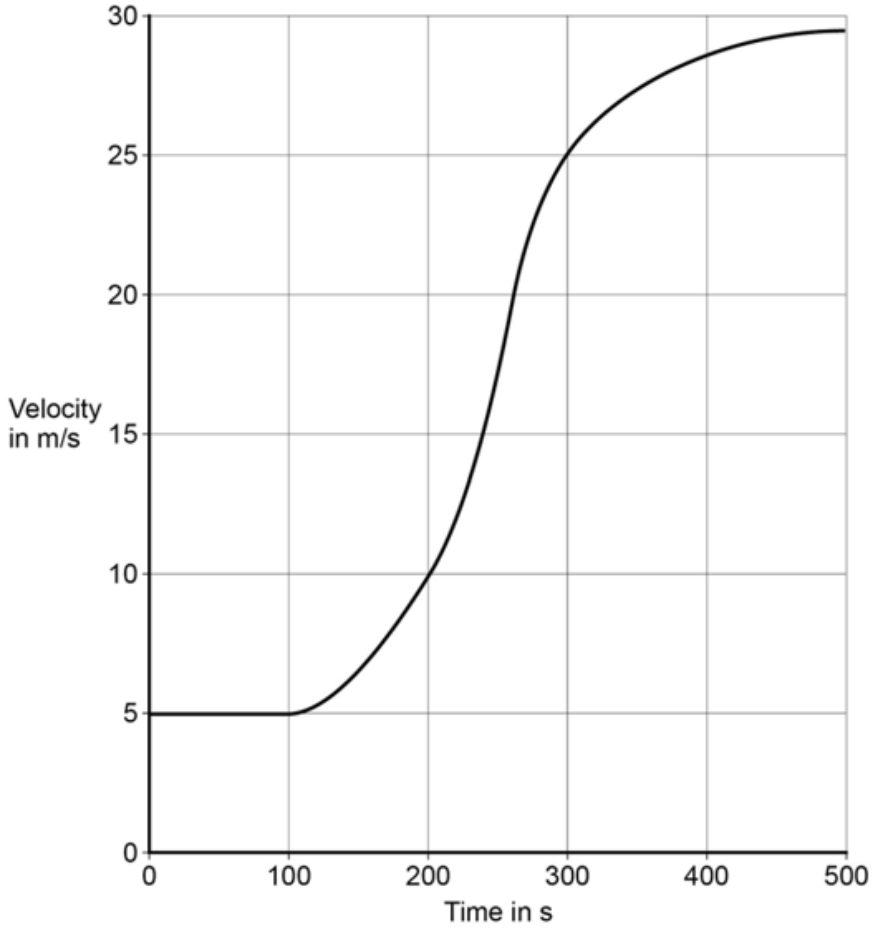
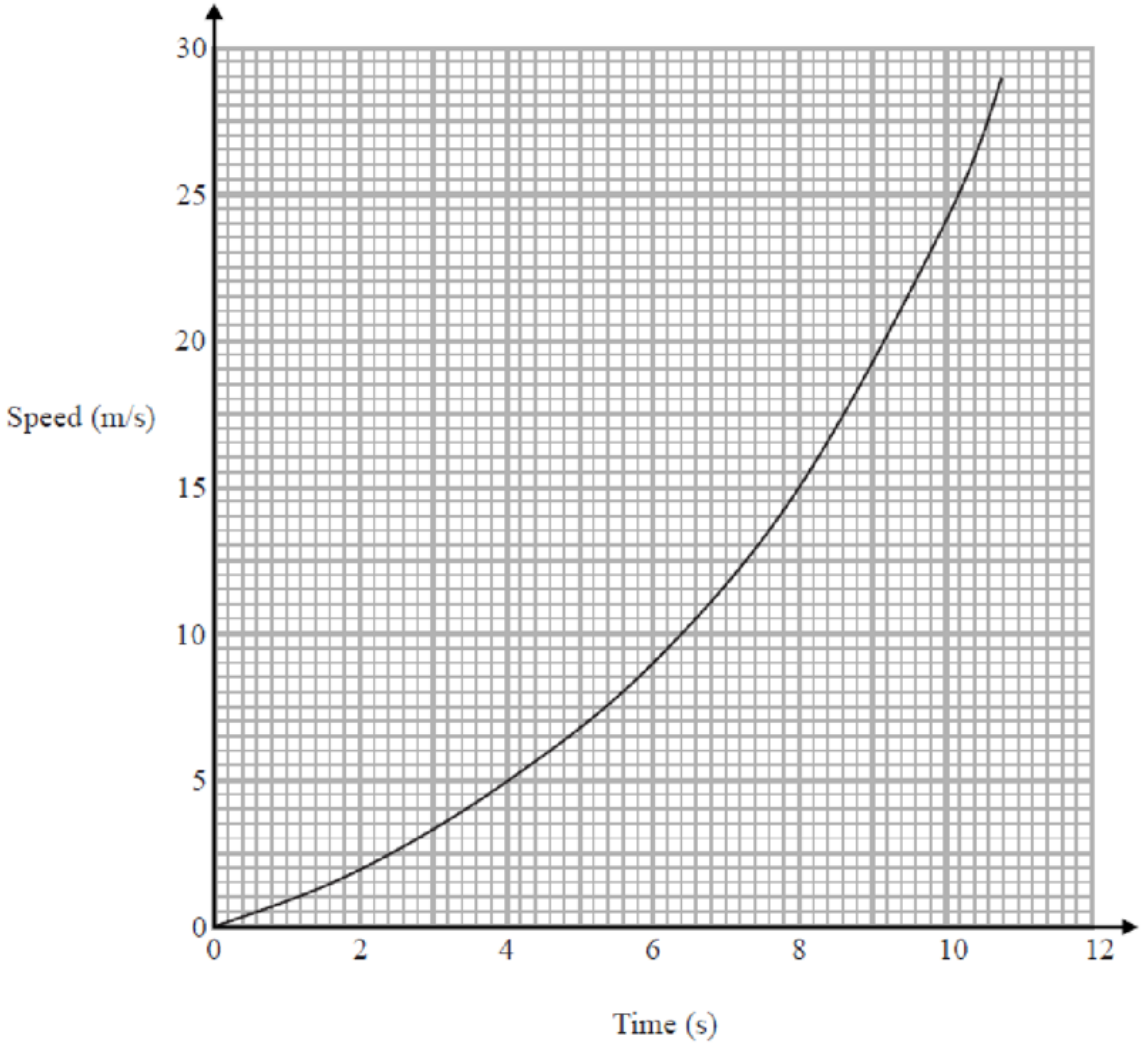


Figure 15

[3 marks]

Maths

6. Here is a speed-time graph for a car.



a) Work out an estimate for the distance the car travelled in the first 10 seconds.
Use 5 strips of equal width.

.....m

[3 marks]

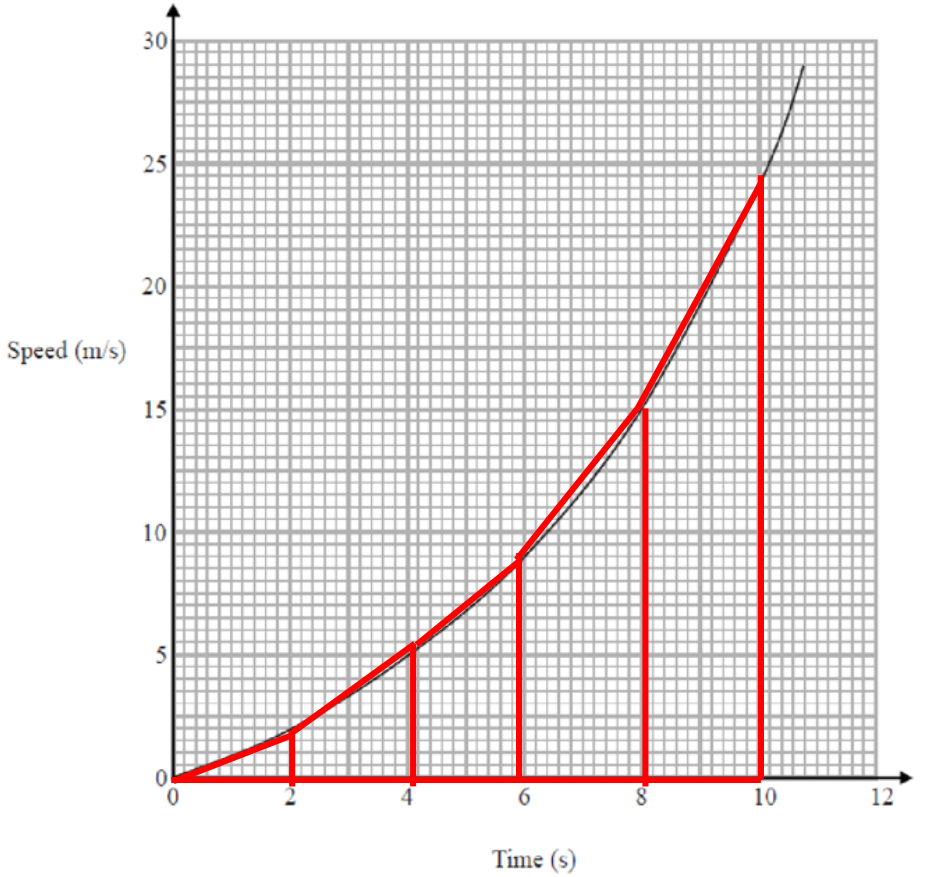
b) Is your answer to (a) an underestimate or an overestimate of the actual distance?

Give a reason for your answer.

[1 mark]

Maths - Answers

6. Here is a speed-time graph for a car.



a) Work out an estimate for the distance the car travelled in the first 10 seconds.
Use 5 strips of equal width.

Trapezium rule

$$\frac{1}{2} \times height \times (ends + 2 \times middles)$$

$0.5\times 2(0 + 24 + 2 \times (2 + 5 + 9 + 15))$

= 86m

.....m

[3 marks]

b) Is your answer to (a) an underestimate or an overestimate of the actual distance?

Give a reason for your answer.

Overestimate, as each trapezium used to calculate the area is drawn above the curve.

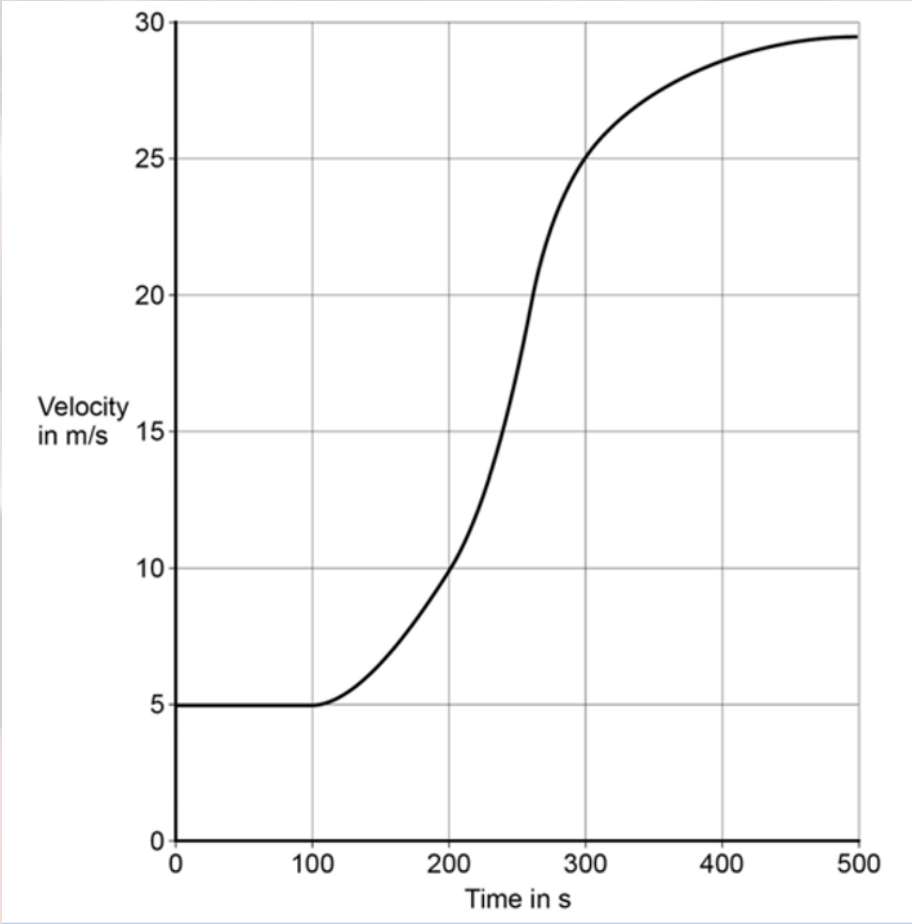
[1 mark]

Velocity/time graphs

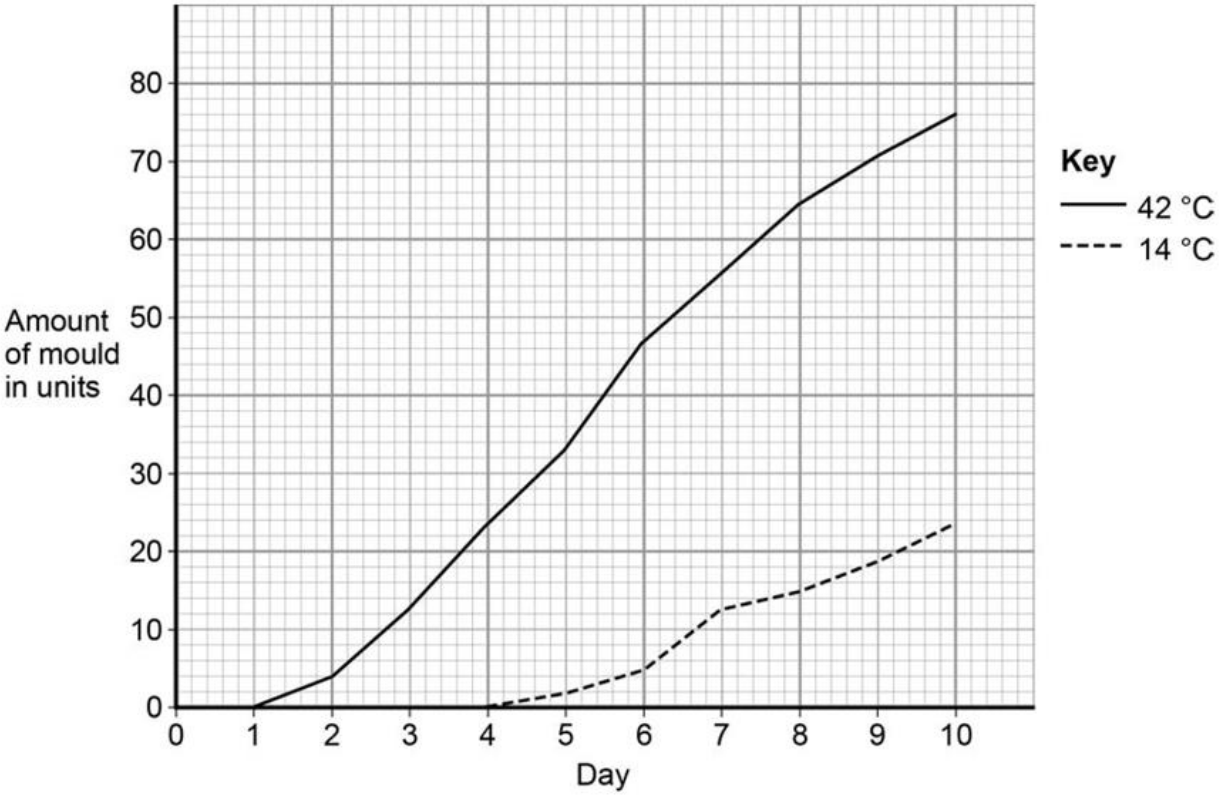
- The distance travelled is the area under the curve.
- Consider the units:

$$\frac{m}{s} \times s = m$$

- Science – count the number of squares
- Maths – students may use the trapezium rule.



7. Determine the rate of mould growth at 42 °C between day 2 and day 7.



Rate of mould growth = ...units per day

[2 marks]

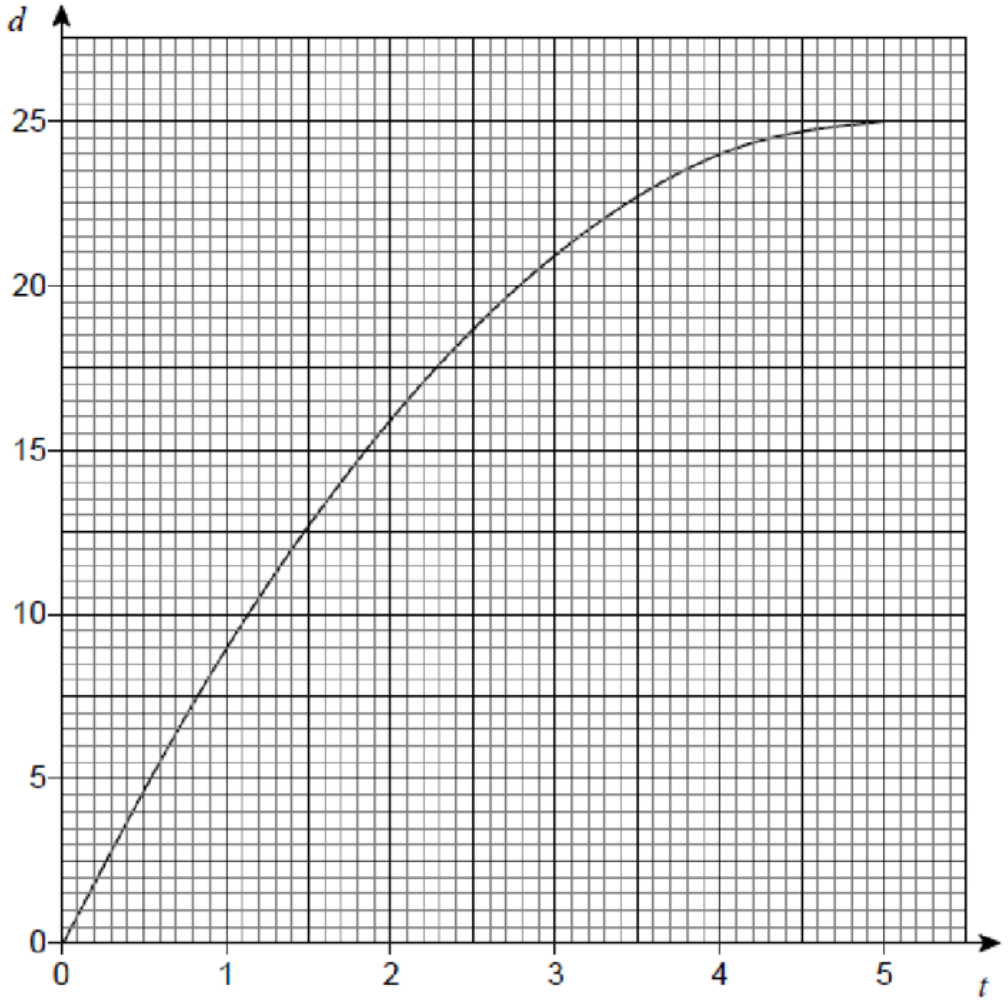
Maths

7. A container is filled with water in 5 seconds.

The graph shows the depth of water, d cm, at time t seconds.

Use the graph to estimate the rate at which the depth of water is increasing at 3 seconds.

You must show your working.



[2 marks]

Science - Answers

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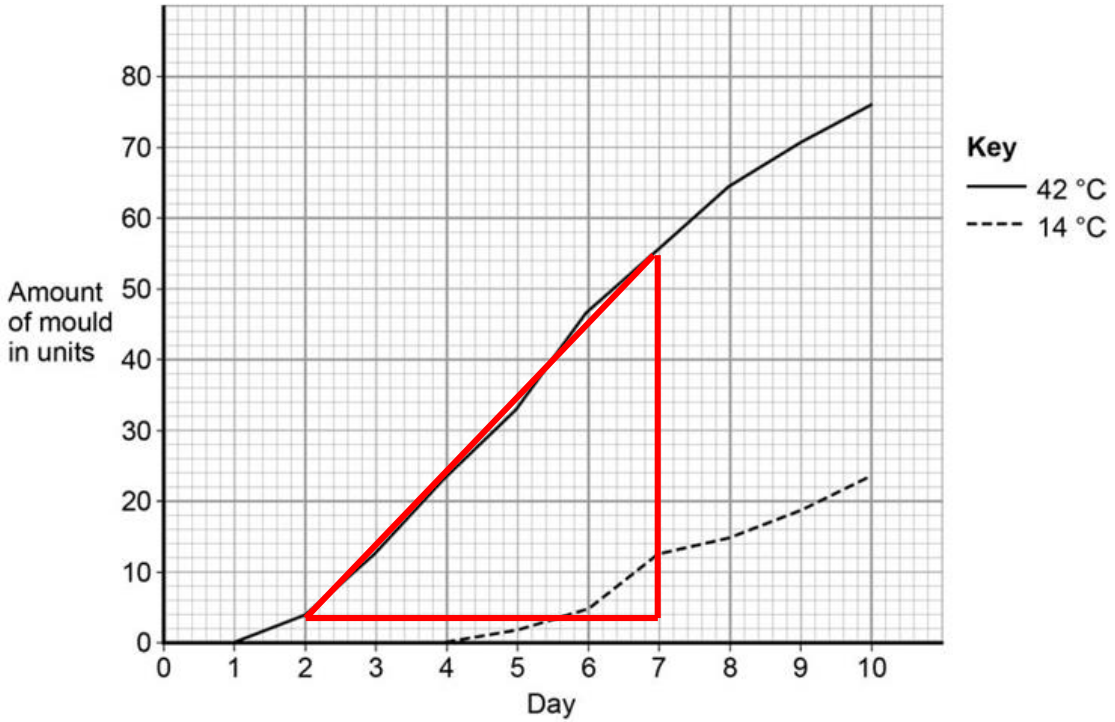

Rate of mould growth = ... $\frac{56-4}{5} = 10.4$ .....units per day

[2 marks]

Maths - Answers

7. A container is filled with water in 5 seconds.

The graph shows the depth of water, d cm, at time t seconds.

Use the graph to estimate the rate at which the depth of water is increasing at 3 seconds.

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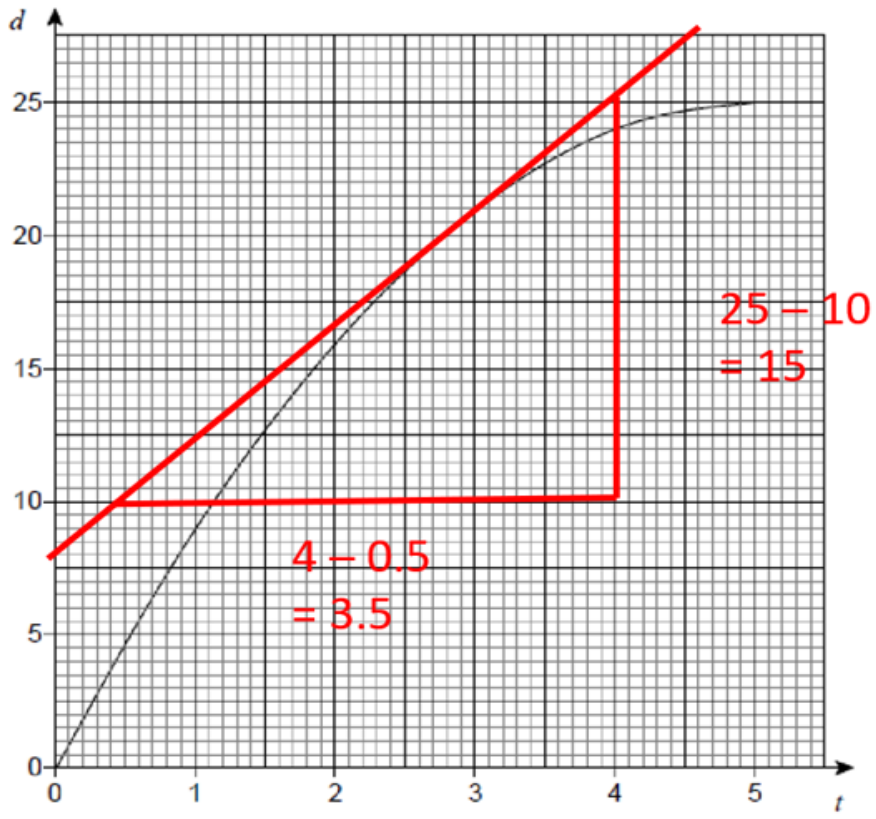


$\frac{15}{3.5} = 4.29\ cm/s$

[3.9-4.5]

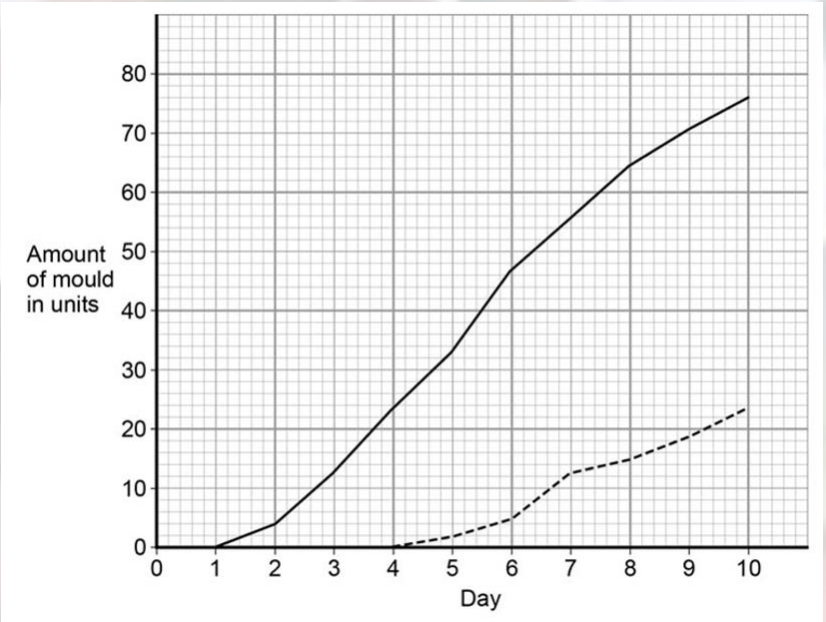
[2 marks]

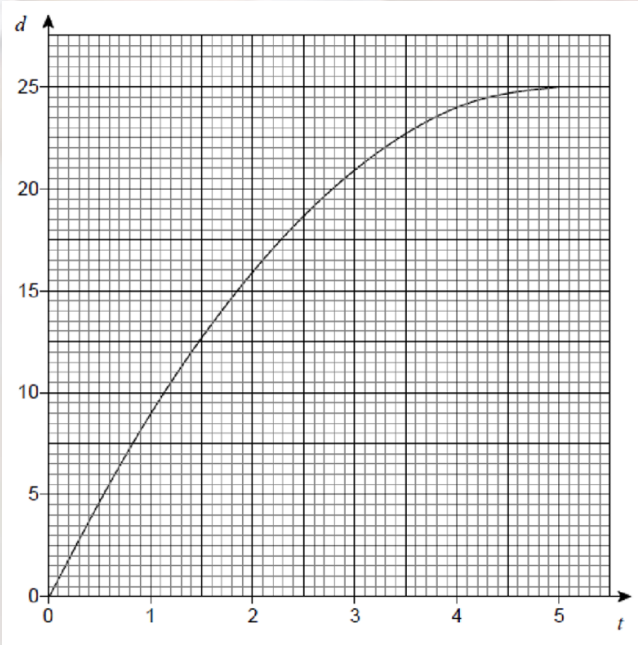
Rates of change

- There is a greater focus on rates of change in the new maths and science GCSE
- Consider the units of the gradient of the tangent

Units of gradient = $\frac{amount\ of\ mould}{day}$

i.e. amount of mould per day





Units of gradient = $\frac{cm}{seconds}$

i.e. change in depth per second

Maths requirements of GCSE Science

Mathematical Skill
1. Arithmetic and numerical computation
a) Recognise and use expressions in decimal form
b) Recognise and use expressions in standard form
c) Use ratios, fractions and percentages
d) Make estimates of the results of simple calculations
2. Handling data
a) Use an appropriate number of significant figures
b) Find arithmetic means
c) Construct and interpret frequency tables and diagrams, bar charts and histograms
d) Understand the principles of sampling as applied to scientific data (biology questions only)
e) Understand simple probability
f) Understand the terms mean, mode and median
g) Use a scatter diagram to identify a correlation between two variables
h) Make order of magnitude calculations
3. Algebra
a) Understand and use the symbols: =, <>, >, ∝ , ~
b) Change the subject of an equation
c) Substitute numerical values into algebraic equations using appropriate units for physical quantities
d) Solve simple algebraic equations
4. Graphs
a) Translate information between graphical and numeric form
b) Understand that y = mx + c represents a linear relationship
c) Plot two variables from experimental or other data
d) Determine the slope and intercept of a linear graph
e) Draw and use the slope of a tangent to a curve as a measure of rate of change
f) Understand the physical significance of area between a curve and the x-axis and measure it by counting squares as appropriate
5. Geometry and trigonometry
a) Use angular measures in degrees
b) Visualise and represent 2D and 3D forms including two dimensional representations of 3D objects
c) Calculate areas of triangles and rectangles, surface areas and volumes of cubes