

Surname <i>StemUp Model Solution</i>	Centre Number	Candidate Number
Other Names		0



GCSE

3310U50-1



A17-3310U50-1

**MATHEMATICS – NUMERACY
UNIT 1: NON-CALCULATOR
HIGHER TIER**

MONDAY, 6 NOVEMBER 2017 – MORNING

1 hour 45 minutes

ADDITIONAL MATERIALS

The use of a calculator is not permitted in this examination.
A ruler, a protractor and a pair of compasses may be required.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen or correction fluid.

You may use a pencil for graphs and diagrams only.

Write your name, centre number and candidate number in the spaces at the top of this page.

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

If you run out of space, use the continuation page at the back of the booklet. Question numbers must be given for all work written on the continuation page.

Take π as 3.14.

INFORMATION FOR CANDIDATES

You should give details of your method of solution when appropriate.

Unless stated, diagrams are not drawn to scale.

Scale drawing solutions will not be acceptable where you are asked to calculate.

The number of marks is given in brackets at the end of each question or part-question.

In question 4(b), the assessment will take into account the quality of your linguistic and mathematical organisation, communication and accuracy in writing.

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1.	7	
2.	6	
3.	9	
4.	12	
5.	5	
6.	4	
7.	8	
8.	8	
9.	7	
10.	6	
11.	8	
Total	80	

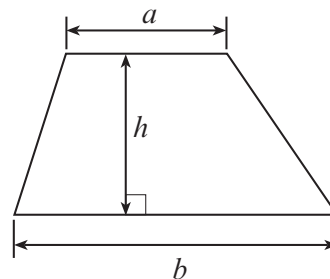
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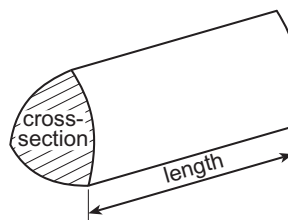
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Formula List - Higher Tier

Area of trapezium $= \frac{1}{2}(a + b)h$

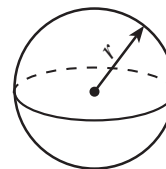


Volume of prism = area of cross-section $\times$ length



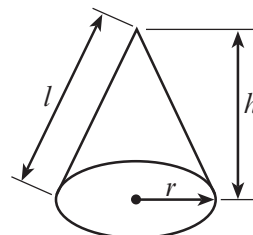
Volume of sphere $= \frac{4}{3}\pi r^3$

Surface area of sphere $= 4\pi r^2$



Volume of cone $= \frac{1}{3}\pi r^2 h$

Curved surface area of cone $= \pi r l$

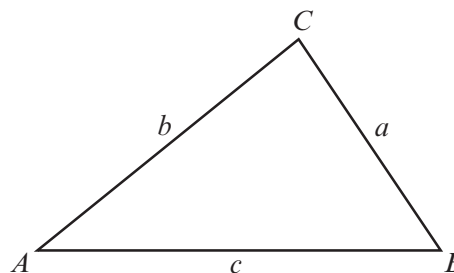


In any triangle ABC

Sine rule $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

Cosine rule $a^2 = b^2 + c^2 - 2bc \cos A$

Area of triangle $= \frac{1}{2}ab \sin C$



The Quadratic Equation

The solutions of $ax^2 + bx + c = 0$ where $a \neq 0$ are given by $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Annual Equivalent Rate (AER)

AER, as a decimal, is calculated using the formula $\left(1 + \frac{i}{n}\right)^n - 1$, where i is the nominal interest rate per annum as a decimal and n is the number of compounding periods per annum.



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1. (a) Ysgol Fron Isa and Ysgol Caewen are two very different high schools. One school is large, and in a rural area. The other is a small school in a town. The town in which the small school is situated has many traffic-free cycle routes.

All of the pupils in Years 7 to 10 were surveyed in both of these schools. They were asked the following questions.

Do you cycle to school?

Yes ☐ No ☐

If you answered 'no', would you like to cycle to school?

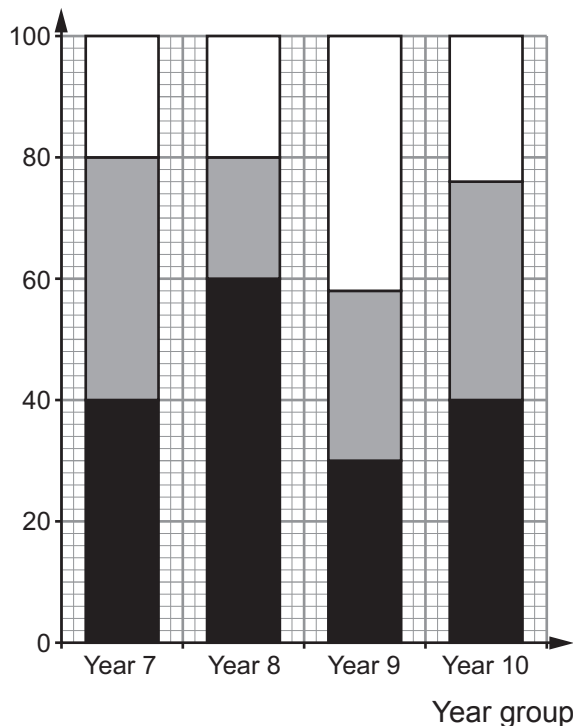
Yes ☐ No ☐

The results were displayed in graphs, as shown below.

Key:  Cycle  Would like to cycle  Others

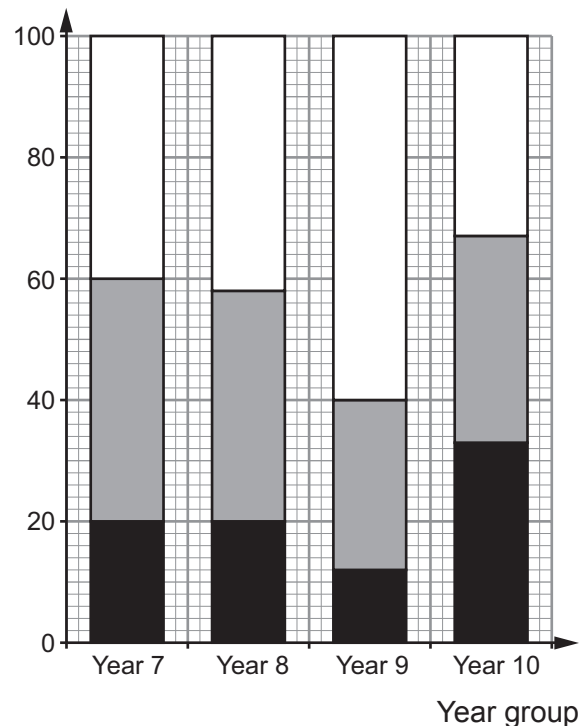
Ysgol Fron Isa

Percentage of pupils



Ysgol Caewen

Percentage of pupils



- (i) Which school and year group has an approximately equal split between the 3 categories:
- pupils who cycle to school,
 - pupils who would like to cycle to school, and
 - other pupils?

[1]

School: *Caewen* Year Group: *10*

- (ii) Circle either TRUE or FALSE for each of the following statements.

[3]

There are definitely more pupils in Ysgol Fron Isa who cycle to school than in Ysgol Caewen.	TRUE	<u>FALSE</u>
Both schools have pupils in each year group with no interest in cycling to school.	<u>TRUE</u>	FALSE
The questions asked were biased.	TRUE	<u>FALSE</u>
Approximately 20% of the pupils surveyed in Ysgol Caewen cycle to school.	<u>TRUE</u>	FALSE
It is more likely that it is Ysgol Fron Isa that is the small school situated in a town.	<u>TRUE</u>	FALSE

- (b) In January 2011, there were 1200 miles of National Cycle Network (NCN) routes in Wales. In January 2016, there were 1400 miles of NCN routes in Wales.

- (i) If the number of miles of NCN routes in Wales were to continue to increase by the same number of miles per year, how many miles of cycle routes would there be in January 2018? [2]

Increase from 2011 to 2016 = $1400 - 1200 = 200$ miles

Increase per year = $200 \div 5 = 40$ miles

January 2016 to January 2018 is 2 years: $2 \times 40 = 80$ miles

Miles in January 2018 = $1400 + 80 = 1480$ miles

Answer: 1480 miles

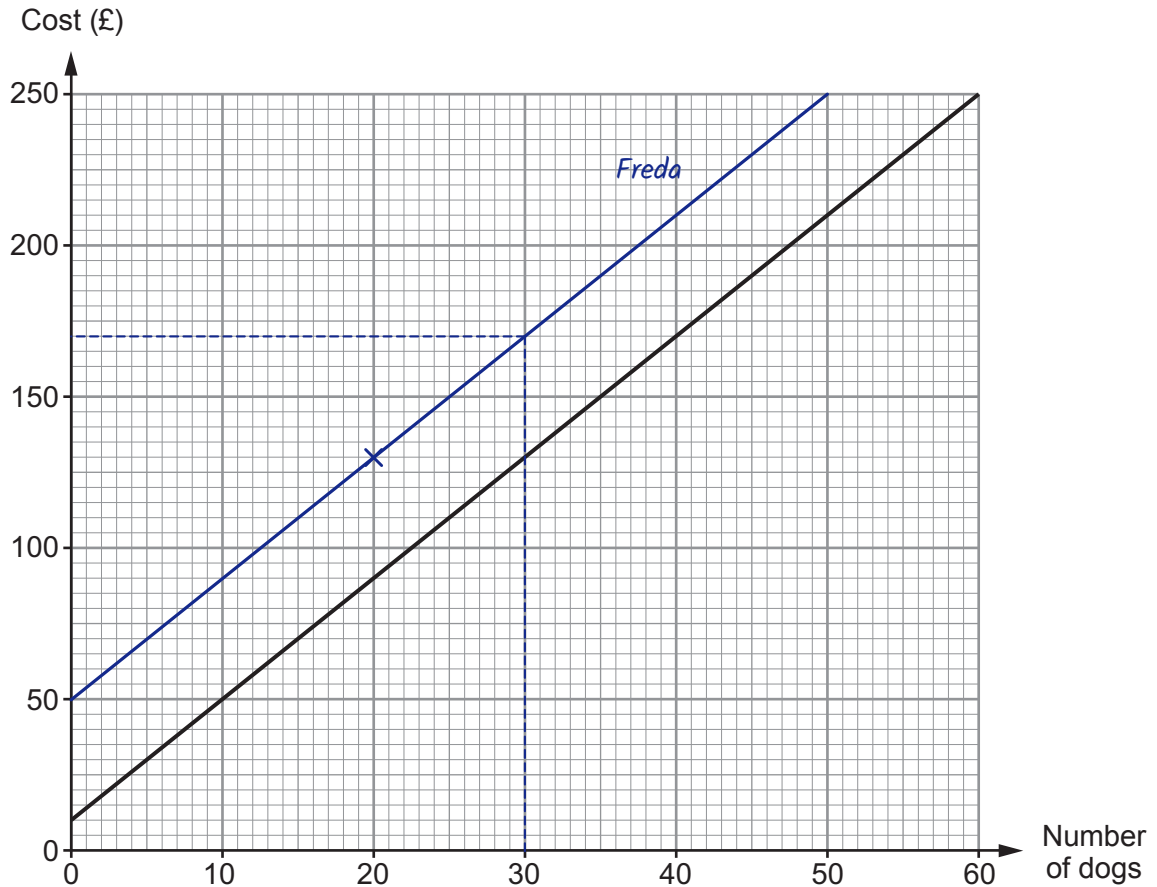
- (ii) Why is your answer in (i) unlikely to be an accurate estimate of the number of miles of NCN routes in Wales in January 2018? [1]

The routes are unlikely to increase by the same number of

miles every year; the increase can vary from year to year.



2. William owns and runs dog kennels.
His costs depend on the number of dogs in the kennels.
The running costs for one day are shown on the graph below.



- (a) Why does the graph not pass through (0, 0)?

[1]

There are fixed costs (e.g. rent, electricity and bills) that

William still has to pay even when there are no dogs.



- (b) What is the increase in the daily running costs for each additional dog that is kept in the kennels? [2]

Gradient = change in cost $\div$ change in number of dogs

$$= (£250 - £50) \div (60 - 10)$$

$$= £200 \div 50 = £4$$

Increase in daily running cost = £4 for each extra dog

- (c) (i) Freda also runs a dog kennels.
The cost of keeping 20 dogs in her kennels for one day is £130.
She knows that as the number of dogs increases, the overall cost increases at the same rate as in William's kennels.

Display this information on the graph paper opposite.

[2]

Line through (20 dogs, £130) parallel to William's line:

$$\text{at 0 dogs: } £130 - 20 \times £4 = £50$$

$$\text{at 50 dogs: } £130 + 30 \times £4 = £250$$

Line drawn from (0, £50) to (50, £250) on the graph.

- (ii) Find the cost of keeping 30 dogs for one day in Freda's kennels.

[1]

£ 170



3.



Meirion's Window Cleaning Business

No job too small!

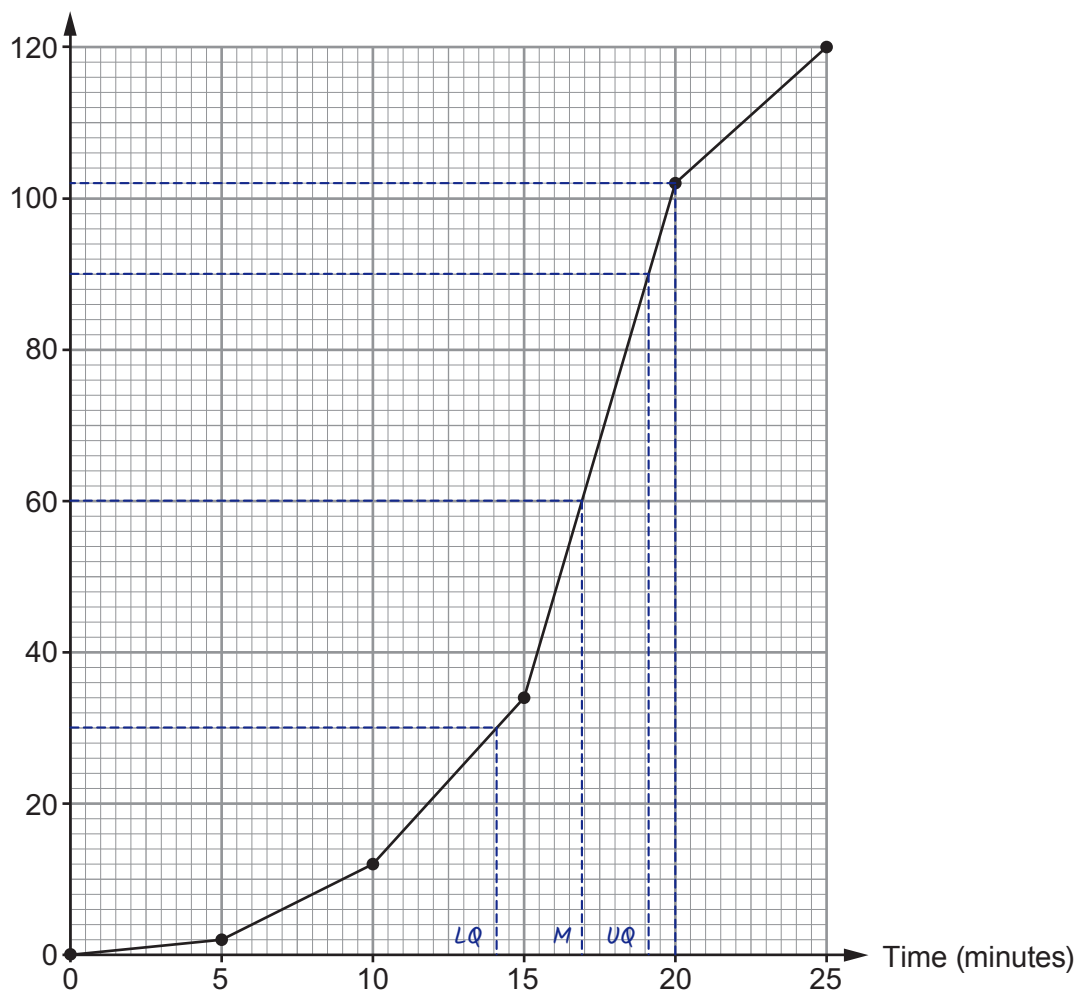
Email: meirion@mwcb.cymru

Meirion is a window cleaner.

From Monday to Friday, he records how long he spends cleaning windows for each of his customers.

He draws a cumulative frequency diagram to display the findings.

Cumulative frequency



- (a) (i) Use Meirion's cumulative frequency diagram to find the median and interquartile range of the times he spends cleaning windows for each of his customers. [3]

Median 16.9 minutes

Median = 60th value. UQ (90th) = 19.1, LQ (30th) = 14.1, $19.1 - 14.1 = 5$

Interquartile range 5 minutes

- (ii) Meirion looks back at his raw data.
He finds that the median is actually 17 minutes 30 seconds.
Why is there a difference between the median from his cumulative frequency diagram and the actual median from his raw data? [1]

The diagram is drawn from grouped data with the points joined by straight lines, so the median read from it is only an estimate; the raw data gives the exact median.

- (b) Meirion is looking at the time it took to clean individual customers' windows.
Find the number of customers whose windows took between 10 and 15 minutes to clean. [2]

Customers taking up to 15 minutes = 34, up to 10 minutes = 12

Number taking between 10 and 15 minutes = $34 - 12 = 22$ customers

- (c) Meirion thinks that for approximately 80% of his customers, he cleaned their windows in less than 20 minutes.
Is Meirion correct?
You must show all your working. [3]

Total customers = 120. 80% of 120 = $0.8 \times 120 = 96$ customers

From the graph, 102 customers took less than 20 minutes.

Percentage = $102 \div 120 \times 100 = 17/20 \times 100 = 85\%$

(96 customers would be reached at about 19.6 minutes.)

85% is approximately 80% (102 is close to 96).

So yes, Meirion is correct: about 80% of his customers had their windows cleaned in less than 20 minutes.



4. Megan Pugh's electricity bill is shown below.
It covers the period May, June and July 2017.

Megan Pugh
203 Stryd Bryntor
Maesgwyn

Period	Previous meter reading	Present meter reading	Number of units of electricity used
May, June and July 2017	13450	13900	450

Charge for electricity: 450 units at 20p per unit	£90.00
Standing charge: 3 months at £7.60 per month	£22.80
Total charges:	£112.80

VAT at 5%: 5% of £112.80	£5.64
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Amount to pay: £112.80 + £5.64 = £118.44

- (a) On 1 August 2017, the charge per unit for electricity was increased by 5%.
What is the increased cost per unit of electricity?
Circle your answer.

[1]

20.5p 21p 21.5p 22p 22.5p

5% of 20p = 1p, so new cost = 20p + 1p = 21p

- (b) *In this part of the question you will be assessed on the quality of your organisation, communication and accuracy in writing.*

Megan wants to calculate her next 3-monthly electricity bill.
She knows the following:

- Her meter reading on 31 October 2017 was 14400.
- The charge per unit for electricity has increased by 5% since her last bill.
- The standing charge has increased by 20p **per month** since her last bill.
- VAT remains at 5%.

On 31 October 2017, Megan had £470 in her bank account.

After paying her next 3-monthly electricity bill, will Megan be able to buy a new washing machine costing £330?

You must show all your working.

[9 + 2 OCW]



Number of units used = $14400 - 13900 = 500$ units

New charge per unit = $20p + 5\% \text{ of } 20p = 20p + 1p = 21p$

Charge for electricity = $500 \times 21p = 10500p = £105.00$

New standing charge = $£7.60 + £0.20 = £7.80$ per month

Standing charge for 3 months = $3 \times £7.80 = £23.40$

Total charges = $£105.00 + £23.40 = £128.40$

VAT at 5%: $10\% \text{ of } £128.40 = £12.84$, so $5\% = £12.84 \div 2 = £6.42$

Amount to pay = $£128.40 + £6.42 = £134.82$

Money in the bank after paying the bill:

$£470.00 - £134.82 = £335.18$

The washing machine costs £330, and $£335.18 > £330$.

Money left after buying the washing machine:

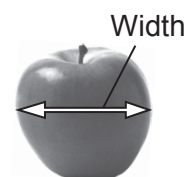
$£335.18 - £330.00 = £5.18$

Conclusion: Yes, Megan will be able to buy the washing machine.

Her next electricity bill will be £134.82, which leaves her with £335.18. This is enough for the £330 washing machine, and she will still have £5.18 left in her bank account.

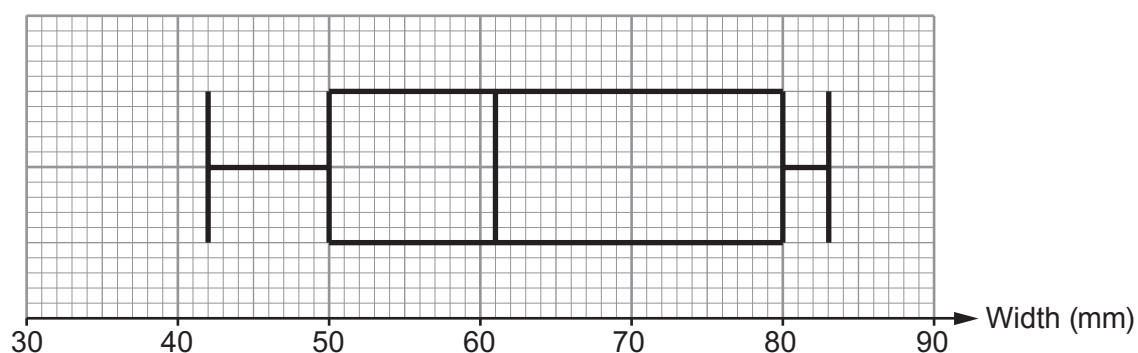


5. Lena has three apple trees in her garden. She has one Gala apple tree, one Orange Pippin tree and one Pink Lady tree. She picks 50 apples from each of the 3 trees. She records the width of each apple, as shown.

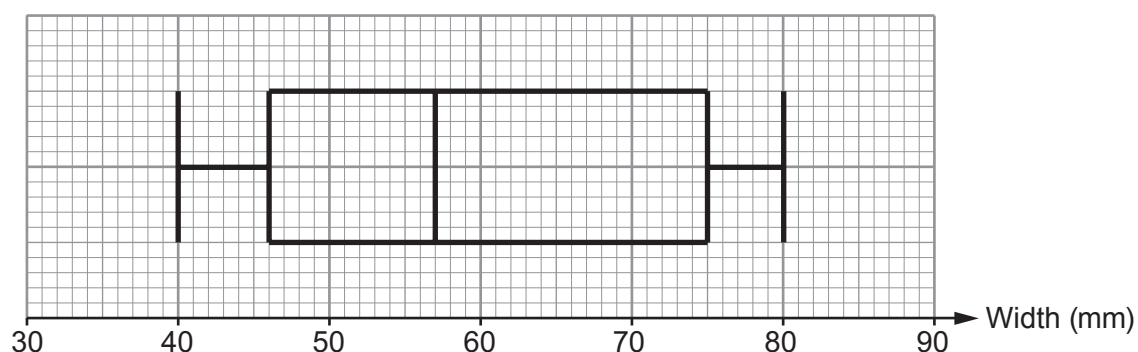


Lena constructs box and whisker diagrams for the widths of the apples collected from each of the three trees.

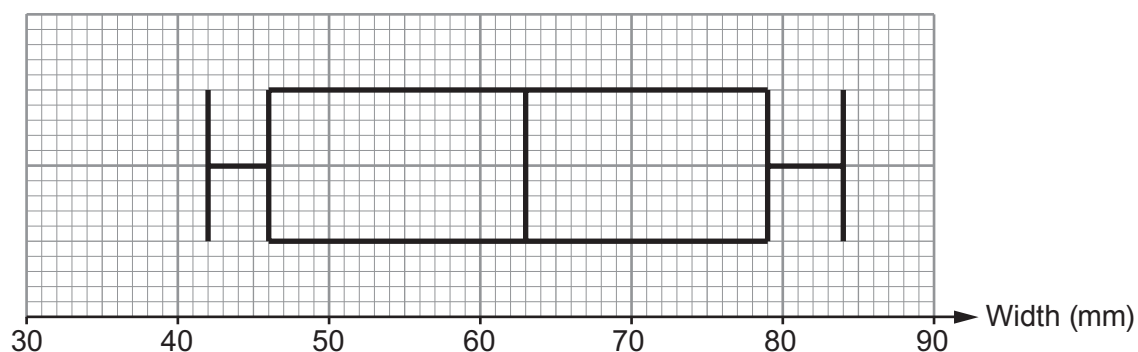
Gala apple tree



Orange Pippin apple tree



Pink Lady apple tree



(a) Complete each of the following statements.

- (i) 'Apples from the Orange Pippin apple tree have the least median width.

The median width of apples recorded for this tree is 57 mm.' [1]

- (ii) 'The range of the widths of apples recorded for the Gala apple tree is 41 mm.'

[1]

$$\text{Range} = 83 - 42 = 41 \text{ mm}$$

- (iii) 'The Pink Lady apple tree has apples with the greatest interquartile range of widths.

The interquartile range of the widths of apples recorded for this tree is 33 mm.'

[2]

$$\text{IQRs: Gala } 80 - 50 = 30, \text{ Orange Pippin } 75 - 46 = 29,$$

$$\text{Pink Lady } 79 - 46 = 33 \text{ mm (greatest)}$$

- (b) Which tree has a higher proportion of larger apples?
You must give a reason for your answer.

[1]

Gala, because it has the highest upper quartile (80 mm), so

25% of its apples are wider than 80 mm, more than the other trees.



6. Daniel has made a pizza to share with some friends.

After he has taken his share, he calculates that he has $0.8\dot{3}$ of the pizza left.
Daniel shares what he has left equally between 3 of his friends.
Calculate the fraction of the whole pizza that each of these 3 friends will have.
Give your answer as a fraction in its lowest terms.

[4]

$$\text{Let } x = 0.8333\ldots$$

$$10x = 8.333\ldots$$

$$100x = 83.333\ldots$$

$$100x - 10x = 83.333\ldots - 8.333\ldots \quad \text{so} \quad 90x = 75$$

$$x = \frac{75}{90} = \frac{5}{6}$$

$$\text{Each friend gets } \frac{5}{6} \div 3 = \frac{5}{6} \times \frac{1}{3} = \frac{5}{18}$$

$$\text{Each friend has } \frac{5}{18} \text{ of the whole pizza.}$$

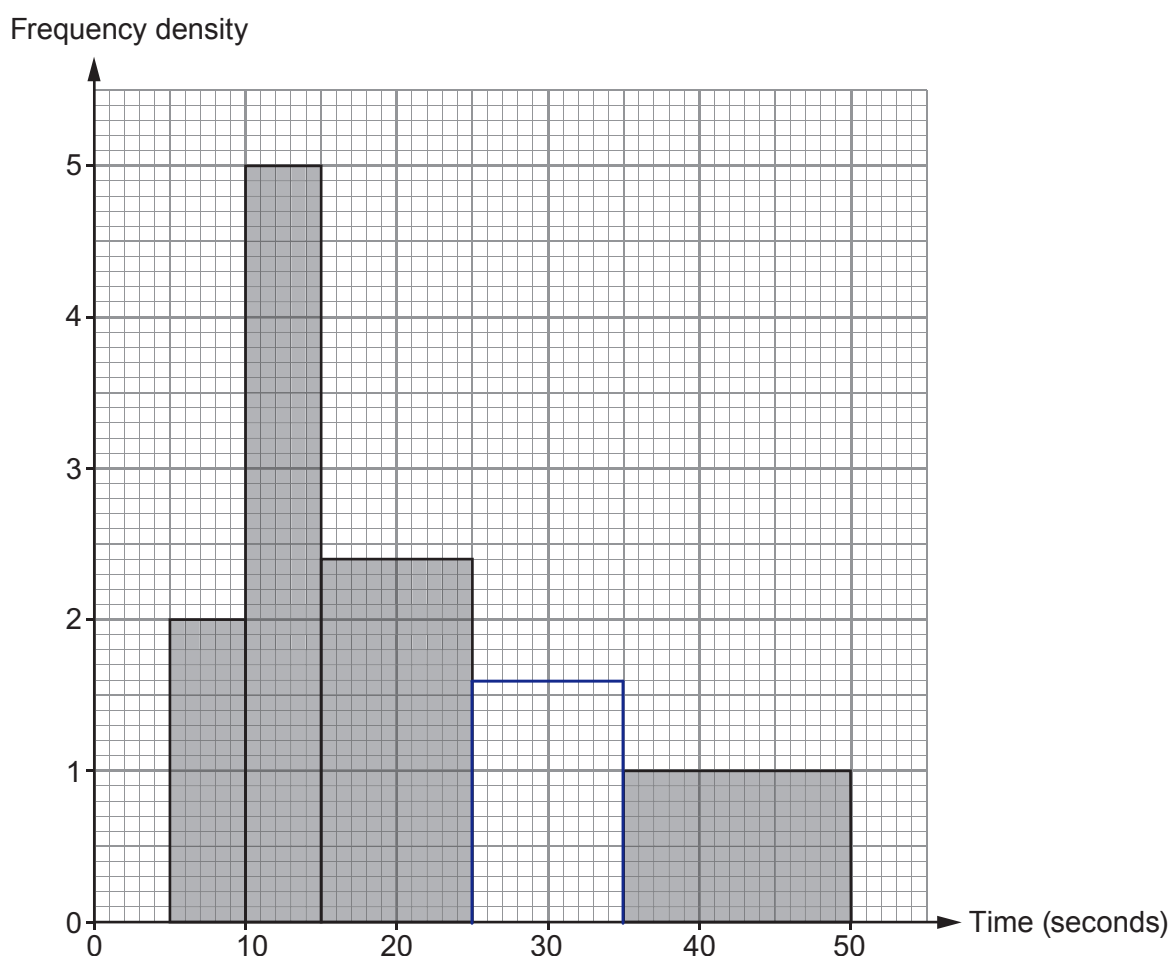


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7. The times taken by a group of pupils to answer a numeracy question were recorded. The histogram below shows some of the results.



- (a) The remaining 16 pupils took between 25 and 35 seconds to answer the question. Complete the histogram. [1]

$$\text{Frequency density} = 16 \div 10 = 1.6$$

- (b) What is the greatest possible range of times taken by the pupils to answer the question? Circle your answer. [1]

50 seconds 4 seconds 40 seconds 45 seconds 35 seconds

$$\text{Greatest range} = 50 - 5 = 45 \text{ seconds}$$



- (c) Calculate the total number of pupils that were in the group.

[2]

5 to 10 s: $5 \times 2 = 10$, 10 to 15 s: $5 \times 5 = 25$,

15 to 25 s: $10 \times 2.4 = 24$, 25 to 35 s: 16, 35 to 50 s: $15 \times 1 = 15$

Total = $10 + 25 + 24 + 16 + 15 = 90$ pupils

Answer: 90 pupils

- (d) Gareth was one of the pupils in the group.
He says,

"The time I took to answer the question was 18 seconds. This means I was in the fastest 50% of the pupils."

- (i) Explain how Gareth's statement could be true.
You must use calculations to justify your answer.

[3]

Half of the pupils = 50% of 90 = 45 pupils

Pupils taking up to 15 s = $10 + 25 = 35$

15 to 18 s is $3/10$ of the 15 to 25 s group: $3/10 \times 24 = 7.2$

Pupils taking up to 18 s $\approx 35 + 7.2 = 42.2$, about 42 pupils

So Gareth was about the 42nd fastest pupil, and $42 < 45$.

If the times in the 15 to 25 s group are spread evenly, Gareth

is in the fastest 50% of the pupils, so his statement is true.

- (ii) Explain how Gareth's statement could be false.

[1]

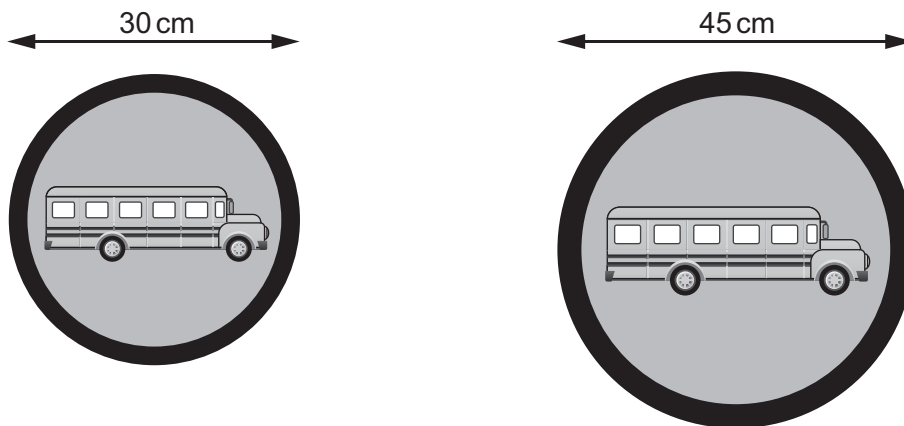
The 24 times in the 15 to 25 s group may not be spread evenly.

If more than 10 of them took less than 18 s, Gareth would be

slower than the 45th pupil, so not in the fastest 50%.



8. A company produces two **similar** road signs.



Diagrams not drawn to scale

- (a) The cost of the paint needed for the smaller road sign is £1.60.
Calculate the cost of the paint needed for the larger sign.

[4]

$$\text{Length scale factor} = 45 \div 30 = \frac{3}{2} = 1.5$$

$$\text{Area scale factor} = \left(\frac{3}{2}\right)^2 = \frac{9}{4} = 2.25$$

$$\text{Cost of paint for larger sign} = £1.60 \times \frac{9}{4}$$

$$= £1.60 \div 4 \times 9 = £0.40 \times 9 = £3.60$$

$$\text{Cost of paint for the larger sign} = £3.60$$



- (b) The selling price of the smaller road sign is £12.00.
This selling price was calculated from the cost price by:
- adding a profit of 25%,
 - then adding VAT at 20%.

Calculate the cost price of the smaller road sign.
You must show all your working.

[4]

$$\text{Selling price} = \text{cost price} \times 1.25 \times 1.20$$

Remove the VAT first (120% = £12.00):

$$£12.00 \div 1.2 = £10.00 \quad (10\% = £1.00, \text{ so } 100\% = £10.00)$$

$$\text{Price before VAT} = £10.00$$

Remove the 25% profit (125% = £10.00):

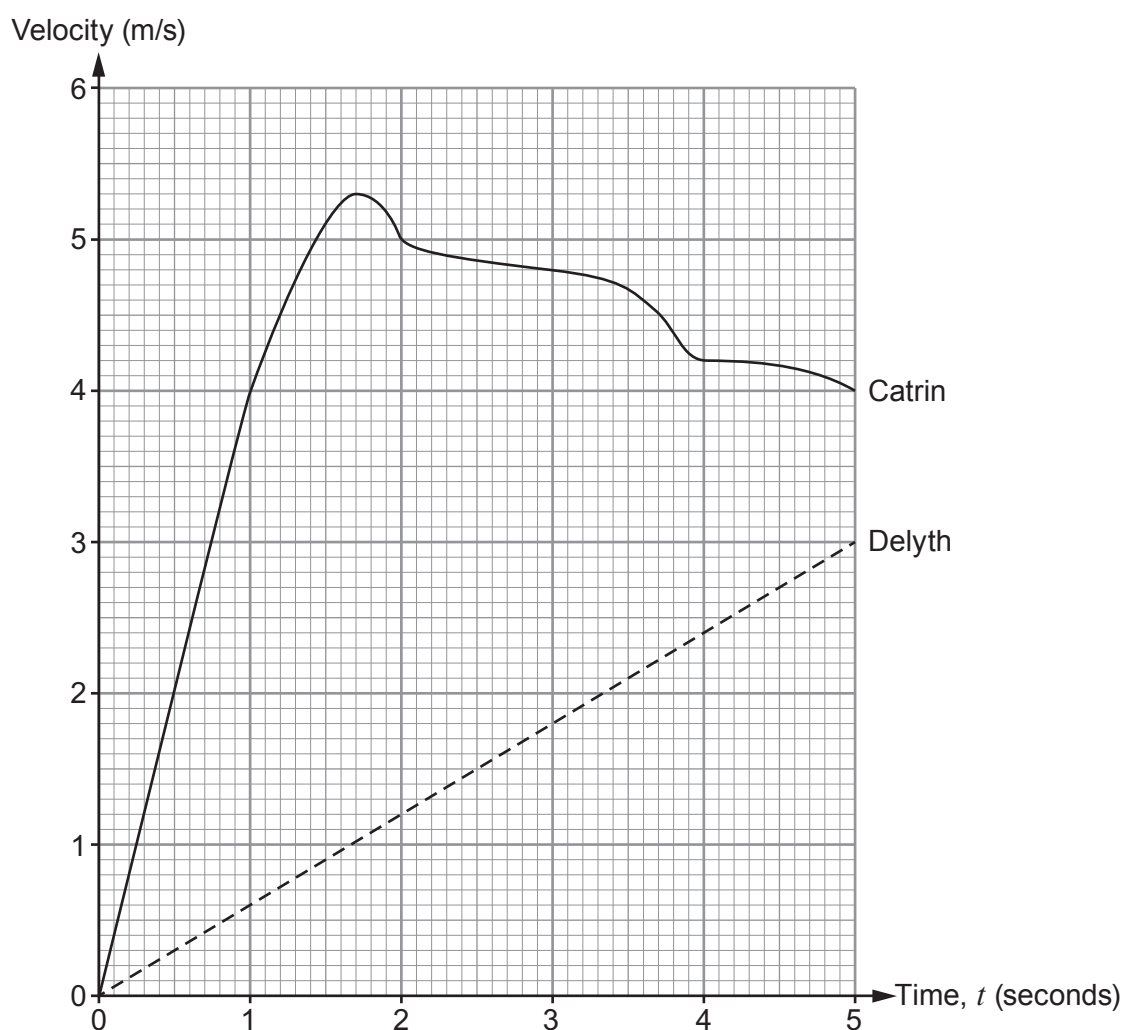
$$£10.00 \div 1.25 = £8.00 \quad (25\% = £2.00, \text{ so } 100\% = £8.00)$$

$$\text{Cost price of the smaller road sign} = £8.00$$

$$\text{Check: } £8.00 + 25\% = £10.00, \quad £10.00 + 20\% = £12.00$$



9. Two runners, Catrin and Delyth, start a race at the same time. The velocity-time graph shows their velocities over the first 5 seconds of the race.



- (a) After the start of the race, what was the earliest time that Catrin's acceleration was 0 m/s^2 ? [1]

At about 1.7 seconds (the top of the curve, where the gradient is 0)



- (b) Use the trapezium rule to calculate an estimate of the distance Catrin travelled in the first 5 seconds of the race.
Use Catrin's velocities at times $t = 0$, $t = 1$, $t = 2$, $t = 3$, $t = 4$ and $t = 5$.
You must show all your working. [3]

Catrin's velocities: $t = 0, 1, 2, 3, 4, 5$ gives $v = 0, 4, 5, 4.8, 4.2, 4$

Strip width $h = 1$

Distance $\approx \frac{1}{2} \times h \times [\text{first} + \text{last} + 2 \times (\text{sum of the others})]$

$= \frac{1}{2} \times 1 \times [0 + 4 + 2(4 + 5 + 4.8 + 4.2)]$

$= \frac{1}{2} \times [4 + 2 \times 18]$

$= \frac{1}{2} \times 40 = 20$

Distance Catrin travelled ≈ 20 m

- (c) (i) Calculate an estimate of how far Catrin was ahead of Delyth after 5 seconds. [2]

Delyth: distance = area of triangle = $\frac{1}{2} \times 5 \times 3 = 7.5$ m

Catrin was ahead by $20 - 7.5 = 12.5$ m

Answer: 12.5 m

- (ii) Explain why your answer to (c) (i) is an underestimate. [1]

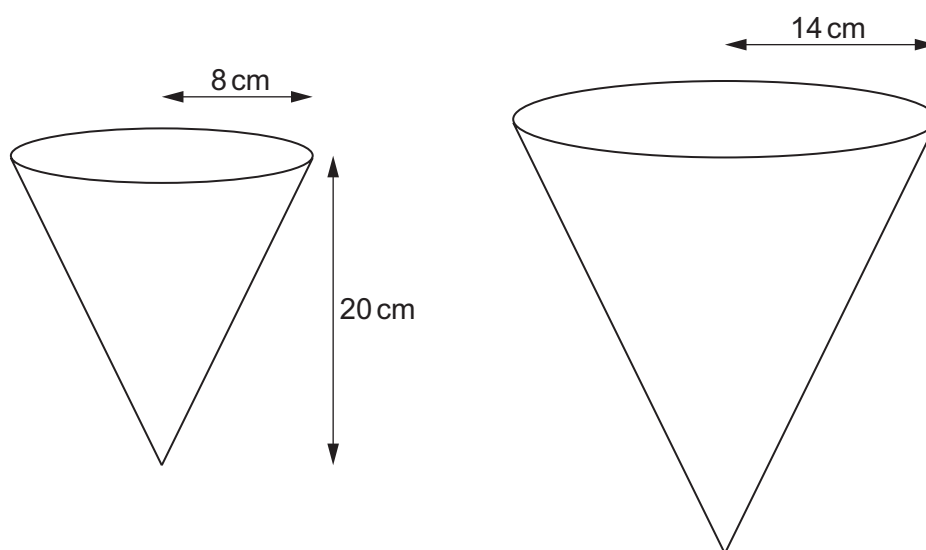
Catrin's curve lies above the tops of the trapeziums, so the

trapeziums underestimate her distance; Delyth's distance

(a straight line) is exact, so the gap is underestimated.



10. The diagram below shows two **similar** flasks for measuring liquid.



Diagrams not drawn to scale

The flasks are in the shape of cones.

The smaller flask has a base radius of 8 cm and a vertical height of 20 cm.

The larger flask has a base radius of 14 cm.

- (a) Calculate the vertical height of the larger flask.

[2]

Similar cones: height $\div$ radius is the same for both

Smaller flask: $20 \div 8 = 2.5$

Height of larger flask = $14 \times 2.5 = 35$

Vertical height of the larger flask = 35 cm



- (b) The larger flask is now partly filled with liquid up to a vertical height of 15 cm.

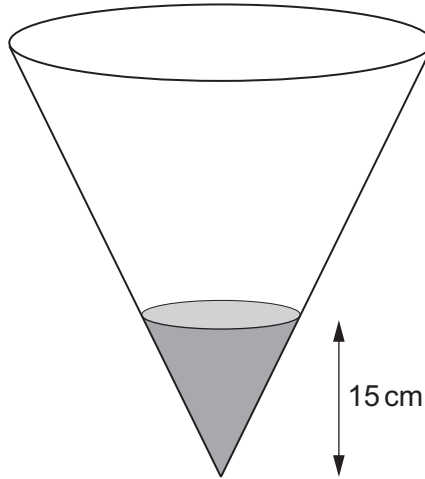


Diagram not drawn to scale

Calculate the volume of liquid in the flask.
Give your answer in terms of π .

[4]

The liquid is a cone similar to the flask (height 35 cm, radius 14 cm).

$$\text{Radius of liquid} = 15 \times 14 \div 35 = 15 \times 0.4 = 6 \text{ cm}$$

$$\text{Volume of cone} = \frac{1}{3}\pi r^2 h$$

$$\text{Volume of liquid} = \frac{1}{3} \times \pi \times 6^2 \times 15$$

$$= \frac{1}{3} \times \pi \times 36 \times 15$$

$$= \pi \times 12 \times 15 = 180\pi$$

$$\text{Volume of liquid} = 180\pi \text{ cm}^3$$



11. A company is building a new headquarters.
The diagram below shows the ground plan of the new headquarters.

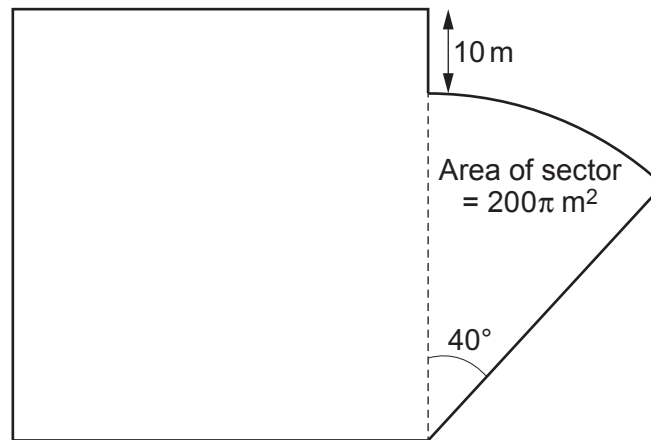


Diagram not drawn to scale

The plan consists of a square and a sector of a circle.

- (a) Using the information given in the diagram, calculate the radius of the sector of the circle.

Give your answer in the form $a\sqrt{b}$, where a is an integer and b is a prime number. [5]

$$\text{Area of sector} = \frac{40}{360} \times \pi \times r^2$$

$$200\pi = \frac{40}{360} \times \pi \times r^2 = \frac{1}{9} \pi r^2$$

$$r^2 = 200 \times 9 = 1800$$

$$r = \sqrt{1800}$$

$$1800 = 900 \times 2$$

$$r = \sqrt{900 \times 2} = 30\sqrt{2}$$

$$\text{Radius of the sector} = 30\sqrt{2} \text{ m}$$



- (b) The square is to be covered in concrete.

Calculate the area of the square.
Expand any brackets, and simplify your answer.

[3]

$$\text{Side of the square} = 10 + 30\sqrt{2} \text{ m}$$

$$\text{Area} = (10 + 30\sqrt{2})^2 = (10 + 30\sqrt{2})(10 + 30\sqrt{2})$$

$$= 100 + 300\sqrt{2} + 300\sqrt{2} + 900 \times 2$$

$$= 100 + 600\sqrt{2} + 1800$$

$$= 1900 + 600\sqrt{2}$$

$$\text{Area of the square} = 1900 + 600\sqrt{2} \text{ m}^2$$

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