Surname	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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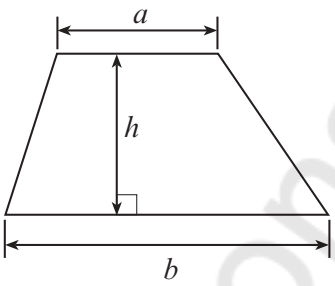
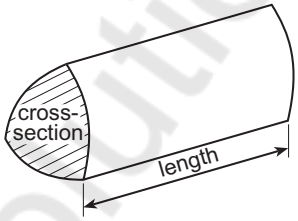
Formula List - Higher Tier

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



Volume of prism = area of cross-section × length

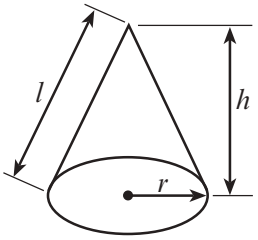


Volume of sphere $= \frac{4}{3}\pi r^3$

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

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

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

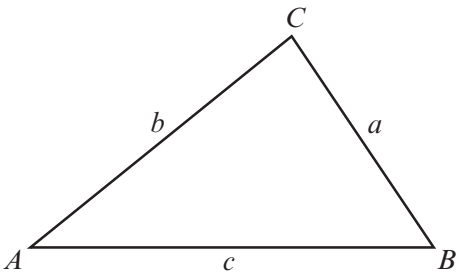


In any triangle ABC

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.

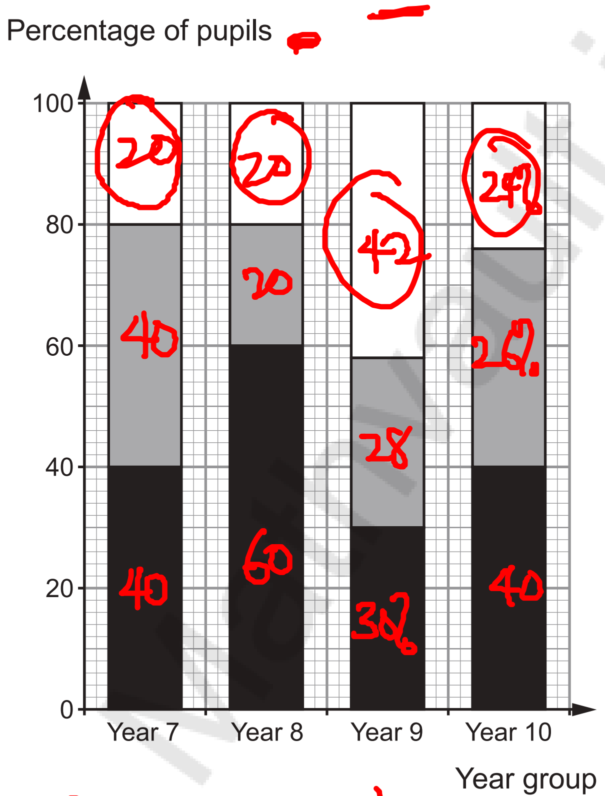
All of the pupils in Years 7 to 10 were surveyed in both of these schools. They were asked the following questions.

Do you cycle to school?	Yes	☐	No	☐
If you answered 'no', would you like to cycle to school?	Yes	☐	No	☐

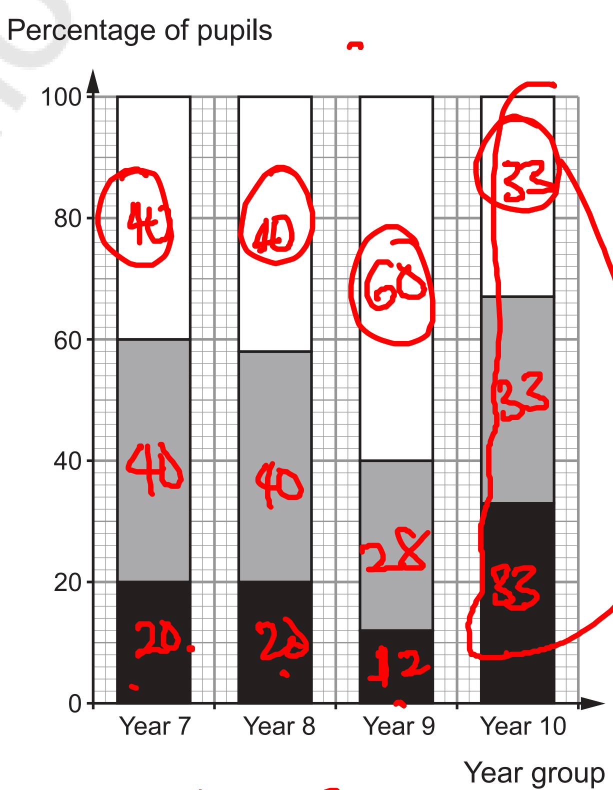
The results were displayed in graphs, as shown below.

Key: ■ Cycle ▒ Would like to cycle □ Others

Ysgol Fron Isa



Ysgol Caewen



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(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: Ysgol Caewen Year Group: Year 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	FALSE
Both schools have pupils in each year group with no interest in cycling to school.	TRUE	FALSE
The questions asked were biased.	TRUE	FALSE
Approximately 20% of the pupils surveyed in Ysgol Caewen cycle to school.	TRUE	FALSE
It is more likely that it is Ysgol Fron Isa that is the small school situated in a town.	TRUE	FALSE

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(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]

Also 1480 miles

In 2011 → 1200 miles 2017 = 1440 miles

In 2016 → 1400 miles 2018 = 1480 miles

In 2018 → ?

Between 2011 and 2016. There are 5 years

Increase in miles is 1400 − 1200 = 200 miles

Increase per year = $\frac{200}{5}$ = 40 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]

(i) The rate of people cycling to school might increase, it is not a linear function

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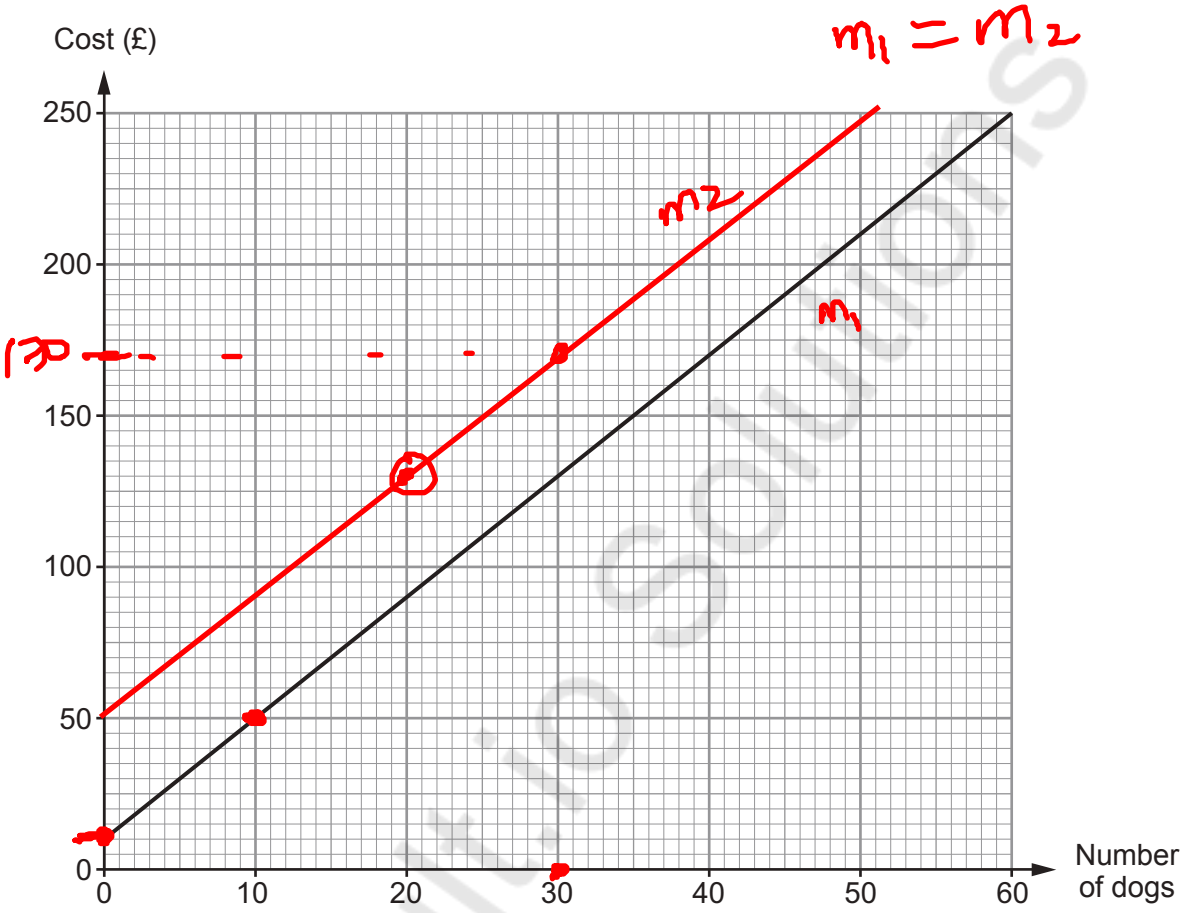
2. William owns and runs dog kennels.
His costs depend on the number of dogs in the kennels.
The running costs for one day are shown on the graph below.



(10, 50)
(0, 10)

(a) Why does the graph not pass through (0, 0)? [1]

So, he has a fixed cost that he must pay per day.
fixed cost of €10 per day

(0,10) (10,50)
x_1 y_1 x_2 y_2

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

Increase = gradient

$\text{gradient} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{50 - 10}{10 - 0} = \frac{40}{10}$

gradient = 4

Cost increase = £4

(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]

Cost (1 day) = £130
(20 dogs = £130)
Slope Freda = Slope William

(ii) Find the cost of keeping 30 dogs for one day in Freda's kennels. [1]

£ 170

Examiner only

3.

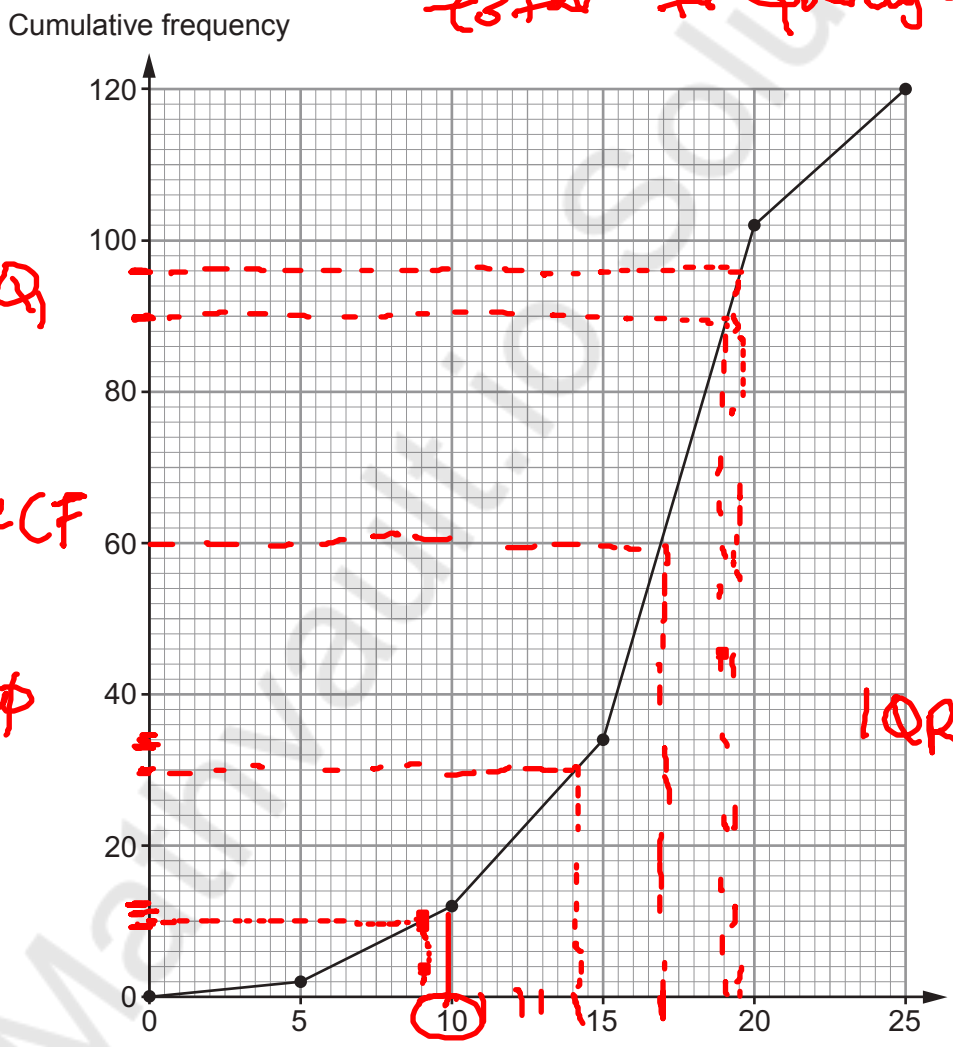
Meirion's Window Cleaning Business

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.



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(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 ..... 17 ..... minutes

IQR = $Q_3 - Q_1$ = 19 − 14 = 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]

From Data median = 17 mins 30sec
From CF graph median = 17 mins
(1) The raw data has more information
Since the cummulative frequency graph has been group.

(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]

34 − 12 / 22

number of customer at 10 mins = 12 customers
number of customer at 15 mins = 34 customers
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]

12 & 1 / 96

80% of customer (CF) (120)
80/100 × 120 = 96th position
at 96th position; time = 19 mins 30sec
So, Meirion is right because
19.30 < 20 minutes

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Examiner only

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

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

Increase = 5% of 20p = $\frac{5}{100} \times 20 = \frac{100}{100} = 1p$

New Price = 20 + 1 = 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]

Yes, he can buy a washing machine since he will have £5.18 left in his account

Examiner only

Previous meter reading 13900
Present meter reading 14400
Number of unit used = 14400 − 13900
= 500 units
Cost per unit is 20p previously
There is increase of 5%
New price per unit = 105% of 20
$= \frac{105}{100} \times \frac{20}{1} = 21p$
Total cost of 500 units is 500 × 21
= 10500p
= €105
Previous standing Charge = €7.60
This is increase by 20p = €0.20
So New standing charge = 7.60 + 0.20
= €7.80
Total standing charge (3 months) = 3 × 7.80
= €23.40
Total Electricity Payment without VAT is
105 + 23.40 = €128.40
VAT = 5% of 128.40
VAT = $\frac{5}{100} \times 128.40 = €6.42$
20

Total Bill = 6.42 + 128.40 =
= €134.82

New Balance of megan = 470 − 134.82
Balance after electricity Bill = €335.18

Cost of washing machine = €330

New Balance after buying WM = 335.18 − 330

= €5.18 ✓

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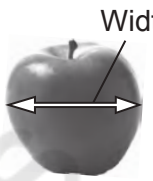
5. Lena has three apple trees in her garden.
She has one Gala apple tree, one Orange Pippin tree and one Pink Lady tree.
She picks 50 apples from each of the 3 trees.
She records the width of each apple, as shown.

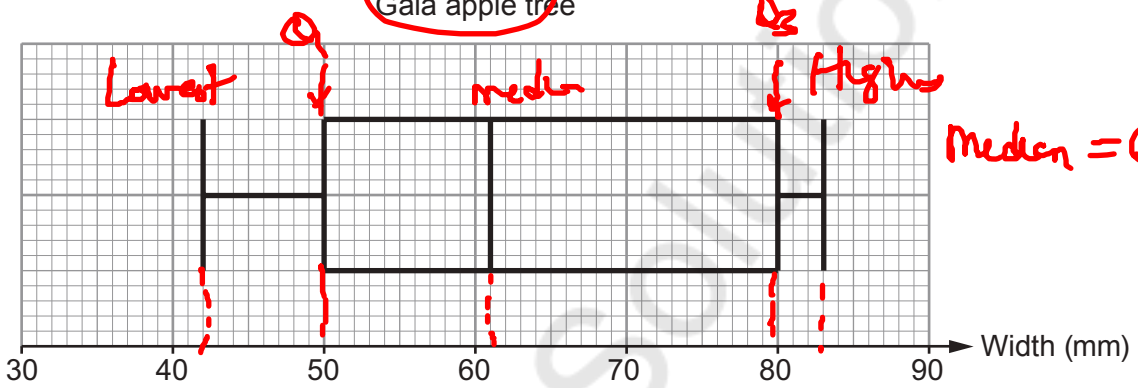


Range = Highest − lowest = 83 − 42 = 41

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

83
42
41

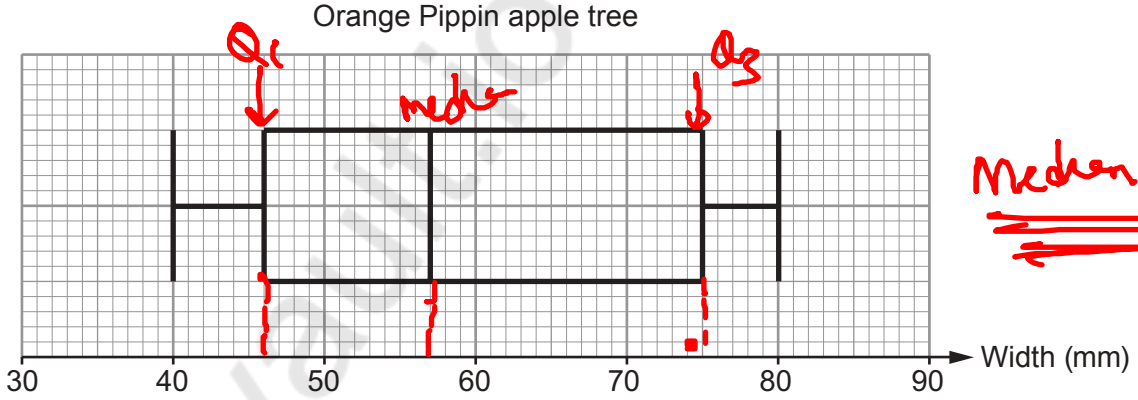
Gala apple tree



Median = 61

IQR = $Q_3 - Q_1$ = 80 − 50 = 30

Orange Pippin apple tree

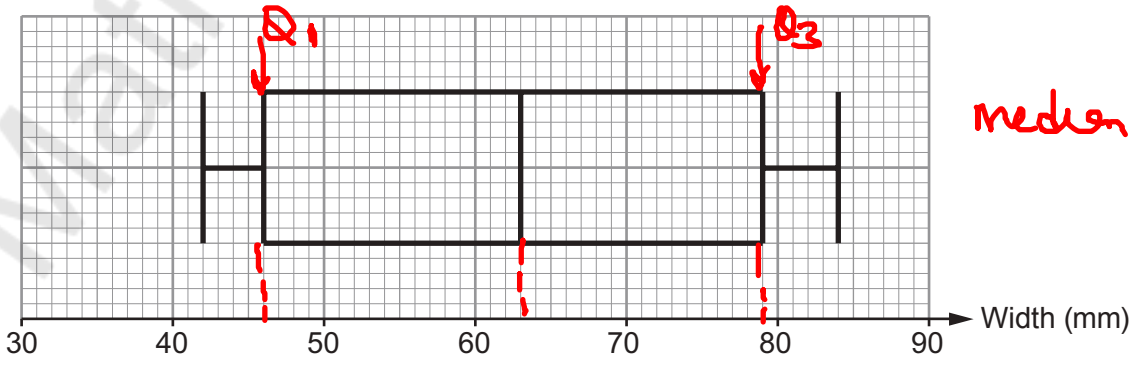


Median = 57

61
45
46
29

IQR = $Q_3 - Q_1$ = 75 − 46 = 29

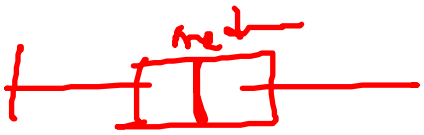
Pink Lady apple tree



Median = 63

79
46
33

IQR = $Q_3 - Q_1$ = 79 − 46 = 33



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(a) Complete each of the following statements.

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

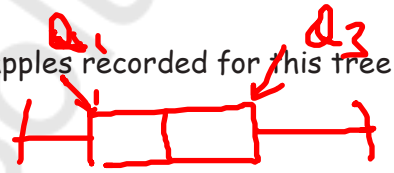
The median width of apples recorded for this tree is 57 mm.' [1]

(ii) 'The range of the widths of apples recorded for the Gala apple tree is 41 mm.' [1]

Range = highest value − lowest value = 83 − 42 = 41

(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]



IQR = $Q_3 - Q_1$

(b) Which tree has a higher proportion of larger apples?
You must give a reason for your answer. [1]

Using median to discuss the average we can say that the Pink lady apple tree has a higher proportion of larger apples because it has the greatest median which is 63mm

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

After he has taken his share, he calculates that he has $0\cdot8\dot{3}$ 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]

0.8333

Generally, the pizza left = $0.8\overline{3}$

Convert $0.8\overline{3}$ to fraction

Let $x = 0.8\overline{3}$

$10x = 8.\overline{3}$ — (1)

$100x = 83.\overline{3}$ — (2)

Subtract (1) from (2)

$90x = 75$

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

$x = \frac{5}{9}$

Share $\frac{5}{9}$ left among three friends

Each $= \frac{5}{9} \div 3 = \frac{5}{9} \times \frac{1}{3} = \frac{5}{27}$

Each friend will have $\frac{5}{27}$

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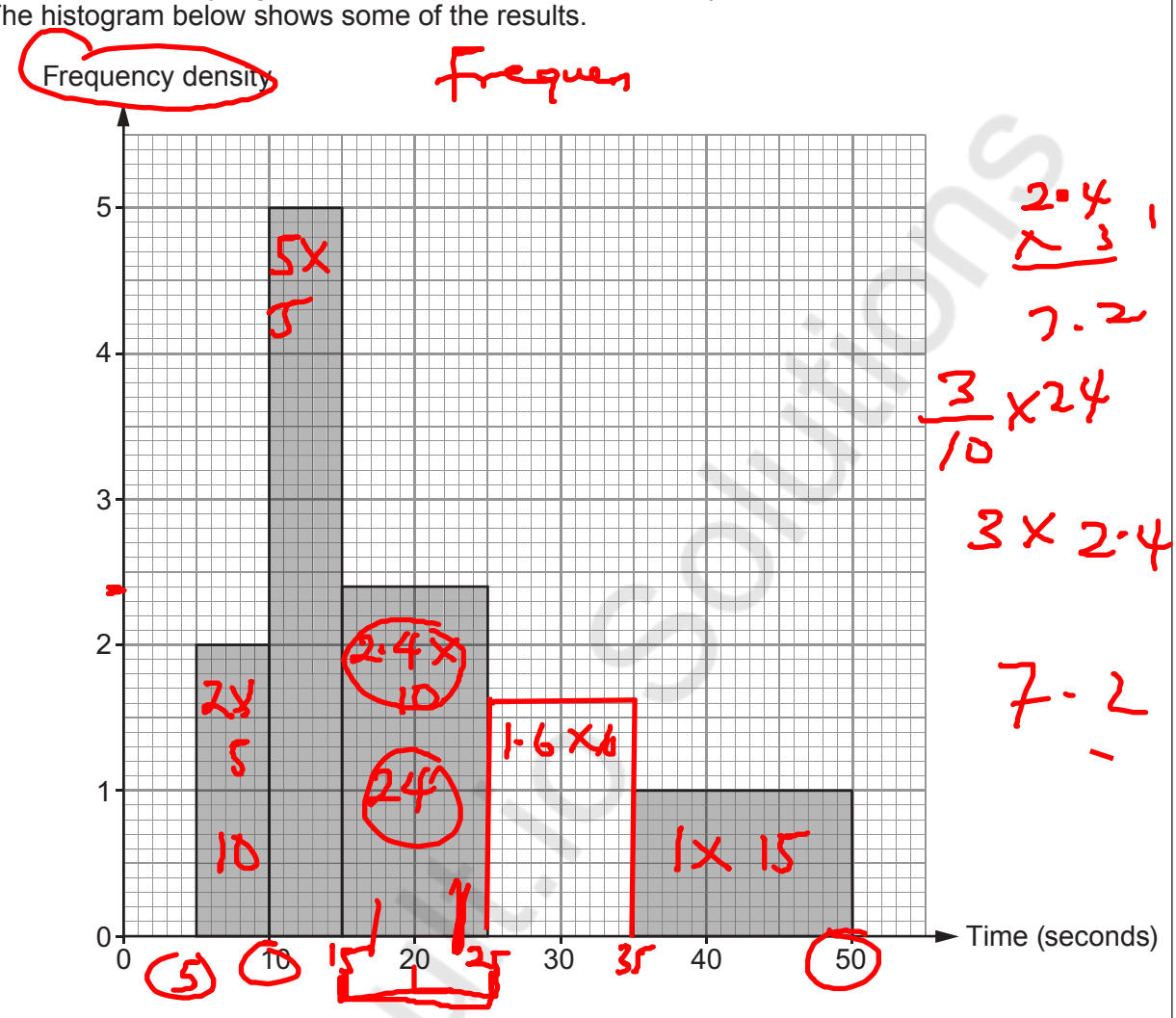
7. The times taken by a group of pupils to answer a numeracy question were recorded. The histogram below shows some of the results.



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

(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

35 7
40 15
15

Examiner only

(c) Calculate the total number of pupils that were in the group. [2]

Frequency density = $\frac{\text{Number people}}{\text{Time}}$ = 90

Number people = Freq D × T

Number people = 2×5 + 5×5 + 2·4×10 + 1·6×10 + 1×15

10 + 25 + 24 + 16 + 15

(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."

5–10
10–15
3
35
8
43

(i) Explain how Gareth's statement could be true.
You must use calculations to justify your answer. [3]

50% of pupils = 50% of 90 = 45

check how many student took 18sec

10 + 25 + (8) = 43

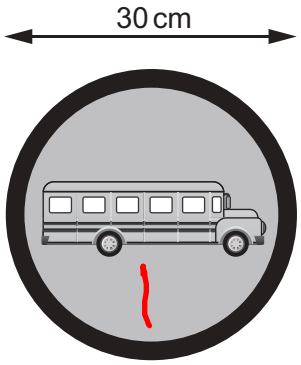
student that took 18 secs were 43 which is less than 50% of the class (45) - Gareth is right

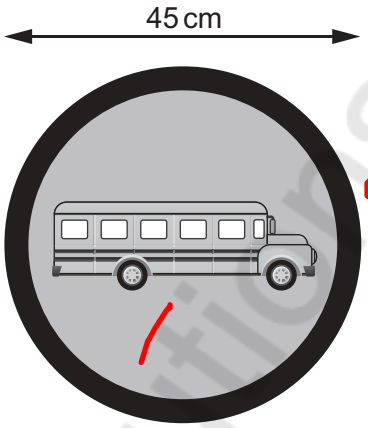
(ii) Explain how Gareth's statement could be false. [1]

Gareth could be one of the slowest in the time group 15 to 25 sec

Examiner only

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]

Smaller sign = €1·60

Smaller sign area = $\pi r^2 = \pi \times 15^2$ cm^2

Smaller area requires €1·60

$15^2 \pi$ cm^2 = €1·60

Area bigger sign = $\pi r^2 = \pi \times \left(\frac{45}{2}\right)^2$

$= \frac{45^2}{4} \pi$ cm^2

$0.4 \times 9 = 3.6$

$1 \text{ cm}^2 = \frac{1.6}{15^2 \pi}$

$\frac{45^2 \pi}{4}$ cm^2 = $\frac{1.6}{15^2 \pi} \times \frac{45^2 \pi}{4}$

$\frac{1.6 \times 45^2 \pi}{15^2 \pi \times 4} = \frac{0.4 \times 3^2 \times 15^2}{15^2 \times 4}$

€3·6

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(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. €8
You must show all your working. [4]

Let Costprice = x

Selling price = €12

Case 1: 25% of cost price + Costprice = SP

125% of Costprice = Selling Price

$\frac{125}{100} \times x = 12$

$x = \frac{12 \times 100}{125} = \frac{48}{5}$

$x = 9.60$

$x = €9.60$ [Costprice without VAT]

Case 2: VAT

120% of costprice = 9.6

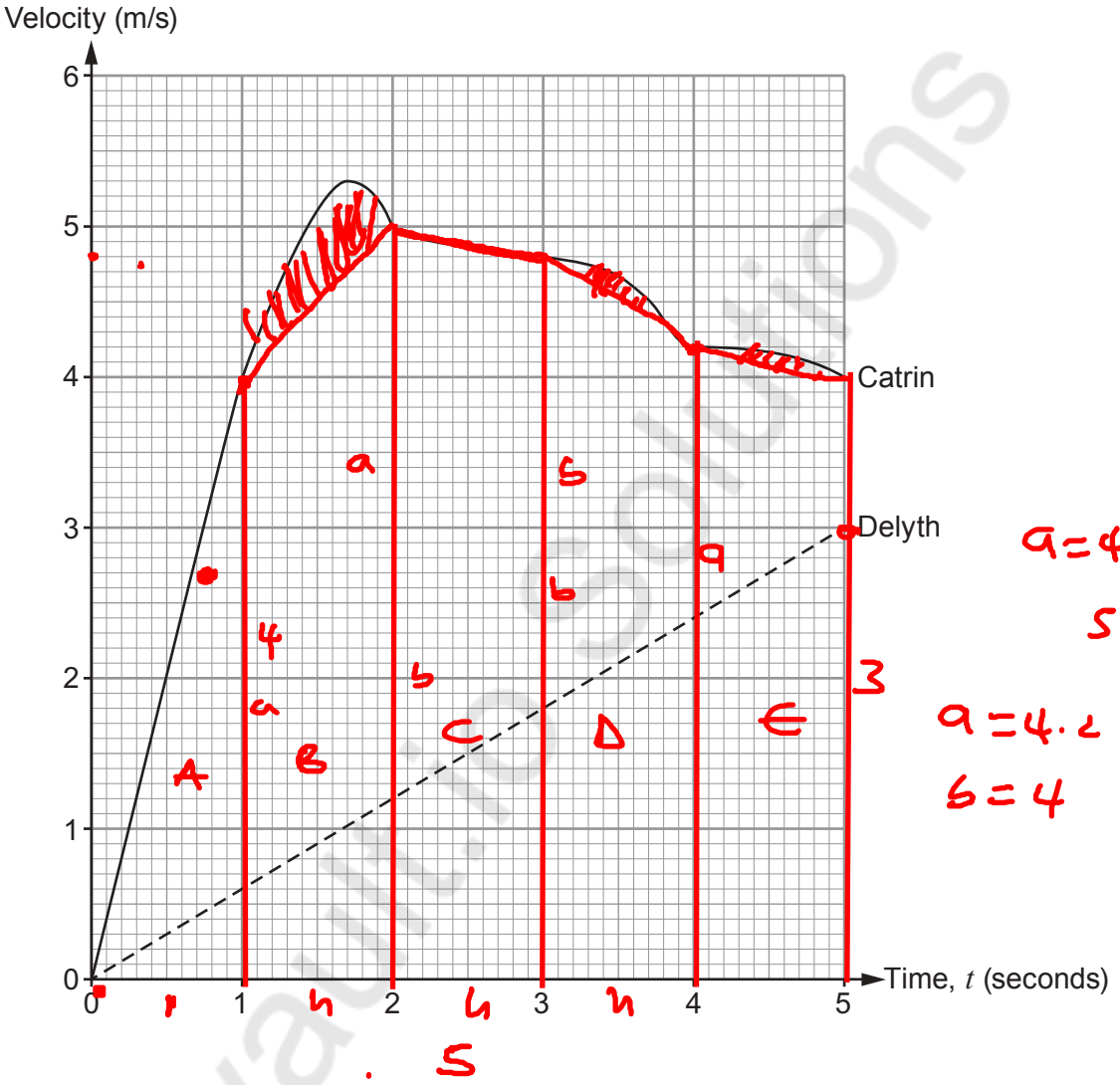
$\frac{120}{100} \times x = 9.6$

$x = \frac{9.6 \times 100}{120} = \frac{48}{6}$

$8x = 48$ $= €8$

Examiner only

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]

1.7 sec

Examiner only

(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]

Area (A) $= \frac{1}{2} b \times h = \frac{1}{2} \times 1 \times 4 = 2m$

Area (B) $= \frac{1}{2}(a+b)h = \frac{1}{2}(4+5)1 = 4.5m$

Area (C) $= \frac{1}{2}(a+b)h = \frac{1}{2}(5+4.8)1 = 4.9m$

Area (D) $= \frac{1}{2}(a+b)h = \frac{1}{2}(4.2+4.8)1 = 4.5m$

Area (E) $= \frac{1}{2}(a+b)h = \frac{1}{2}(4+4.2)1 = 4.1m$

Total Distance Catrin travelled is

$2 + 4.5 + 4.9 + 4.5 + 4.1$

$= 20m$

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

After 5 seconds Catrin travelled 20m

Delyths Distance $= \frac{1}{2} b \times h = \frac{1}{2} \times 5 \times 3 = 7.5m$

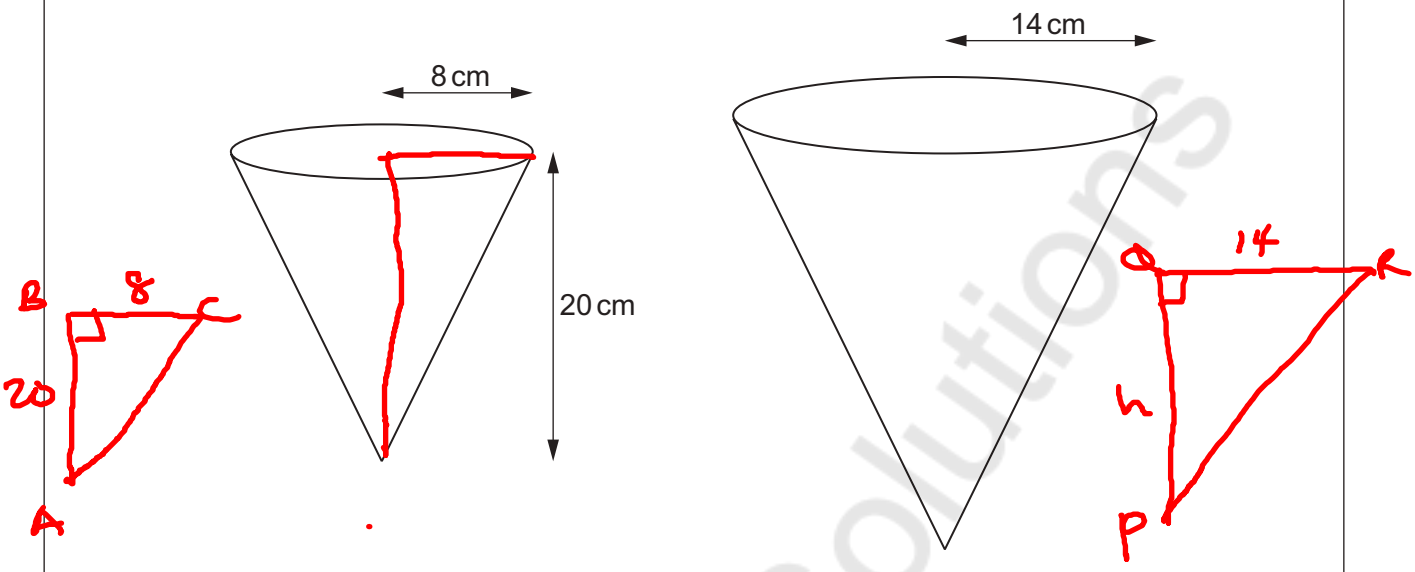
$20 - 7.5m = 12.5m$

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

The trapezium cut off some part of the distance travelled by Catrin. The distance is meant to be a little greater than 20m

Examiner only

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]

$\triangle ABC \equiv \triangle PQR$

$\frac{AB}{PQ} = \frac{BC}{QR} = \frac{AC}{PR}$

$\frac{20}{h} = \frac{8}{4} \times \frac{4}{7}$

$20 \times 7 = 4 \times h$

$\frac{20 \times 7}{4} = \frac{4 \times h}{4}$

$h = 35\text{ cm}$

Examiner only

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

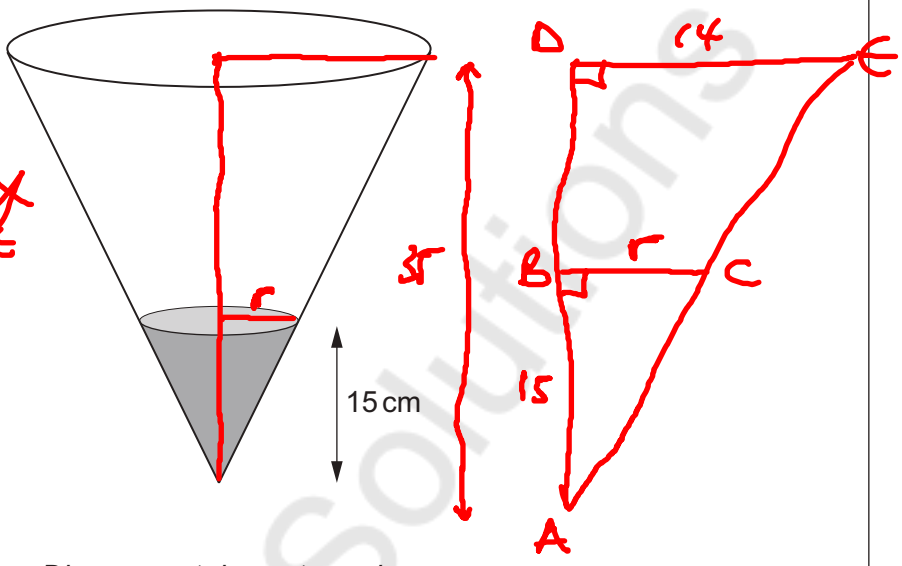


Diagram not drawn to scale

Calculate the volume of liquid in the flask.
Give your answer in terms of π. [4]

$\Delta ABC \equiv \Delta ADE$

$\frac{AB}{AD} = \frac{BC}{DE} = \frac{AC}{AE}$

$\frac{15}{35} = \frac{r}{14}$

$3 \times 14 = 7 \times r$

$\frac{3 \times 14}{7} = \frac{7 \times r}{7}$

$r = 6$

$r = 6$ cm $\quad h = 15$ cm

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

$V_{cone} = \frac{1}{3} \times \pi \times 6^2 \times 15$ $\qquad 30$

$= \frac{1}{3} \times \pi \times 6^2 \times 6 \times 15$

$V_{Liquid} = 180\pi \text{ cm}^3$

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

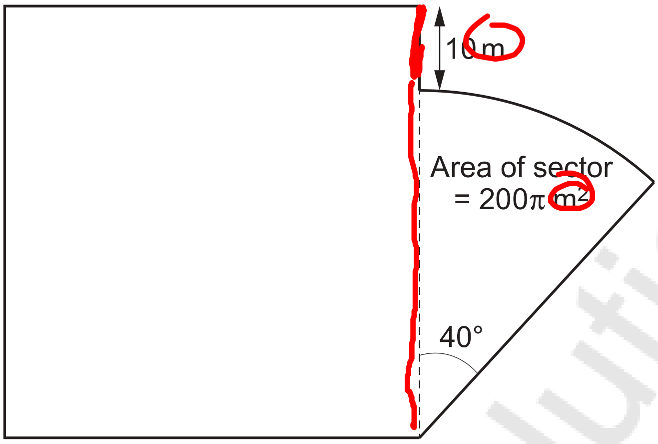

Diagram not drawn to scale

$s = 10 + r$

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]

Area of a sector $= \frac{\theta}{360} \times \pi r^2$

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

$200\pi \times 360 = 40\pi r^2$

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

$r^2 = 1800$

$r = \sqrt{1800} = \sqrt{900 \times 2} = \sqrt{900} \times \sqrt{2}$

$r = 30\sqrt{2}$

$a = 30$ $b = 2$ $a\sqrt{b}$

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

Calculate the area of the square.
Expand any brackets, and simplify your answer. [3]

Area of square = s^2

One side of the square is $s = 10 + 30\sqrt{2}$ m

$A = s^2$

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

$A = 10(10 + 30\sqrt{2}) + 30\sqrt{2}(10 + 30\sqrt{2})$

$A = 100 + 300\sqrt{2} + 300\sqrt{2} + 900\sqrt{4}$

$A = 100 + 600\sqrt{2} + 900 \times 2$

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

END OF PAPER

$A = 1900 + 600\sqrt{2}$ m²

$A = 100[19 + 6\sqrt{2}]$ m²

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Question number	Additional page, if required. Write the question number(s) in the left-hand margin.

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