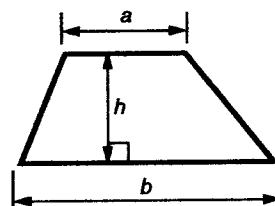
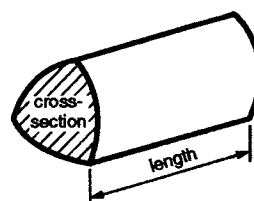


Formulae Sheet: Higher Tier

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



Volume of prism = (area of cross-section) \times length

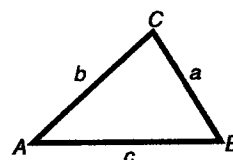


In any triangle ABC

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

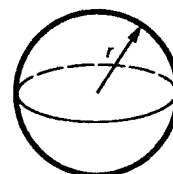
Cosine rule $a^2 = b^2 + c^2 - 2bc \cos A$

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



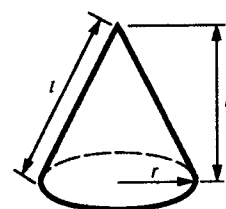
Volume of sphere = $\frac{4}{3} \pi r^3$

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



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

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



The Quadratic Equation

The solutions of $ax^2 + bx + c = 0$,
where $a \neq 0$, are given by

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

PLEASE DO NOT WRITE ON THIS PAGE

1 Calculate.

$$(a) \frac{31.8 \times 0.4}{5.3 - 2.8} = (31.8 \times 0.4) \div (5.3 - 2.8)$$

.....

 (a) 5.088 [2]

$$(b) \sqrt{4.7^3} = \sqrt{103.823} = 10.18935719$$

Give your answer correct to 2 decimal places.

.....

 (b) 10.19 to 2 d.p. [2]

2 Reuben bought 2 bars of chocolate and 44 jelly snakes.
 The chocolate bars cost 84 pence each and the jelly snakes cost x pence each.

(a) Write down an expression for the total cost, in pence.

$$2 \times 84 + 44x$$

.....
 (a) $168 + 44x$ [1]

Reuben spent £5.20 altogether.

(b) Write down an equation and solve it to find the cost of one jelly snake.

$$168 + 44x = 520$$

$$44x = 520 - 168$$

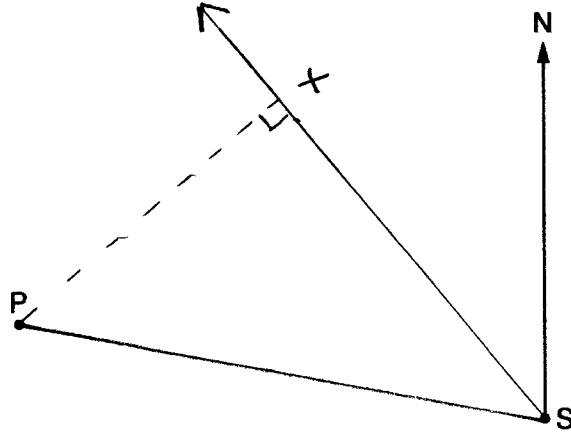
$$44x = 352$$

$$x = \frac{352}{44}$$

$$x = 8$$

.....
 (b) 8 pence [3]

3 The diagram shows the positions of a phone mast, P, and a school, S.



(a) Find the bearing of the phone mast from the school.

.....
 (a) 280 ° [1]

(b) Richard cycles from the school, in a straight line, on a bearing of 320°.

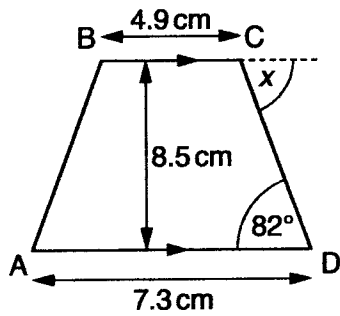
(i) Draw a line to show Richard's route. [1]

(ii) Mark a point X on the line where Richard is closest to the phone mast. [1]

(iii) What should angle PXS be?

.....
 (b) (iii) 90° [1]

4 (a) ABCD is a trapezium.



NOT TO SCALE

$$A = \frac{1}{2}(a+b)h$$

$$= \frac{1}{2}(7.3+4.9) \times 8.5$$

(i) Work out the area of ABCD.

.....

.....

.....

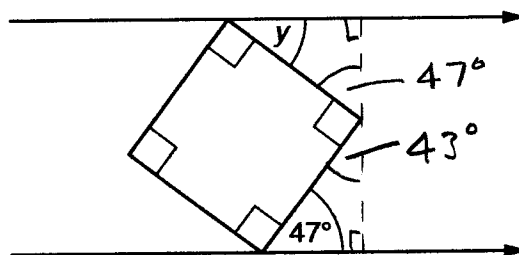
(a)(i) 51.85 cm² [2]

(ii) Find the size of angle x.
Give a reason for your answer.

x = 82 ° because alternate angles are equal

..... [2]

(b) This diagram shows a square between two parallel lines.



NOT TO SCALE

Find the size of angle y.

.....

(b) 43 ° [2]

5 Josh completed a mini-triathlon in which he swam, cycled and ran.

(a) Josh swam 0.75 km in 15 minutes.

Calculate the average speed for his swim.

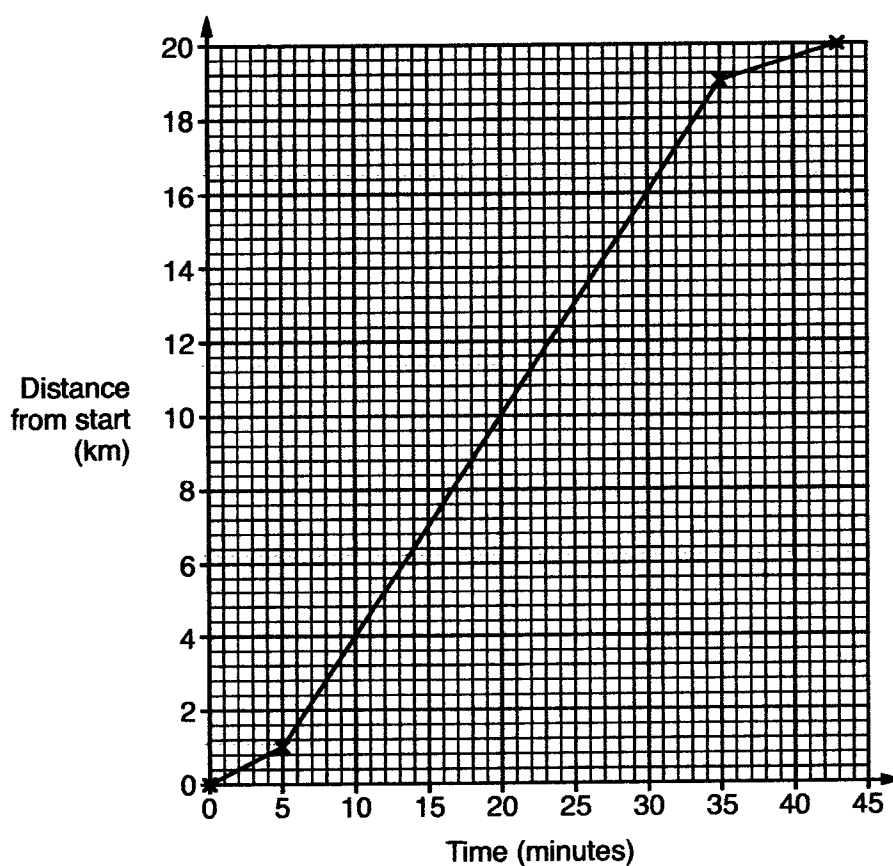
0.75 km in 15 min

 4 x 0.75 km in 60 min = 1 hr

 3 km/h

(a) 3 km/h [3]

(b) This distance-time graph represents his cycling stage.



Between which times did Josh cycle fastest?

.....

(b) 5 minutes and 35 minutes [1]

- (c) Josh completed the 5 km run at an average speed of 12 km/h.

How long altogether did Josh take to complete the mini-triathlon?

$$\text{Time for Run} = \frac{D}{S} = \frac{5}{12} \text{ hr} = \frac{5}{12} \times 60 \text{ min}$$

$$= 25 \text{ min}$$

$$\text{Time for cycle} = 43 \text{ min}$$

$$\text{Time for swim} = 15 \text{ min}$$

$$\text{Total time} = 25 + 43 + 15 = 83 \text{ min}$$

(c) 83 minutes [4]

- 6 In this question, n is an integer.

Which of these statements describes $5n + 1$?

always even

always odd

sometimes odd, sometimes even

Explain how you decided.

$$\text{When } n = 1 \quad 5(1) + 1 = 6 \text{ even}$$

$$\text{When } n = 2 \quad 5(2) + 1 = 11 \text{ odd}$$

$5n + 1$ is sometimes odd, sometimes even

because when n is odd $5n + 1$ is even

when n is even $5n + 1$ is odd [2]

7 Solve.

(a) $3x - 5 = x + 4$

$$3x - x = 4 + 5$$

$$2x = 9$$

$$x = \frac{9}{2}$$

(a) $x = 4\frac{1}{2}$ [3]

(b) $\frac{x}{3} - 2 = 70$

$$x - 6 = 210$$

 $(\times 3 \text{ throughout})$

$$x = 210 + 6$$

$$x = 216$$

(b) $x = 216$ [2]

(c) $5x + 6 > 28$

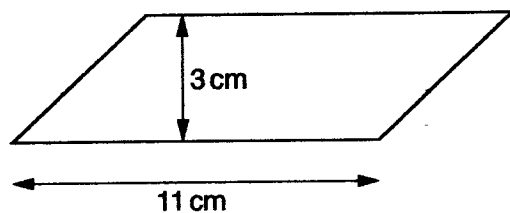
$$5x > 28 - 6$$

$$5x > 22$$

$$x > \frac{22}{5}$$

(c) $x > 4\frac{2}{5}$ [2]

- 8 A block of beeswax is made in the shape of a prism. Its cross-section is a parallelogram as shown.



NOT TO SCALE

The length of the prism is 6 cm.

Calculate the volume of the block of beeswax.

$$\begin{aligned} \text{Vol} &= \text{Area of cross-section} \times \text{length} \\ &= 11 \times 3 \times 6 \\ &= 198 \text{ cm}^3 \end{aligned}$$

.....
.....
.....
.....

198 cm³ [3]

- 9 (a) (i) Write 36 as a product of prime factors.

$$\begin{array}{r} 2 \overline{)36} \\ 2 \overline{)18} \\ 3 \overline{)9} \\ 3 \overline{)3} \\ 1 \end{array}$$

(a) (i) 36 = 2 × 2 × 3 × 3 [2]

- (ii) Explain how your answer to part (a)(i) shows that 36 is a square number.

$$\underline{36 = 2^2 \times 3^2 = (2 \times 3)^2 = 6^2}$$

Each prime factor is squared [1]

- (b) What is the smallest whole number you need to multiply 350 by to get a square number?

$$\begin{array}{r} 2 \overline{)350} \\ 5 \overline{)175} \\ 5 \overline{)35} \\ 7 \overline{)7} \\ 1 \end{array}$$

$$350 = 2 \times 5^2 \times 7$$

Multiply by $2 \times 7 = 14$

then all prime factors will be squared

.....
.....

(b) 14 [3]

- 10 Lilia kept a record of the number of miles she travelled in her car each day in July, August and September.

The table summarises the data for July.

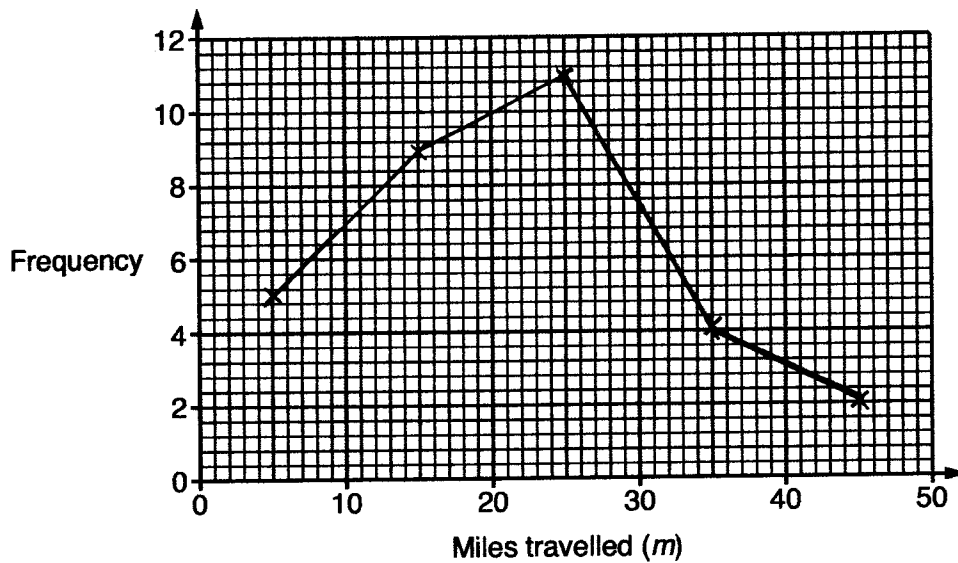
Miles travelled (m)	Frequency	Midpoint	freq \times midpoint
$0 \leq m < 10$	5	5	25
$10 \leq m < 20$	9	15	135
$20 \leq m < 30$	11	25	275
$30 \leq m < 40$	4	35	140
$40 \leq m < 50$	2	45	90
	31		665

- (a) Work out an estimate of the mean daily number of miles travelled in July.

.....
 estimate for mean = $\frac{665}{31} = 21.4516$

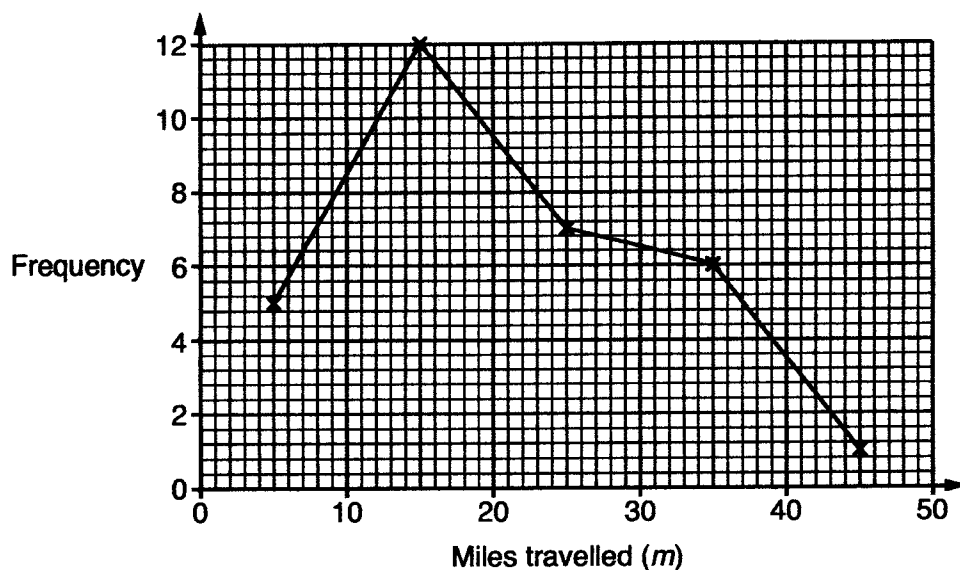
(a) 21.45 miles [4]

- (b) Draw a frequency polygon for the data for July.



[2]

(c) This graph summarises the data for August.



(i) What is the modal class interval?

(c)(i) $10 \leq m < 20$ [1]

(ii) Which class interval contains the median?

5 in 0-10
12 in 10-20
so 17 in 0-20 16th is median

(ii) $10 \leq m < 20$ [1]

(d) Write down one difference between the daily number of miles Lilia travelled in July and in August.

Median higher in July (since in 20-30 interval)

[1]

For July
5 in 0-10
9 in 10-20
so 14 in 0-20
median is 16th so in 20-30 interval

(e) This table summarises the data for the first 29 days in September.

Miles travelled (m)	Frequency
$0 \leq m < 10$	7
$10 \leq m < 20$	8
$20 \leq m < 30$	10
$30 \leq m < 40$	3
$40 \leq m < 50$	1

- (i) How many miles could Lilia travel on the 30th day in September so that the class interval in which the median for September lies does not change?
Explain how you worked out your answer.

.....

 Any distance less than 20 miles because $\text{median} = \frac{30+1}{2} = 15.5^{\text{th}}$ item
 Already 15 from 0 to 20 so final distance cannot be
 in next interval without median moving to 20-30. [2]

- (ii) In fact, Lilia travelled 40 miles on the 30th day in September.

In which class interval should this distance be recorded?

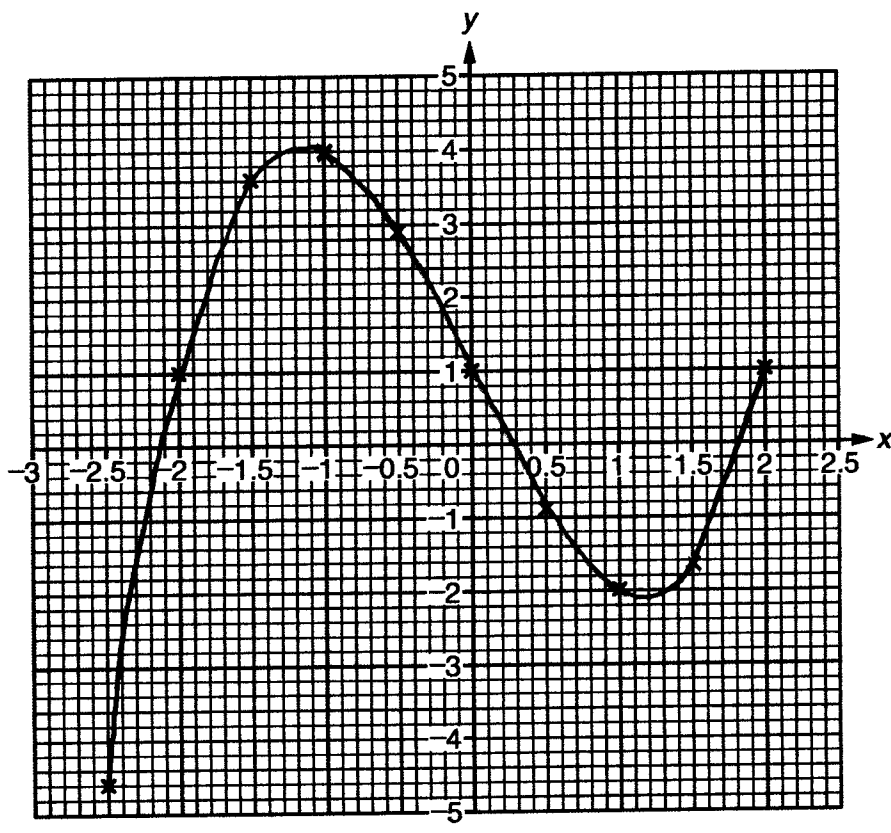
(e)(ii) $40 \leq m < 50$ [1]

11 (a) Complete this table for $y = x^3 - 4x + 1$.

x	-2.5	-2	-1.5	-1	-0.5	0	0.5	1	1.5	2
y	-4.625	1	3.625	4	2.875	1	-0.875	-2	-1.625	1

$$\begin{aligned} & (-1)^3 - 4(-1) + 1 && (1.5)^3 - 4(1.5) + 1 \\ \dots\dots\dots & && \dots\dots\dots \\ = & -1 + 4 + 1 && = -1.625 \dots\dots\dots [2] \\ = & 4 \end{aligned}$$

(b) Plot the remaining points and draw the graph of $y = x^3 - 4x + 1$ for $-2.5 \leq x \leq 2$.



[2]

(c) Use your graph to estimate the value of x when y = -3.

.....

(c) $x = -2.4$ [1]

12 Solve algebraically these simultaneous equations.

$$\begin{aligned} 4x + 3y &= 19 & \textcircled{1} \\ 6x + 2y &= 11 & \textcircled{2} \end{aligned}$$

$$\begin{aligned} \textcircled{1} \times 2 \quad 8x + 6y &= 38 & \textcircled{3} & \text{sub } 6x \text{ in } \textcircled{1} \\ \textcircled{2} \times 3 \quad 18x + 6y &= 33 & \textcircled{4} & 4(-\frac{1}{2}) + 3y = 19 \\ & & & -2 + 3y = 19 \\ & & & 3y = 19 + 2 \\ & & & 3y = 21 \\ & & & y = \frac{21}{3} = 7 \\ \textcircled{4} - \textcircled{3} \quad 10x &= -5 & & \\ & x = \frac{-5}{10} & & \\ & x = -\frac{1}{2} & & \\ & & & x = -\frac{1}{2} \quad y = 7 \quad [4] \end{aligned}$$

13 £1000 was invested for one year at a fixed annual rate of interest. 20% tax was deducted from the interest before it was paid. The amount of interest paid was £52.

Calculate the rate of interest before tax was deducted.

$$\begin{aligned} 80\% \text{ of interest was } £52 \\ 100\% \text{ of interest was } £52 \times \frac{100}{80} = £65 \\ £65 \text{ is } 6.5\% \text{ of } £1000 \\ \underline{\hspace{10em}} 6.5 \hspace{1em} \% [4] \end{aligned}$$

14 (a) Simplify.

$$(i) \frac{x^6 y^4}{x^2} = x^4 y^4$$

$$(a)(i) \underline{x^4 y^4} \quad [1]$$

$$(ii) (3x^4 y)^2 = 9x^8 y^2$$

$$(ii) \underline{9x^8 y^2} \quad [2]$$

(b) Solve, giving your answers correct to 2 decimal places.

$$x^2 - 25x + 19 = 0$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$x = \frac{25 \pm \sqrt{(-25)^2 - 4 \times 1 \times 19}}{2}$$

$$x = 24.22$$

$$x = 0.78$$

$$x = \frac{25 \pm \sqrt{549}}{2}$$

$$(b) \underline{x = 24.22, x = 0.78} \quad [3]$$

(c) y is inversely proportional to x and $y = 196$ when $x = 4$.Find an equation connecting x and y .

$$y = \frac{k}{x}$$

$$y = \frac{784}{x}$$

$$\text{Sub } y = 196 \\ x = 4$$

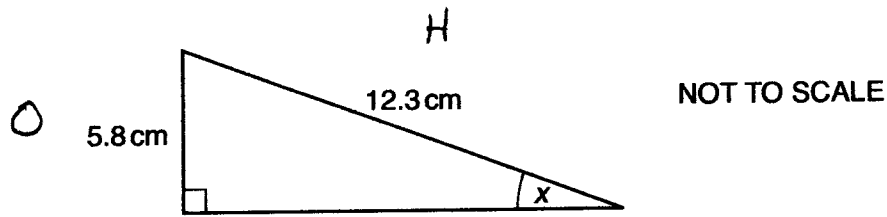
$$196 = \frac{k}{4}$$

$$196 \times 4 = k$$

$$784 = k$$

$$(c) \underline{y = \frac{784}{x}} \quad [2]$$

- 15 (a) Calculate the size of angle x .

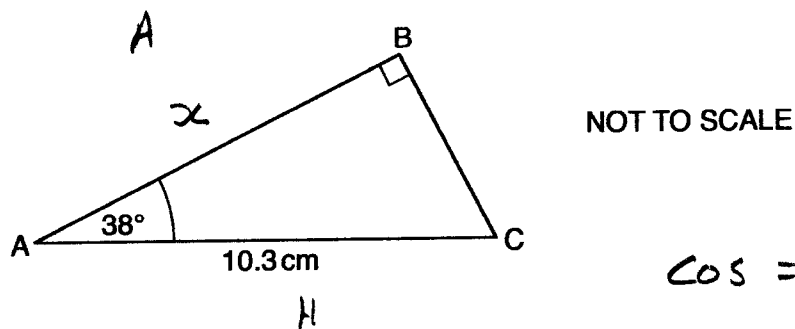


$$\sin = \frac{O}{H} \quad \sin x = \frac{5.8}{12.3}$$

$$x = \sin^{-1}\left(\frac{5.8}{12.3}\right) = 28.13^\circ$$

(a) 28.13 ° [3]

- (b) Calculate the length AB.



$$\cos = \frac{A}{H}$$

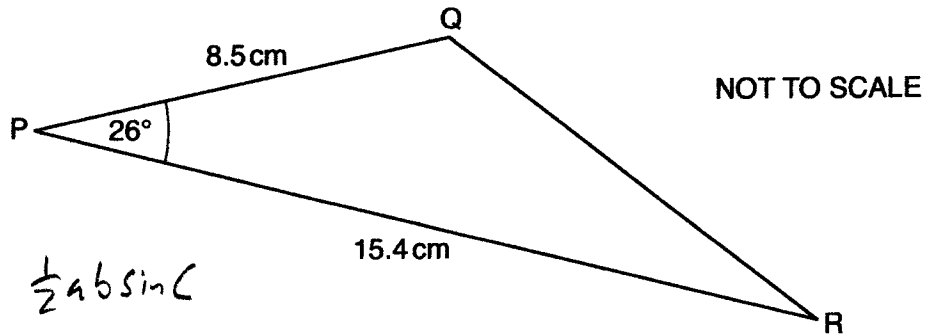
$$\cos 38^\circ = \frac{x}{10.3}$$

$$10.3 \cos 38^\circ = x$$

$$8.12 = x$$

(b) 8.12 cm [3]

(c) Calculate the area of triangle PQR.



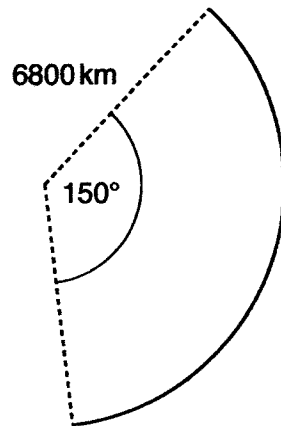
$$\text{Area} = \frac{1}{2}ab\sin C$$

$$\text{Area} = \frac{1}{2} \times 8.5 \times 15.4 \times \sin 26^\circ$$

$$= 28.69 \text{ cm}^2$$

(c) 28.69 cm² [2]

- 16 A satellite travels in a path which is taken to be a circle of radius 6800 km.



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Calculate the distance that the satellite travels when it turns through an angle of 150° .
Give your answer to a suitable degree of accuracy.

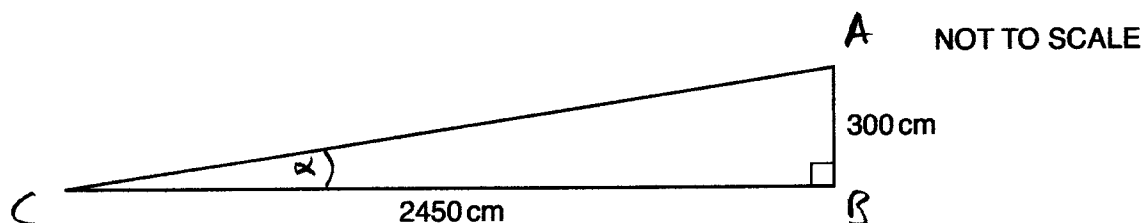
$$\text{Travels } \frac{150}{360} \times 2\pi r$$

$$= \frac{150}{360} \times 2 \times \pi \times 6800 = 17802.35837$$

$$\underline{17800} \text{ km [4]}$$

- 17 Regulations state that ramps for electric wheelchairs must make an angle with the horizontal of less than 7.2° .

The diagram shows a ramp with dimensions that were measured to the nearest 10 centimetres.



Is it certain that this ramp satisfies the regulations for electric wheelchairs?
You must support your answer with working.

$$\tan \alpha = \frac{AB}{BC}$$

$$245 \leq AB \leq 305$$

$$2445 \leq AC \leq 2455$$

$$\text{Max } \alpha \text{ when } \tan \alpha = \frac{305}{2455}$$

$$\alpha = \tan^{-1} \left(\frac{305}{2455} \right) = 7.08^\circ$$

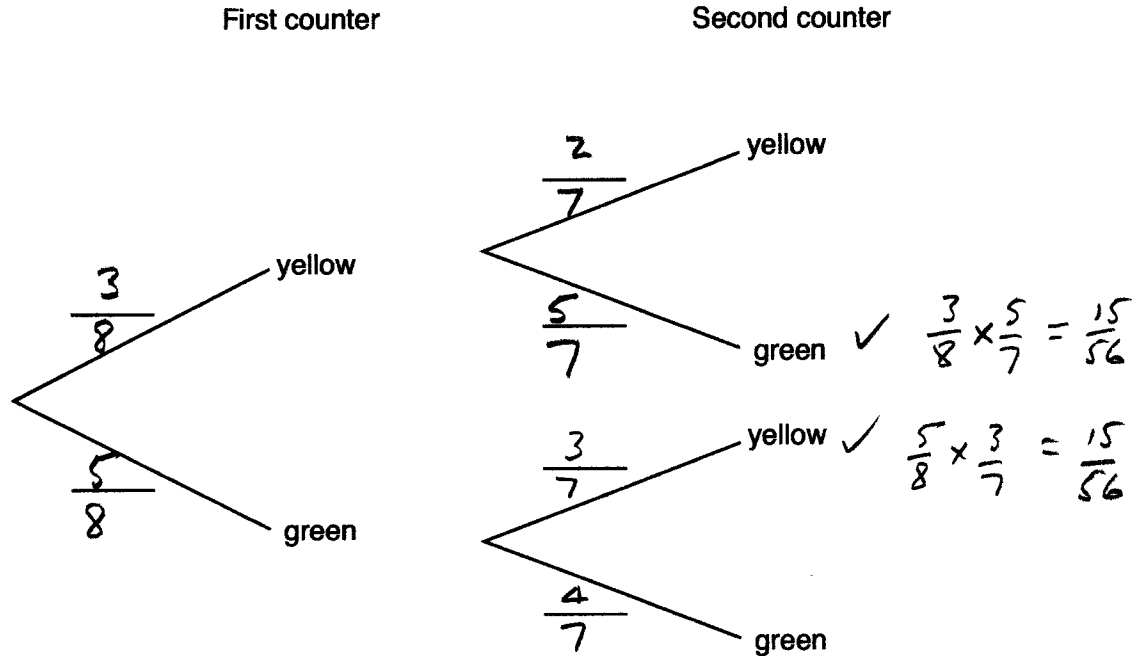
[5]

Yes it is certain regulations are satisfied
since $7.08^\circ < 7.2^\circ$

TURN OVER FOR QUESTION 18

- 18 A bag contains 3 yellow counters and 5 green counters. A counter is taken at random from the bag and is not replaced. A second counter is then taken at random from the bag.

(a) Complete the tree diagram to show the probabilities of taking yellow and green counters.



[3]

(b) Work out the probability that the counters taken are different colours.

.....
 $P(\text{Different Colours}) = \frac{15}{56} + \frac{15}{56} = \frac{30}{56} \text{ or } \frac{15}{28}$

(b) $\frac{15}{28}$ [3]



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