

Formulae Sheet: Higher Tier

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



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

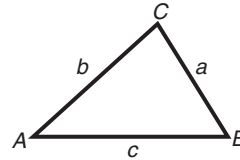


In any triangle ABC

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

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

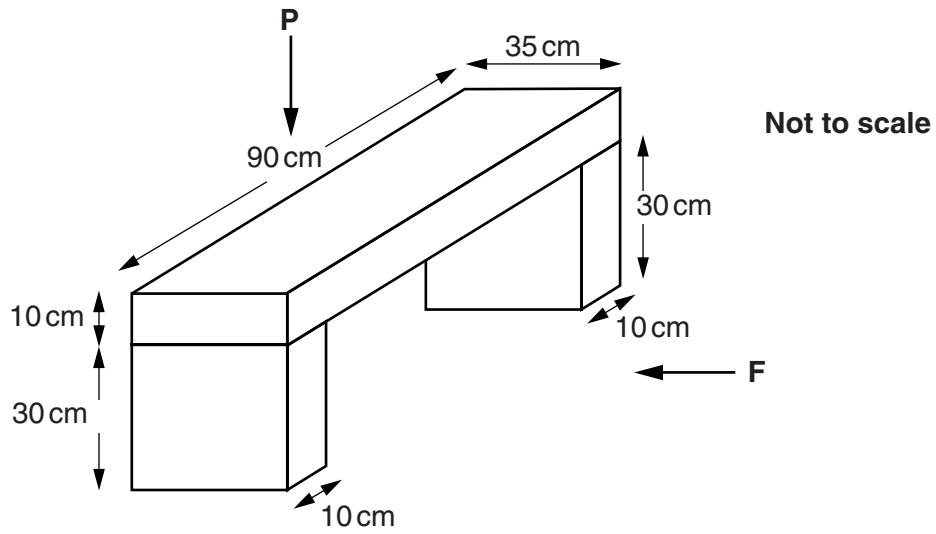
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1 Complete the five missing amounts in this bill.

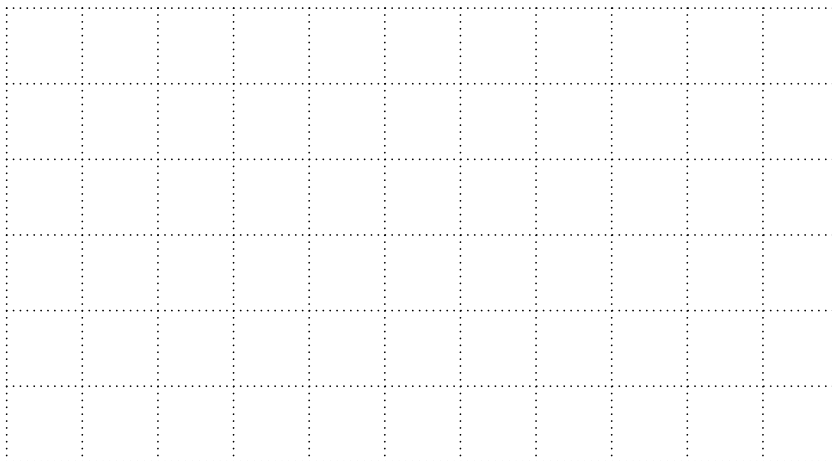
35 m ² of carpet at £25.20 per m ²	£_____
35 m ² of underlay at £_____ per m ²	£_____
Fixings	£ 13.35
Cost of all items	£ 1112.00
VAT (20% of the cost of all items)	£_____
TOTAL	£_____

[5]

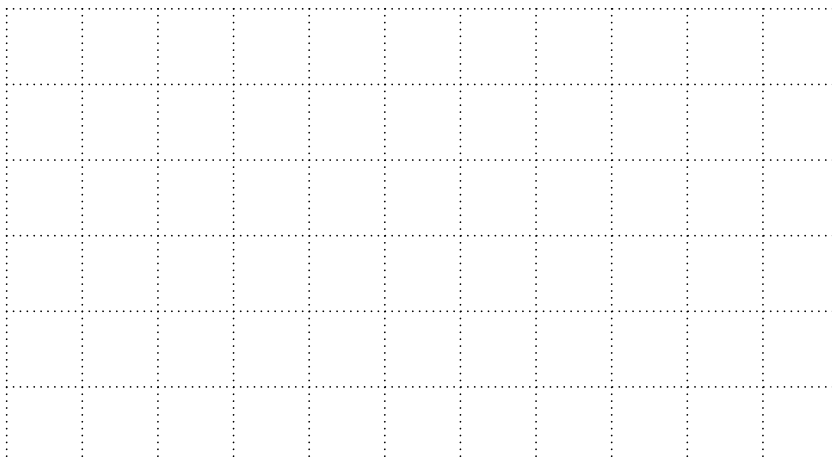
2 This garden bench is made from three cuboids.



(a) On the grids, draw the front elevation (view from F) and the plan (view from P). Use a scale of 1 cm to represent 10 cm.



Front elevation



Plan

[4]

- (b) Work out the total volume of the garden bench.
Give the units of your answer.

(b) _____ [4]

- (c) The weight of the bench is 75 kg, correct to the nearest kilogram.

What are the upper and lower bounds of this weight?

(c) Upper bound _____ kg

Lower bound _____ kg [2]

- 3* Ken has £4000 to invest.
He decides to invest it for 3 years at a rate of 5% per year.

How much more interest will he earn if he invests it at Compound Interest rather than Simple Interest?

£ _____ [5]

- 4 A box contains yellow, blue, red and green pencils.
Josie takes a pencil at random.

The probability that she takes a yellow pencil is 0.2.

The probability that she takes a blue pencil is 0.35.

The probability that she takes a red pencil is 0.15.

- (a) (i) What is the probability that Josie will take a green pencil?

(a)(i) _____ [2]

- (ii) What is the probability that Josie will take a yellow **or** a blue pencil?

(ii) _____ [2]

- (b) Josie takes a pencil at random from the box, checks its colour and returns it to the box.
She then takes another pencil at random.

What is the probability that the first pencil is red **and** the second pencil is red?

(b) _____ [2]

- (c) There are 8 yellow pencils in the box.

How many pencils are in the box altogether?

(c) _____ [3]

5 (a) Multiply out.

$$3(7x + 6)$$

(a) _____ [2]

(b) Multiply out and simplify fully.

$$6(y - 5) + 2(3 + 2y)$$

(b) _____ [3]

6 The equation $x^3 - 6x = 4$ has a solution between 2 and 3.

Use trial and improvement to find this solution correct to one decimal place.
Show all your trials and their outcomes.

_____ [4]

7 Anil is doing a traffic survey.

He is recording how much of the traffic approaching his town goes to the town centre and how much uses the ring road around the town.

Every Monday for three weeks, Anil stands at the junction of the road to the town centre and the ring road.

He counts the number of cars going in each of these directions.

Here are his results.

Direction	Number of cars		
Town centre	275	255	241
Ring road	174	195	170

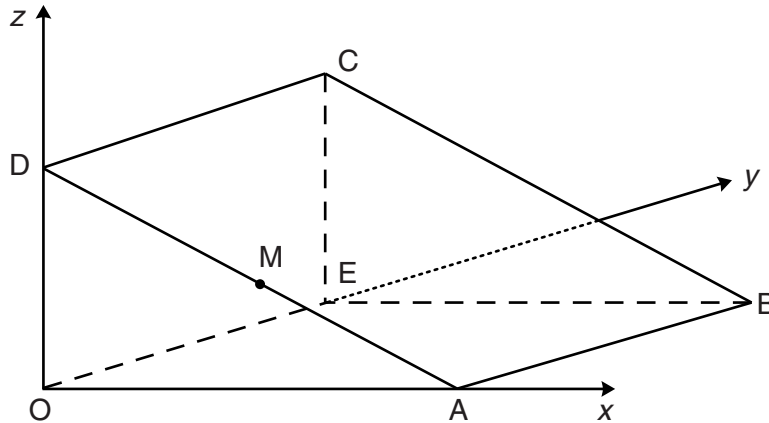
(a) Explain why it is reasonable to estimate the probabilities of cars travelling in each of these directions from this survey.

_____ [1]

(b) Use the figures to estimate the probability that next Monday a randomly chosen car approaching the town will go to the town centre.

(b) _____ [3]

- 8 The diagram shows a triangular prism.
 O is the origin, A is (6, 0, 0), E is (0, 5, 0) and D is (0, 0, 3).
 All lengths are in centimetres.



(a) Write down the coordinates of

(i) C,

(a)(i) (_____ , _____ , _____) [1]

(ii) B,

(ii) (_____ , _____ , _____) [1]

(iii) M, the midpoint of AD.

(iii) (_____ , _____ , _____) [1]

(b) Work out the area of triangle OAD.

(b) _____ cm² [2]

(c) Work out the length BD.

(c) _____ cm [3]

- 9 (a) Write 1.86×10^5 as an ordinary number.

(a) _____ [1]

- (b) This is a formula used in physics.

$$E = mc^2$$

Calculate E when $m = 5 \times 10^{-4}$ and $c = 3 \times 10^8$.
Give your answer in standard form.

(b) _____ [2]

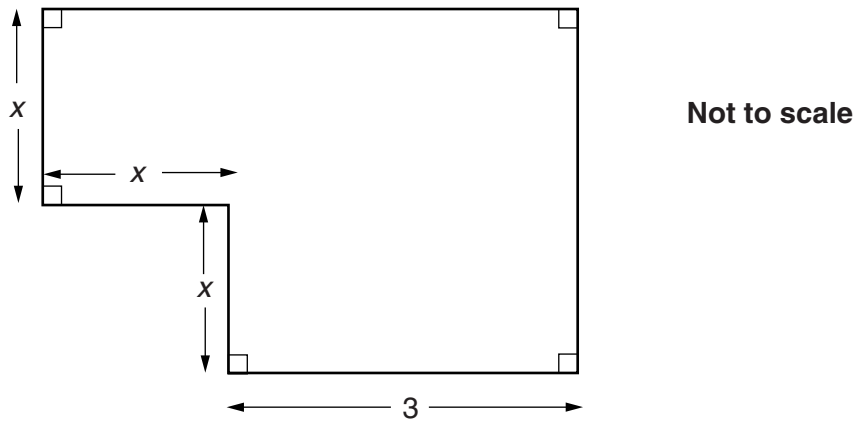
- (c) Rearrange the formula

$$E = mc^2$$

to make c the subject.

(c) _____ [2]

- 10 The diagram shows the plan of a room.
All lengths are in metres.



- (a) Show that the total area of the room, $A\text{m}^2$, can be given by this formula.

$$A = x^2 + 6x$$

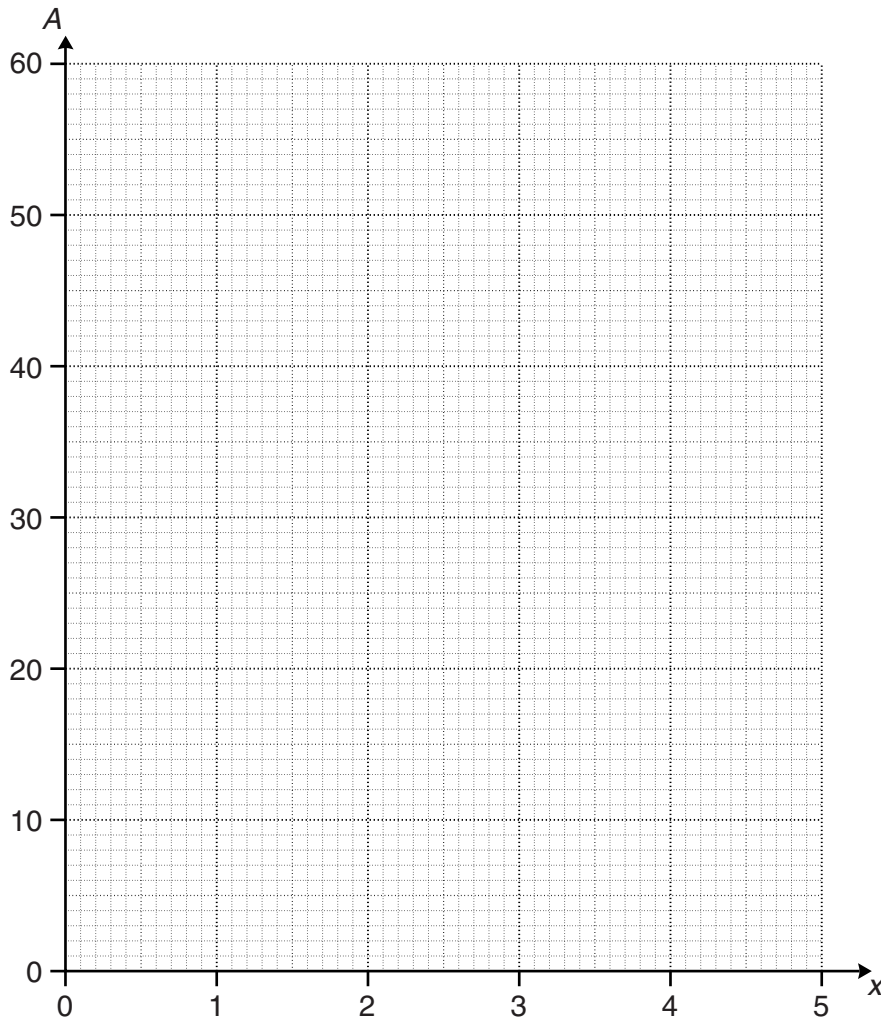
[2]

- (b) Complete the table for $A = x^2 + 6x$.

x	0	1	2	3	4	5
A	0		16	27	40	

[2]

(c) Draw the graph of $A = x^2 + 6x$ for x from 0 to 5.



[2]

(d) The total area of the room is 35 m^2 .

Use your graph to find the length x .

(d) _____ m [1]

11 (a) Solve this quadratic equation by factorisation.

$$x^2 - 7x + 10 = 0$$

(a) _____ [3]

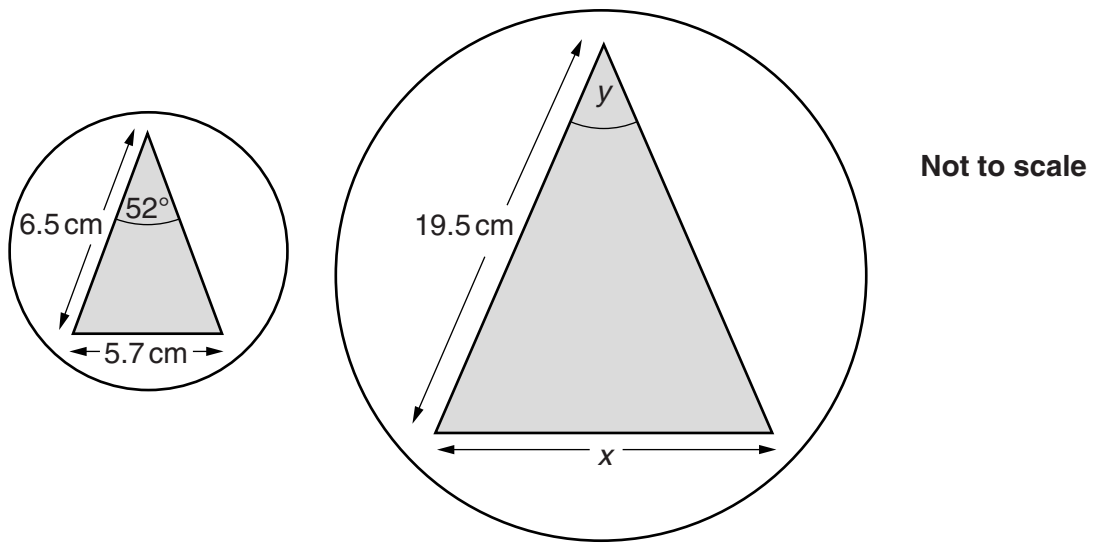
(b) Solve algebraically these simultaneous equations.

$$\begin{aligned}4x + 3y &= 6 \\ y &= 13 - 5x\end{aligned}$$

(b) $x =$ _____

$y =$ _____ [4]

12 These diagrams are mathematically similar.



(a) Calculate the length x .

(a) _____ cm [3]

(b) What is the size of angle y ?

(b) _____ ° [1]

(c) The area of the smaller circle is 51 cm^2 .

Calculate the area of the larger circle.

(c) _____ cm^2 [2]

13 (a) Work out.

$$(\sqrt{3})^2$$

(a) _____ [1]

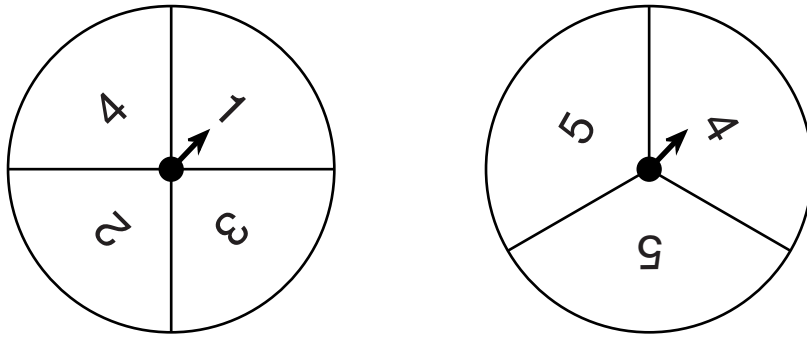
(b) Multiply out and simplify fully.

$$(4 + 5\sqrt{3})(2 + 7\sqrt{3})$$

You must show your working.

(b) _____ [3]

14 The diagram shows two fair spinners.

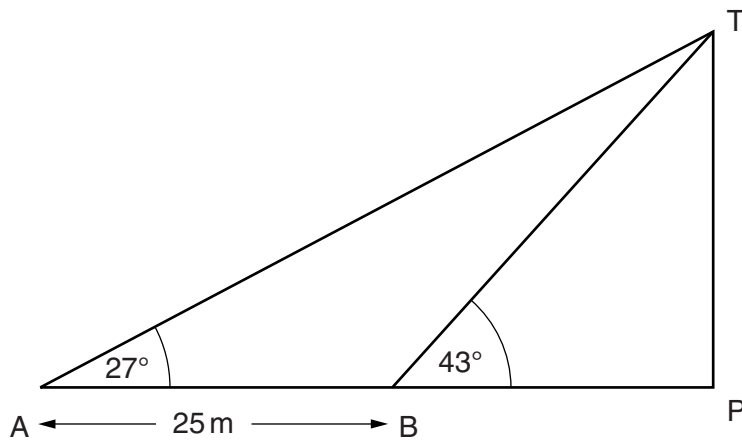


Both spinners are spun and the scores are added together.

Work out the probability that the total of the two scores is 8 or more.
Show your working clearly.

[5]

- 15 TP is a tower on horizontal ground, ABP.
Two straight cables, AT and BT, connect the top, T, of the tower to the ground.



Not to scale

AT and BT make angles with the ground of 27° and 43° respectively.
B is 25m closer to the foot of the tower, P, than A.

Work out the length of the cable AT.

_____ m [4]

16 Peter is using the quadratic formula to solve an equation of the form

$$ax^2 + bx + c = 0.$$

After substituting values and some calculation he arrives at this stage in his working.

$$x = \frac{-5 \pm \sqrt{73}}{4}$$

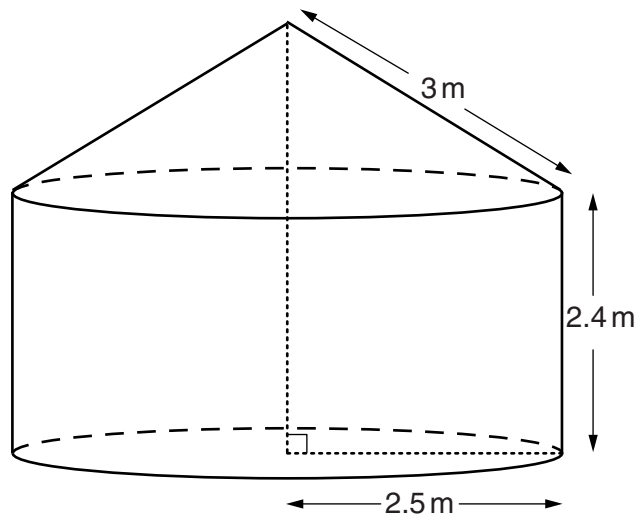
Work out possible values for a , b and c .

$$a = \underline{\hspace{10cm}}$$

$$b = \underline{\hspace{10cm}}$$

$$c = \underline{\hspace{10cm}} \quad [4]$$

17 The diagram shows a tent.



The base of the tent is a circle of radius 2.5 m.
 The walls are vertical and are 2.4 m high.
 The roof of the tent is a cone of slant height 3 m.
 The material to make the tent costs £8.99 per square metre.

Work out the total cost of the material needed to make the walls and roof of the tent.

£ _____ [5]

18 Write as a single algebraic fraction.

$$\frac{x+5}{x-2} - \frac{x}{x-3}$$

[3]

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