

GCSE Mathematics

Calculator

Higher Tier

Free Practice Set 1

1 hour 30 minutes



ANSWERS

Marks shown in brackets for each question (2)

A*	A	B	C	D	E
88	75	60	45	25	15

Legend used in answers

Green Box - Working out

5b means five times b
 $b = -3$ so $5 \times -3 = -15$

Red Box and ✓ - Answer

48 % ✓

Authors Note

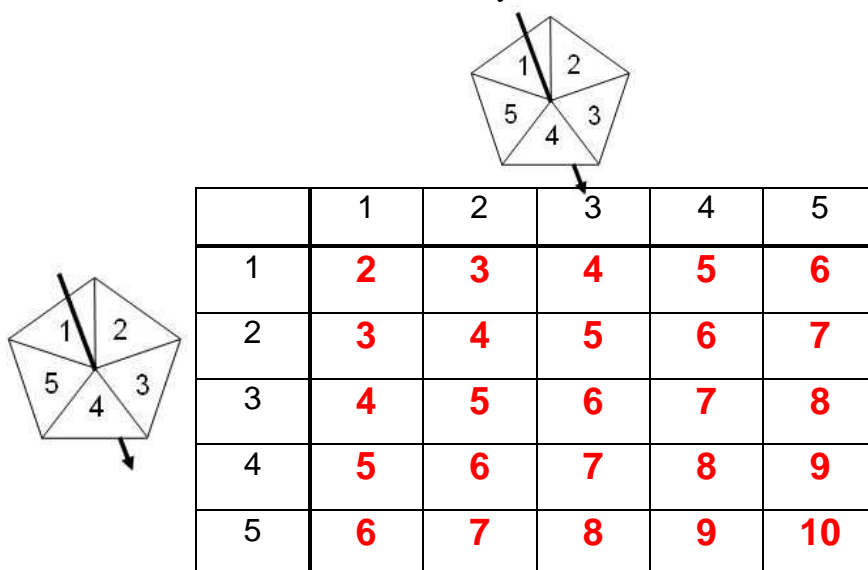
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1. Nadine used two spinners for a game.
He added the scores on both spinners to get a total score

- a) Complete the table showing all the total score combinations.
The first one has been done for you.



- b) What is the probability of getting a total score of 7 or more from the spinners? (1)

In total there are 25 possible scores 5×5

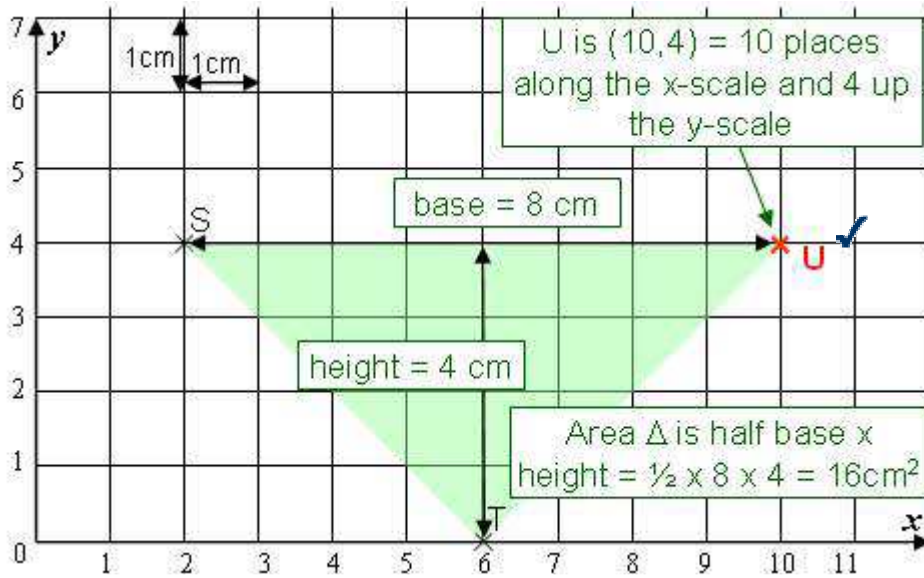
	1	2	3	4	5
1	2	3	4	5	6
2	3	4	5	6	7
3	4	5	6	7	8
4	5	6	7	8	9
5	6	7	8	9	10

A total score of 7 or more can happen 10 times.
Probability (7 or more) = $10 \div 25 = 2/5$

$$\frac{2}{5}$$

(2)

2. Points S and P are shown on the on the centimetre square grid below



a) Mark with a cross and label the point U at the co-ordinates (10, 4)

(1)

b) What is the area of the triangle made by connecting the points S, T and U?

..... **16** . cm²
(2)

3. a) Factorise $3t - 12$

Find a factor that goes into $3t$ and 12
 3 will go into both. Place outside the bracket: $3(t - 4)$

$$4z \times z = 4z^2$$

b) Expand $4z(z - 3)$

$$4z \times -3 = -12z$$

Expanding is the opposite of factorise.
 Use the value outside the brackets and multiply it by the two values inside. Don't forget the minus sign

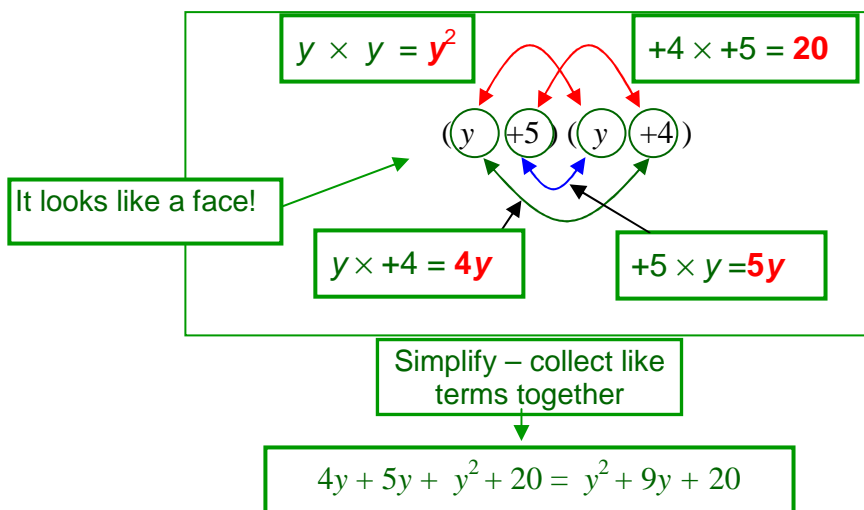
$$3(t - 4)$$

(1)

$$4z^2 - 12z$$

(1)

c) Expand and simplify $(y + 5)(y + 4)$



Double Brackets mean FOUR multiplications

Use **FOIL** to help you remember the 4 multiplications:
First terms
Outer terms
Inner terms
Last terms

OR use a 2×2 grid
 Then simplify

\times	y	$+4$
y	y^2	$+4y$
$+5$	$+5y$	$+20$

$$y^2 + 9y + 20$$

(2)

d) Solve $5(4x - 4) = 5(2x + 9)$

Expand both sides first

$$5 \times 4x = 20x$$

$$5 \times 2x = 10x$$

Solve $5(4x - 4) = 5(2x + 9)$

$$5 \times -4 = -20$$

$$5 \times +9 = 45$$

Then collect terms and simplify to get:

$$20x - 20 = 10x + 45$$

Now solve $20x - 20 = 10x + 45$
Add 20 to both sides
 $20x - 20 + 20 = 10x + 45 + 20$
Subtract 10x from both sides
 $20x - 10x = 10x + 65 - 10x$
 $10x = 65$
Divide both sides by 10
 $x = 6.5$

6.5 ✓

(2)

e) Make z the subject of the formula

$$2x = 4z + 3y$$

We have to get z on one side of the equation and everything else on the other side.

Imagine that each side is different sides of a balance separated by the $=$ sign. To keep it balanced if we change one side we have to change the other side in exact in the same way.

Imagine the values on a pair of scales which are in balance

$$2x = 4z + 3y$$

To get just $4z$ on the right take $3y$ off the scales

$$2x = 4z + 3y - 3y$$
$$2x = 4z$$

When we take $3y$ off the right side the scale becomes unbalanced.

Imagine that we can take off $3y$ from the left side to rebalance the scale

$$2x - 3y = 4z$$

If we divide the right by 4 it will leave us with just z . Do the same to the left side and it stays balanced

$$\frac{2x - 3y}{4} = \frac{4z}{4}$$

Now z is the subject of the formula

$$\frac{2x - 3y}{4} = z$$

Subtract $3y$ from both sides

$$2x - 3y = 4z + 3y - 3y$$
$$2x - 3y = 4z$$

Divide both sides by 4

$$\frac{2x - 3y}{4}$$

$$z = \frac{2x - 3y}{4} \quad (2)$$

f) Solve $3 - 2y = 1 + y$

$$\begin{aligned}
 3 - 2y &= 1 + y \\
 (+2y \text{ both sides}) \quad 3 - 2y + 2y &= 1 + y + 2y \\
 &3 = 1 + 3y \\
 (-1 \text{ both sides}) \quad 3 - 1 &= 1 - 1 + 3y \\
 &2 = 3y \\
 (\div 3 \text{ both sides}) \quad \frac{2}{3} &= y
 \end{aligned}$$

$y = \dots\dots\dots \frac{2}{3} \dots\dots\dots$ (2)

g) Simplify Fully

Remember that $y^2 - 4$ is the
Difference of two squares: (DOTS) = $(y + 2)(y - 2)$

$$\frac{y^2 - 4}{y + 2} \times \frac{4}{y - 4}$$

Expand the DOTs Cancel $y + 2$

$$\frac{y^2 - 4}{y + 2} \times \frac{4}{y - 4} = \frac{(y - 2)(y + 2)}{y + 2} \times \frac{4}{y - 4} = \frac{4(y - 2)}{y - 4} = \frac{4y - 8}{y - 4}$$

$\dots\dots\dots \frac{4y - 8}{y - 4} \dots\dots\dots$ (3)

4. Jenny changed £200 into Australian dollars (Aus\$)
The exchange rate was £1 = Aus\$2.45

a) How many Australian dollars will she get?

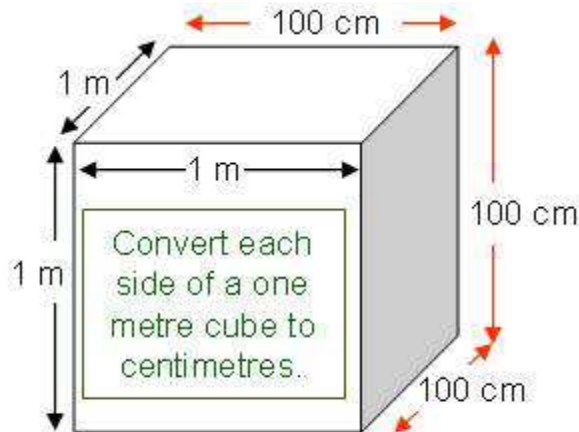
You get more Australian dollars than pounds.
So you multiply by 2.45 to convert pounds into Australian dollars:
 $200 \times 2.45 = 490$

2 0 0 × 2 . 4 5 =

Aus\$ 490 ✓
.....
(2)

b) What is 3 m^3 in cm^3 ?

Don't fall into the trap of thinking that $3 \text{ m}^3 = 100 \text{ cm}^3$
This is wrong because we have only converted metres into centimetres when we have to cube 100

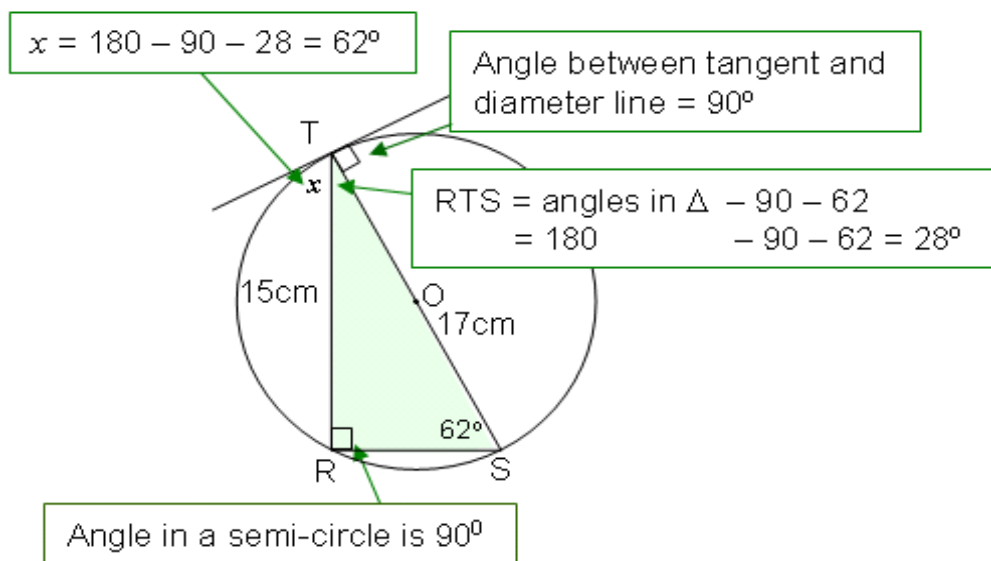


$$\begin{aligned} 1\text{m}^3 &= 1 \text{ m} \times 1 \text{ m} \times 1\text{m} \\ &= 100 \text{ cm} \times 100 \text{ cm} \times 100 \text{ cm} \\ &= 1000000 \text{ cm}^3. \end{aligned}$$

$$1 \text{ m}^3 = 1000000 \text{ cm}^3 \therefore 3 \text{ m}^3 = 3,000,000 \text{ cm}^3$$

3,000,000 ✓
..... cm^3
(1)

5. Three points R, S and T lie on the circumference of the circle centre O.
 A tangent meets the circle at T.
 TS is the diameter of the circle.
 Angle RST = 62°



- a) Work out angle x°

62

(2)

- b) TR = 15 cm and TS = 17cm
 Work out the length of side RS to 1 significant figure

We have a right angled triangle so we can use Pythagoras theorem.

$$\begin{aligned} TS^2 &= TR^2 + RS^2 \\ \text{so } RS^2 &= TS^2 - TR^2 \\ &= 17^2 - 15^2 \\ RS &= \sqrt{(17^2 - 15^2)} = 8 \end{aligned}$$

$$\sqrt{(17^2 - 15^2)} =$$

Alternatively use one of the trigonometry formula e.g. Tan

Tan 62° = opposite side \div adjacent side.

$$\text{so } RS = \frac{15}{\tan 62^\circ} = 7.97 \text{ which is } 8 \text{ to } 1 \text{ significant figure}$$

$$\frac{15}{\tan 62} =$$

8

cm
(3)

6. For her wedding, Laura bought 8 birdcages and 6 metres of material.
 The total cost was £109.98.
 Each birdcage cost £8.79.
 Find the cost of each metre of material.



8 birdcages cost $8 \times £8.79$

$$8 \times 8.79 =$$

70.32

Find the cost of 6 metres of material by subtracting this from the total cost

$$109.98 - 70.32 =$$

39.66

Find the cost of 1 metres of material by dividing this by 6

$$39.66 \div 6 =$$

6.61

6.61

£.....
 (3)

7. A bank pays 5.6% **compound** interest per year on an investment of £6000.
What is the value of your investment after two years?

In this question don't forget that there will be interest on the interest.

In 1st year interest is : $6000 \times 5.6\% = £336$.

6	0	0	0	x	5	.	6	%	=	336
---	---	---	---	---	---	---	---	---	---	-----

So at the end of the first year we have $£6000 + £336 = £6336$.

(We could do this in one go if we did 6000×1.056 . The .056 is the 5.6%)

In the 2nd year interest is: $£6336 \times 5.6\% = 354.82$

6	3	3	6	x	5	.	6	%	=	354.82
---	---	---	---	---	---	---	---	---	---	--------

So at the end of the second year we have $£6336 + £354.82 = £6690.82$

Alternatively: $6000 \times (1.056)^2 = 6690.82$ where .056 = 5.6%, 2 = years

6	0	0	0	x	1	.	0	5	6	x^2	=
---	---	---	---	---	---	---	---	---	---	-------	---

£..

6690.82

(3)

8. Jane paid a £126 sale price for a coat with 25% off the original price. How much was the coat originally?

**Sale
25% off original price**

It's **NOT** 25% of £126 !!!! because £126 was NOT the original price

The original price is reduced by 25% so, £126 is 75% or 0.75 of the original price.

If we say the original price is O and the sale price is S we can make an equation:

$$O \times 0.75 = S$$

and

$$O = S \div 0.75$$
$$O = 126 \div 0.75 = 168$$

Sale price 75% = 0.75

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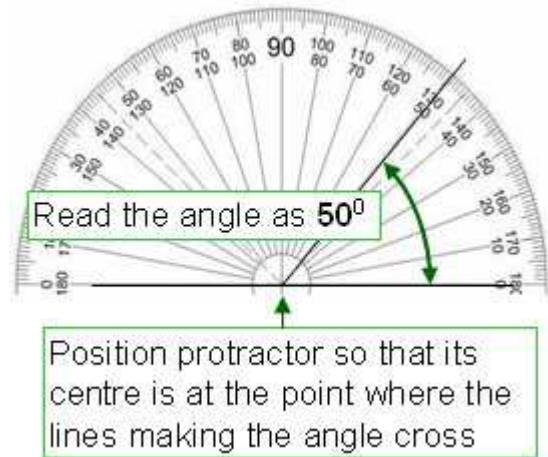
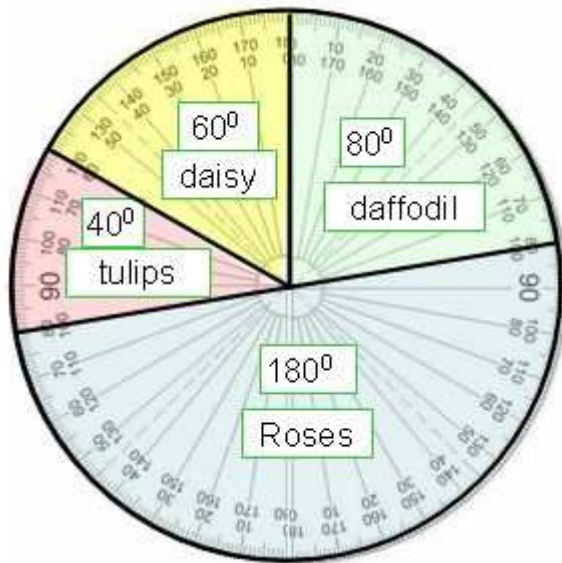
$$\boxed{1} \boxed{2} \boxed{6} \boxed{\div} \boxed{.} \boxed{7} \boxed{5} \boxed{=} \boxed{168}$$

£..... (3)

To do these sorts of questions convert the % to a decimal and divide the sale price by this to get the original price.

9. A survey of 90 people's favourite flowers for Valentine's Day is shown in the accurate pie chart

Diagram accurately drawn



Use the pie chart to complete the table.

Favourite flower	Frequency	Angle
Roses	45	180°
Tulip	10 ✓	40 ✓
Daffodil	20	80 ✓
Daisy	15 ✓	60 ✓
Total	90	360 ✓

The roses are 180 degrees and equal a frequency of 45.
So a frequency of 1 is $180 \div 45 = 4$ degrees.

Daffodils have a frequency of 20 peoples so in degrees they are:
 20×4 degrees = 80 degrees.

Now measure using a protractor.

Tulips measures 40°. To convert this to a frequency do $40 \div 4 = 10$

Daisies measure 60°. To convert this to a frequency do $60 \div 4 = 15$

Check by adding up frequencies = $45 + 10 + 20 + 15 = 90$

Angles $180 + 40 + 80 + 60 = 360$

(2)

10. What is

a)

$$\sqrt{(4.5 + 7.8)}$$

Make sure you add 4.5 and 7.8 before doing the square root
Using brackets tells your calculator to do this

✓ (4 . 5 + 7 . 8) = $\sqrt{12.3}$... 3.51 ✓ (1)

$\sqrt{12.3} = 3.507$. To 2 decimal places this is 3.51

or

4 . 5 + 7 . 8 = ✓ =

b) πr^2 when $r = 3.25$

$$3.25^2 \pi r^2 = \pi \times 3.25^2$$

get π using shift π

The x^2 button squares 3.25

or

shift π x 3 . 2 5 x^2 =

shift π x 3 . 2 5 x 3 . 2 5 = 33.187

To 1 decimal place 33.187 is 33.2

33.2 ✓ (1)

c)

$$\frac{1}{0.25^2}$$

Work out 0.25^2 first = $0.25 \times 0.25 = 0.0625$
Then use the $1/x$ button

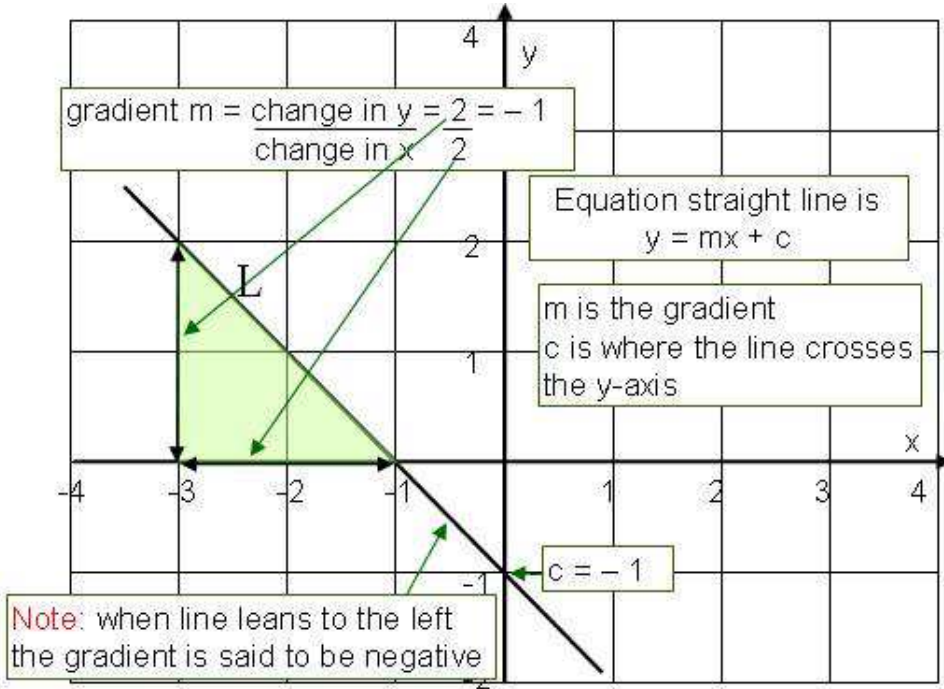
0 . 2 5 x 0 . 2 5 = 1/x = 16 ✓ (1)

or

0 . 2 5 x^2 1/x =

The x^2 button squares 0.25

11.



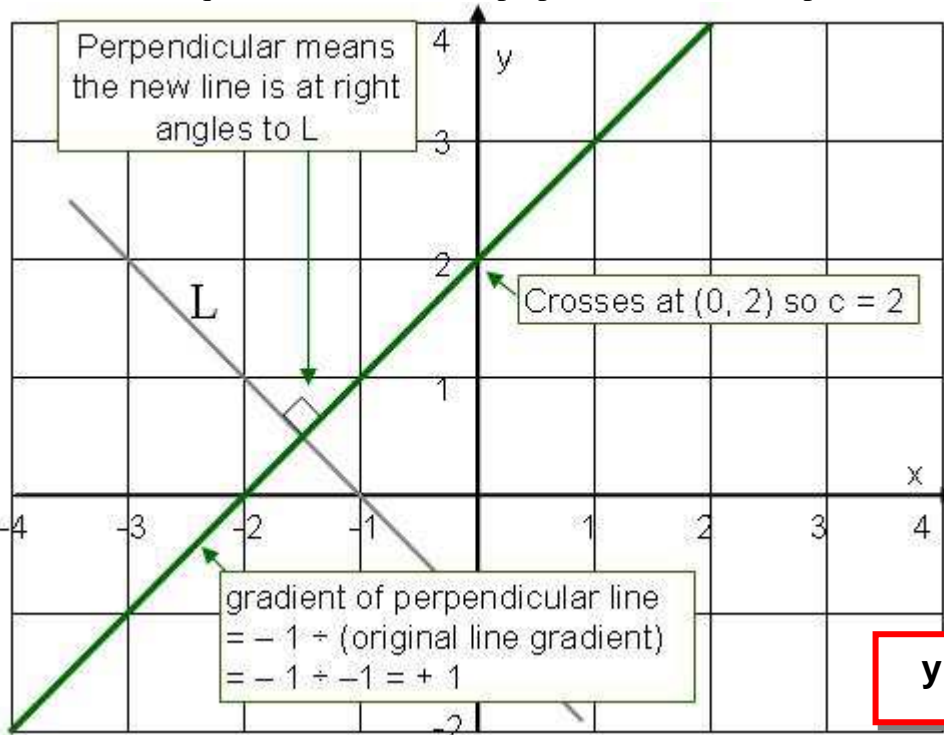
- a) A line L is shown on the grid above.
What is the equation of line L?

A line equation can be written as $y = mx + c$
Where m is the gradient or steepness of the line and C is where the line crosses the y -axis.
We have $y = -1x - 1$ or have $y = -x - 1$

$y = -x - 1$

(2)

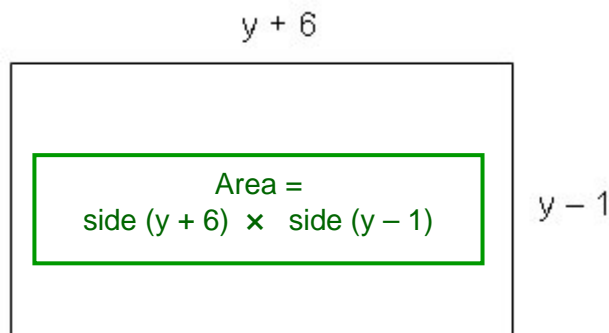
- b) What is the equation of a line that is perpendicular to L and passes through (0,2)



$y = x + 2$

..... (2)

12.



a) Show that the area A of the rectangle above is $A = y^2 + 5y - 6$

Expand and simplify $(y + 6)(y - 1)$

Double Brackets mean FOUR multiplications

Use **FOIL** to help you remember the 4 multiplications:
First terms
Outer terms
Inner terms
Last terms

Simplify and collect like terms together

$$6y - 1y + y^2 - 6 = y^2 + 5y - 6$$

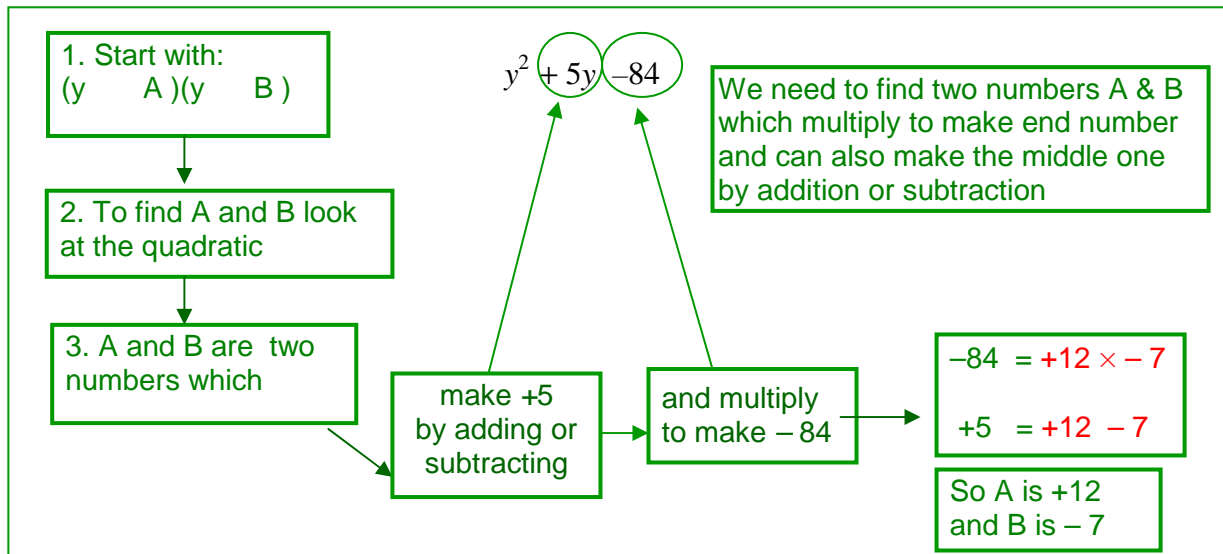
Since area $A =$ side $(y + 6) \times$ side $(y - 1)$ then

$$A = y^2 + 5y - 6$$

(2)

- b) The area is 78 cm^2 . Work out the value for y .

Area = $y^2 + 5y - 6 = 78$
 (- 78 both sides) $y^2 + 5y - 84 = 0$
 This is a Quadratic equation and we need to factorise it to solve it.



Rewrite $y^2 + 5y - 6 = 0$ as $(y + 12)(y - 7) = 0$

If two numbers multiply to make zero it means either of them or both of them = 0 .

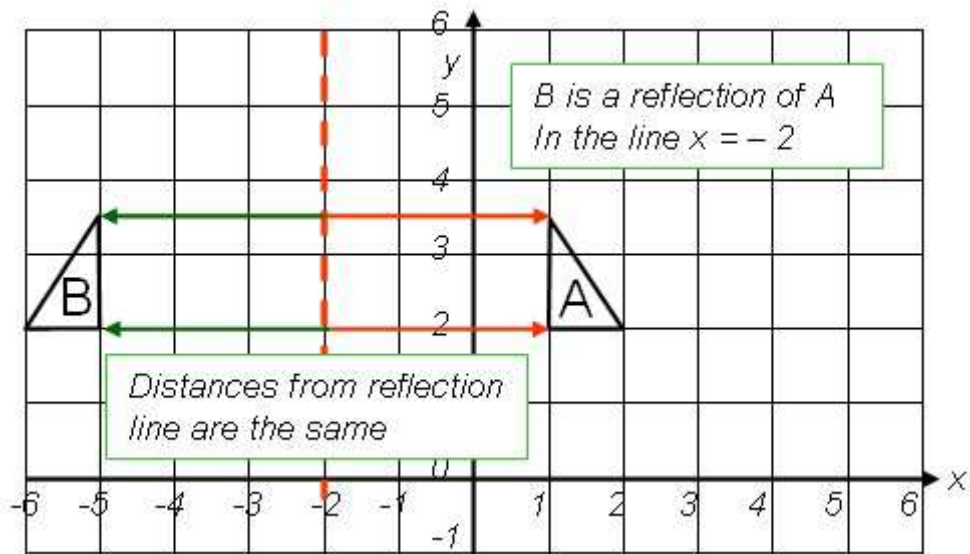
So $(y + 12) = 0$ or $(y - 7) = 0$
 So $y = -12$ or $y = +7$

y must be +7 because the side of the rectangle cannot have a negative length which it would be if we picked $y = -12$

7 ✓

(4)

13.



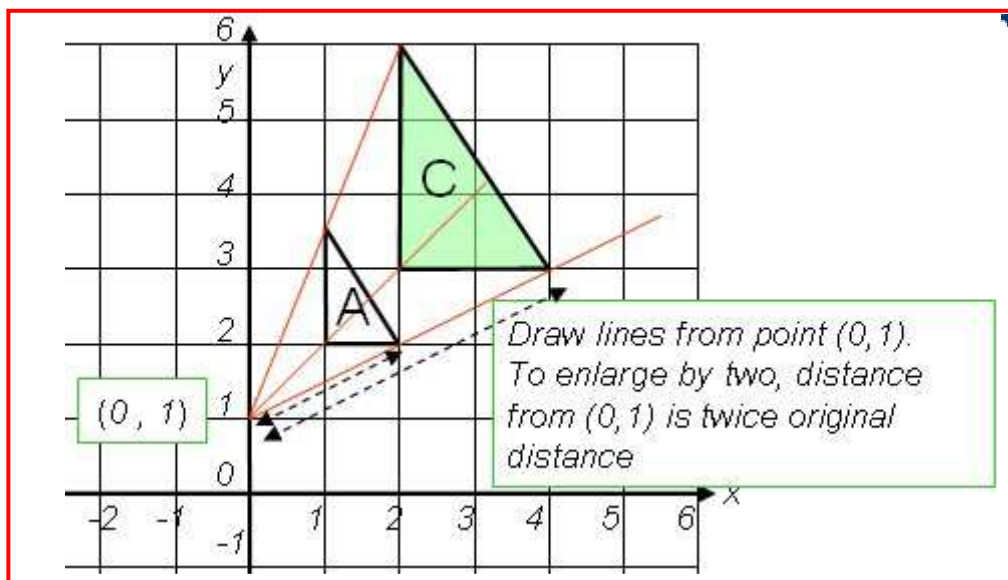
a) What is the single transformation that maps shape A onto shape B

B is a reflection of A in the line $x = -2$

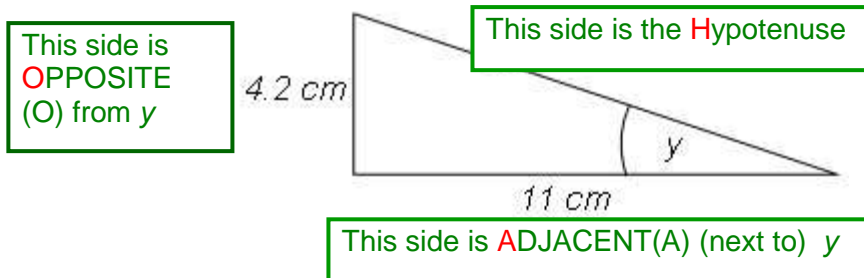
(2)

b) Enlarge shape A with scale factor 2 and centre of enlargement (0,1)
Label the new shape C

(2)

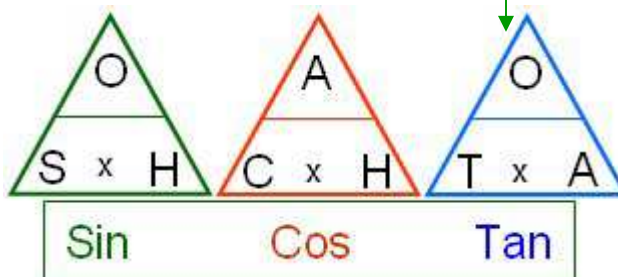


14.



A triangle is shown with sides 4.2 cm and 11 cm.
Calculate the size of angle y
Give your answer to 3 significant figures.

Which Trig formula do we want?
Find the one that has **A** and **O**.
It's **TAN**



Cover up **T** because we want to find this and the formula is $T = \frac{O}{A}$

REMEMBER:
Use \tan^{-1} on your calculator

$$\tan^{-1} y = \frac{4.2}{11} = 20.897$$

3 significant figures
round up to 20.9

4 . 2 ÷ 1 1 = shift \tan^{-1} =

$y = \dots\dots$ 20.9 $\dots\dots^\circ$

(3)

15. Over a six month period in 2008, the average monthly value of the FTSE on the London stock exchange changed as shown below:

May	June	July	August	September	October
6200	6000	5550	5300	5600	4000

- a) In which month did the trend reverse?

From May to October the values decrease so the trend is downwards. However in September it increased from the month before.

September ✓

.....
(1)

- b) What was the percentage decrease to 1 decimal place between May and October?

From May to October the FTSE fell by $6200 - 4000$ points = 2200

The percentage decrease = $\frac{\text{Fall between May to October} \times 100 \%}{\text{Original value in May}}$

$$= \frac{2200}{6200} \times 100 = \frac{2200}{62} = 35.48$$

2 2 0 0 × 1 0 0 ÷ 6 2 0 0 =

35.5 ✓

.....%
(2)

16. a) Simplify $y^9 \times y^3$

When you multiply powers they ADD

y^{12} ✓ (1)

b) Simplify $(y^6)^3$

We have $(y \times y \times y \times y \times y \times y)^3$ so we have y times itself 18 times. In this example the powers MULTIPLY

y^{18} ✓ (1)

c) Simplify $(4x^2)^{-1/2}$

The power $\frac{1}{2}$ means square root. When it also has a minus it means a reciprocal (one over the amount)

$$(4x^2)^{-1/2} \text{ is } \frac{1}{(4x^2)^{1/2}} = \frac{1}{\sqrt{4x^2}} = \pm \frac{1}{2x}$$

$\sqrt{4x^2}$ is $\pm 2x$ because the $\sqrt{4}$ is ± 2 and the $\sqrt{x^2}$ is $\pm x$

$\pm \frac{1}{2x}$ ✓

d) Simplify $y^9 \div y^3$

When you divide powers they SUBTRACT

y^6 ✓ (1)

e) Express in standard form 0.000056

To convert a number to standard form count the jumps needed to get the decimal point between the first two numbers.

Start at the decimal point

b) 0.000056

Jump over digits going Right until you are just before last digit

We made 5 jumps Right so we get 10^{-5}

5.6×10^{-5} ✓

(1)

17. The mass of the planet Venus is 4.869×10^{24} kg
 The mass of the Sun is 408 000 times the mass of Venus.

Work out the mass of the Sun.

Give your answer in standard form correct to 3 significant figures.

$$\begin{aligned} \text{Sun} &= 408\,000 \times 4.869 \times 10^{24} \text{ kg} \\ \text{Sun} &= 4.08 \times 10^5 \times 4.869 \times 10^{24} \\ \text{Sun} &= 4.08 \times 10^{29} \times 4.869 \\ \text{Sun} &= 19.865 \times 10^{29} \\ \text{Sun} &= 1.9865 \times 10^{30} \\ \text{Sun} &= 1.99 \times 10^{30} \text{ (3 sf)} \end{aligned}$$

Standard form only has one digit before the decimal place, multiplied by 10 to a power.
 e.g. 1.2×10^5 ; 3.22×10^{11}

We have to convert this line to standard form by dividing the 19.865 by 10 and adding one to the power to compensate.

$$1.99 \times 10^{30} \text{ kg}$$

(2)

$$4 \ 0 \ 8 \ 0 \ 0 \ 0 \ \times \ 4 \ . \ 8 \ 6 \ 9 \ \times$$

$$1 \ 0 \ x^y \ 2 \ 4 \ =$$

The button x^y does the 10 to the power 24.

18. a) At a car boot sale, Matthew buys CDs and DVDs. He buys x CDs and y DVDs. In total he buys 23 items. The CDs cost 50p each and the DVDs cost 65p each. Altogether he spends 13.15.

State this information as a pair of simultaneous equations

Using algebra to make an equation:
 We have x CDs where x is a certain number of CDs
 Plus y DVDs where y is also a number of DVDs
 Together we have 23 items so we can say
 $x + y = 23$

Each CD costs 50p and we have x CDs so the total cost of CDs is:
 Number of CDs \times cost per CD = $x \times 50 = 50x$
 The total cost of DVDs is:
 Number of DVDs \times cost per DVD = $y \times 65 = 65y$

In total we have spent £13.15. Since we have priced the CD and DVD in pence we have to convert this to pence = 1315 p
 So $50x + 65y = 1315$

$$\begin{aligned} x + y &= 23 \\ 50x + 65y &= 1315 \end{aligned}$$

$$\begin{aligned} x + y &= 23 \\ 50x + 65y &= 1315 \end{aligned}$$

(2)

- b) Solve these simultaneous equations algebraically to find out how many CDs and DVDs he buys.

$$\begin{aligned} 50x + 65y &= 1315 & i \\ x + y &= 23 & ii \end{aligned}$$

Simultaneous equations are two equations with the same values for x and y

Often we can just add or subtract equations to eliminate x or y . But this time it's harder - first we have multiply one equation so x or y is the same as the other equation

$$\begin{array}{r} 50x + 65y = 1315 \quad i \\ \times 50 \rightarrow 50x + 50y = 1150 \quad ii \\ \hline - \\ 15y = 165 \end{array}$$

Multiply line ii by 50 so x becomes $50x$ then we can subtract it from the line above to eliminate x

Now subtract the two equations to eliminate y

So $y = 165 \div 15 = 11$

SUBSTITUTE $y = 11$ in one of the equations

$$\begin{aligned} x + y &= 23 \\ x + 11 &= 23 \text{ so } x = 12 \end{aligned}$$

CD = 12

DVD = 11

(2)

19. A sixth form has the following numbers of students

Years and gender	Number
Year 12 boys	195
Year 12 girls	210
Year 13 boys	105
Year 13 girls	145

The head of sixth form wants to take a sample, stratified by each group of the members of the sixth form.

'Strata' means 'layer'. A stratified sample is made up of different 'layers'.

The sample size is 50

Work out the number of **male** students that should be in the sample.

The proportion of males in the sample has to be the same as the proportion in the entire population of students

The entire population of students is $195 + 210 + 105 + 145 = 655$
Proportion of males = $195 + 105 \div 655 = \frac{300}{655}$

So proportion of males in sample of 50 is $\frac{300}{655} \times 50 = 22.9$ or round to 23

5 0 ÷ 6 5 5 × 3 0 0 =

23

(3)

20. Express $\frac{5}{2-\sqrt{3}}$ in the form $a + b\sqrt{3}$

This is a SURDs question.

We need to make the denominator rational.

To do this multiply both top and bottom by $2 + \sqrt{3}$. (sign change from original)

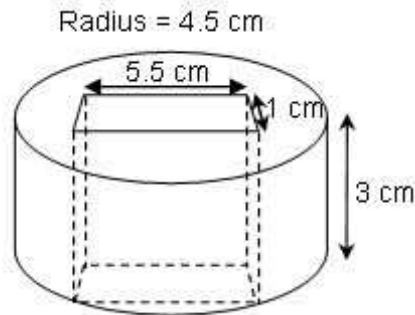
$$\frac{5}{2-\sqrt{3}} \times \frac{2+\sqrt{3}}{2+\sqrt{3}} = \frac{10+5\sqrt{3}}{4+\underbrace{2\sqrt{3}-2\sqrt{3}}_{=3}-\underbrace{\sqrt{3}\sqrt{3}}_{=3}} = \frac{10+5\sqrt{3}}{4-3} = 10+5\sqrt{3}$$

Notice that these parts are opposite so cancel out.

$$\boxed{10 + 5\sqrt{3}}$$

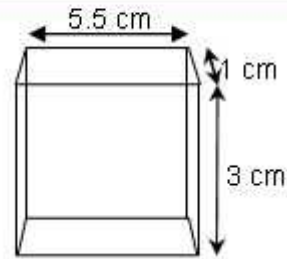
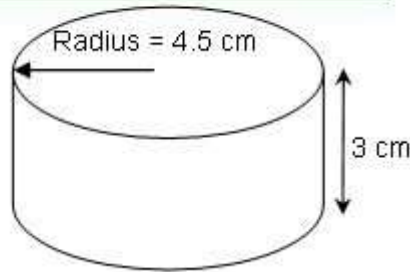
(3)

21. A shape is made from a cylinder of radius 4.5 cm and height 3 cm with a cuboid measuring 5.5cm wide and 1 cm deep cut out of the centre .
- a) Work out the volume of the shape to 2 decimal places



$$\text{Volume cylinder is } \pi r^2 \times \text{height} \\ = 3.142 \times 4.5 \times 4.5 \times 3 \text{ cm}^3$$

$$\text{Volume cuboid width} \times \text{depth} \\ \times \text{height} = 5.5 \times 1 \times 3 \text{ cm}^3$$



volume cylinder	π	\times	4	.	5	\times^2	\times	3	=	190.85
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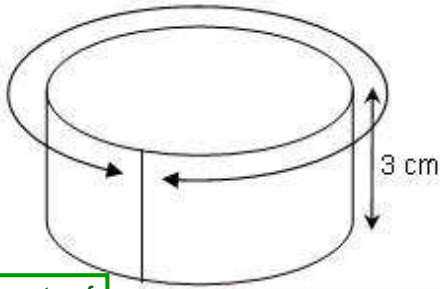
volume cuboid	5	.	5	\times	1	\times	3	=	16.5
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$$\begin{aligned} \text{Volume shape} &= \text{volume cylinder} - \text{volume cuboid} \\ &= 190.85 - 16.5 \\ &= 174.35 \text{ cm}^3 \end{aligned}$$

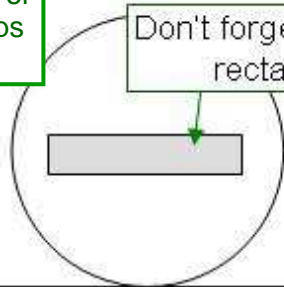
$$174.35 \text{ cm}^3$$

(2)

b) Work out the surface area of the shape to 3 significant figures.

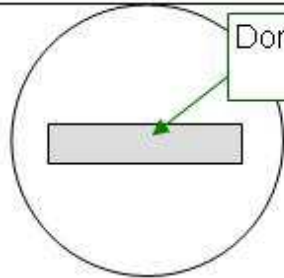


Using a net of the shape helps

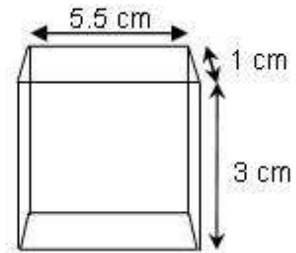


Don't forget to subtract this rectangular area

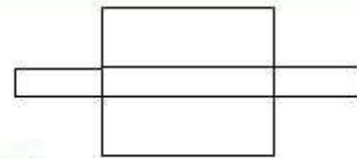
Surface area cylinder
= top + bottom circles + side of cylinder



Don't forget to subtract this rectangular area



Surface area cuboid is four sides shown below excluding top and bottom
= $5.5 \times 3 \times 2$
+ $3 \times 1 \times 2$ cm^2



$$\begin{aligned} \text{Surface area top + bottom circles} &= 2 \times \pi r^2 \\ &= 2 \times 3.142 \times 4.5 \times 4.5 \\ &= 127.25 \text{ cm}^2 \end{aligned}$$

$$2 \times \pi \times 4.5^2 =$$

But we have to remove the rectangle top and bottom from this = $5.5 \times 1 \times 2 \text{ cm}^2$
= 11 cm^2

$$\begin{aligned} \text{Side of cylinder} = 2\pi r \times \text{height} &= 2 \times 3.142 \times 4.5 \times 3 \\ &= 84.83 \text{ cm}^2 \end{aligned}$$

$$2 \times \pi \times 4.5 \times 3 =$$

Add Surface area of 4 sides of cuboid = $5.5 \times 3 \times 2 + 3 \times 1 \times 2 = 39 \text{ cm}^2$

Total surface area = $127.25 - 11 + 84.83 + 39 = 240 \text{ m}^2$

240cm² ✓

(3)

22. Solve $y^2 + 6y - 50 = 0$

Give your answer correct to 3 significant figures.

Because it says the answer is to 3 sf it means that we can't factorise this equation and we either do it by completing the square or using the quadratic formula.

When we complete the square our answer is in the form $(y + a)^2 - b$.

$$y^2 + 6y \rightarrow (y + 3)^2$$

$\text{Halve } 6 = 3$

Work on the first two terms first. Look at the number for the y term and **halve** it. Put this number inside the squared bracket as shown.

$$y^2 + 6y = (y + 3)^2 - 9$$

$\text{Subtract } 3^2 = 9$

There will be an extra value created by the squaring the number in the bracket. To make both sides of the equation equal we have to subtract it.

$$y^2 + 6y - 50 = (y + 3)^2 - 9 - 50$$

$$= (y + 3)^2 - 59$$

Finally we have to put the third term back and then simplify the equation

Solve	$(y + 3)^2 - 59 = 0$	
	$(+ 59)$	$\therefore (y + 3)^2 = 59$
	$\sqrt{\quad}$	$\therefore y + 3 = \pm\sqrt{59}$
	$(- 3)$	$\therefore y = \pm\sqrt{59} - 3$
		$= \pm 7.681 - 3$
		$= -10.68 \text{ or } 4.68$

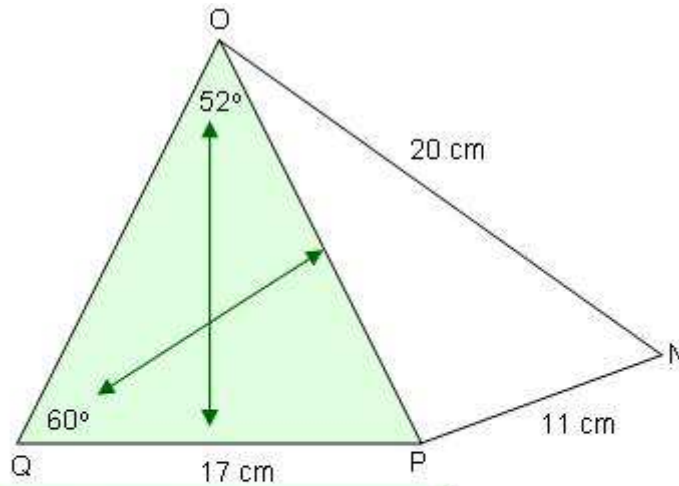
$y = -10.7 \text{ or } 4.68$

(3)

23. In the diagram below, angle QOP = 52° and angle OQP = 60°.
 PN = 11 cm, ON = 20 cm and QP = 17 cm.

When we have a triangle *without a right angle* we use the **sine or cosine rule**.

- a) Find the length of OP correct to one decimal place



Use Sine rule since we have angles opposite sides we know or need to find

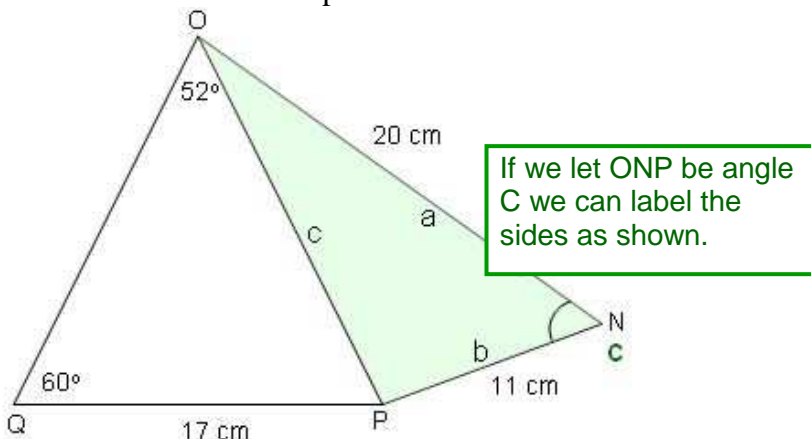
$$\frac{17}{\text{Sine } 52^\circ} = \frac{OP}{\text{Sine } 60^\circ}$$

Rearranging we get: $OP = \frac{17 \times \text{Sin } 60}{\text{Sin } 52} = \frac{17 \times 0.866}{0.899} = 18.68$

1 7 x sin 6 0 ÷ sin 5 2 =

18.7 cm
 (2)

b) Find the angle ONP correct to one decimal place



If we let ONP be angle C we can label the sides as shown.

Now we have OP we can use Cosine rule to find angle ONP
 $c^2 = a^2 + b^2 - 2ab \cos C$
 $\cos C = \frac{a^2 + b^2 - c^2}{2ab}$

Convert to degrees with \cos^{-1}

$$\cos C = \frac{20^2 + 11^2 - 18.68^2}{2 \times 20 \times 11} = \frac{400 + 121 - 348.9}{440} = 0.391 \rightarrow 66.98^\circ$$

2 0 x² + 1 1 x² - 1 8 . 6 8 x² =

÷ (2 x 2 0 x 1 1) = Cos⁻¹ 0.391

Use brackets to make sure all bottom calculations are done together

Convert to degrees with this button. Press shift Cos

67.0

0
(3)

c) Calculate the area of the triangle NOP
 Give your answer correct to three significant figures.

Remember area of $\Delta = \frac{1}{2} a b \sin C$
 $= \frac{1}{2} \times 20 \times 11 \times \sin 67 = \frac{1}{2} \times 11 \times 20 \times 0.92 = 101.2$

0 . 5 x 2 0 x 1 1 x Sin 6 7 =

101.2 to 3 significant figures is 101

y = 101

cm²
(3)

24. Jane recorded how long it took her to jog to school.
She jogged a distance of 945 m, correct to the nearest 1m, in a time of 400 seconds correct to the nearest 10 seconds.

a) For the distance she jogged what is the upper bound?

Upper and Lower Bounds are related to accuracy. Once you know the degree of accuracy to which a measurement has been rounded, you can then find the Upper and Lower bounds.

The Upper Bound is the biggest possible value the measurement can have before it is rounded down.

The Lower Bound is the smallest possible value the measurement can have before it was rounded up

Note: Measured value	= V
Take the level of accuracy A	
Divide by two: A/2	
The Bounds	= $\pm A/2$
Lower Bound	= $V + A/2$
Upper Bound	= $V - A/2$

We want 945m to the nearest metre.
So Accuracy = 1m and Bounds will be ± 0.5 m
Upper bound = $945 + 0.5 = 945.5$ m.

945.5

m

(1)

b) Calculate her maximum possible average speed, in metres per minute.
Write down all the figures on your calculator display

Speed = Distance \div Time
The maximum Speed is when we have
an **upper bound for Distance** and
a **lower bound for Time**



We already have the upper bound for distance = 945.5 m.

For time the level of accuracy A = 10 seconds
So the bounds will be ± 5 seconds

The lowest bound for time = 395s.

We have to convert to metres per minutes so remember to multiply by 60

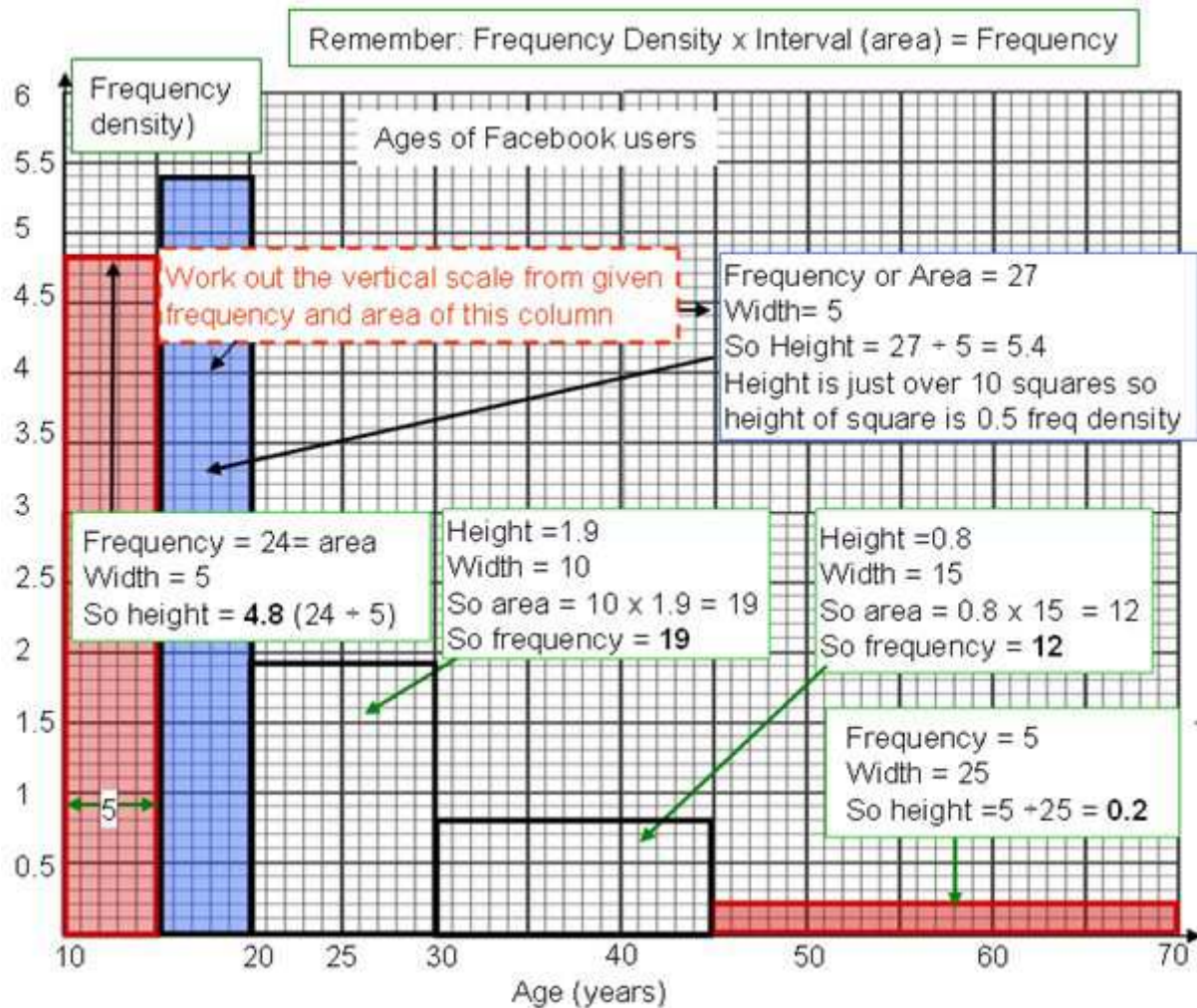
$$\begin{aligned} \text{Speed} &= \frac{\text{Upper bound distance}}{\text{Lower bound time}} = \frac{945.5}{395} \times 60 \\ &= 143.62025 \text{ m/m} \end{aligned}$$

143.62025

m/m

(2)

25. The table and histogram show information about the age of internet Facebook users



a) Use the histogram to complete the table

(2)

Age (t years)	Frequency
$10 < t \leq 15$	24
$15 < t \leq 20$	27
$20 < t \leq 30$	19 ✓
$30 < t \leq 45$	12 ✓
$45 < t \leq 70$	5

b) Use the table to complete the histogram

(2)

TOTAL FOR PAPER: 100 MARKS

END