THE BRITISH INTERNATIONAL SCHOOL ABU DHABI

A NORD ANGLIA EDUCATION SCHOOL

Year 9 Maths

Topic 13–14–15–16 Workbook

In the table below translate the key terms into your home language and write a short definition for each term [if needed visit www.mathsisfun.com/definitions/].

TOPIC 13 – STANDARD FORM		
Integer		
Scientific Notation		
Normal Form		
TOPIC 14 – DECIMALS		
Recurring Decimal		
Fraction		
Convert		
TOPIC 15 – TRIGONOMETRY AND PYTHAGORAS' THEOREM		
Pythagoras' Theorem		
Trigonometry		
Acute Angle		
Right-Angled Triangle		
TOPIC 16 – GRAPHS		
Linear Graph		
Quadratic Graph		
y-intercept		
Gradient		

Powers of 10

1. Fill in the boxes with numbers to show the powers of 10.

$10 \times 10 = 10^{\square}$ $\qquad$ $100\,000 = 10^{\square}$

$10^3 = \square$ $\qquad$ ten thousand $= \square = 10^{\square}$

2. Circle the odd one out.

$\sqrt{100}$ $\qquad$ 10 $\qquad$ 0.01×100 $\qquad$ $\sqrt[4]{10\,000}$ $\qquad$ $100 \div 10$ $\qquad$ $\sqrt[3]{1000}$

3. Put each box into one of the bins, so that each bin contains boxes of the same value.

10^3 $\qquad$ 10^6 $\qquad$ 1000×100

$100\,000$ $\qquad$ 1000^2 $\qquad$ $10\,000 \div 10$

100^3 $\qquad$ 1000 $\qquad$ 10^5

Bin 1	Bin 2	Bin 3

4. To go from the number on the left to the number on the right, you need to multiply or divide by a power of 10. Fill in the boxes with the correct powers.

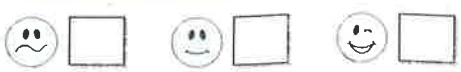
$4 \xrightarrow{\times 10^{\square}} 4000$ $\qquad$ $165 \xrightarrow{\times 10^{\square}} 16\,500$ $\qquad$ $0.25 \xrightarrow{\times 10^{\square}} 2500$

$780 \xrightarrow{\div 10^{\square}} 7.8$ $\qquad$ $0.1 \xrightarrow{\div 10^{\square}} 0.0001$ $\qquad$ $4300 \xrightarrow{\div 10^{\square}} 0.43$

How did you do?

The powers of 10 are 10, 100, 1000, etc. They're pretty useful, I have to admit, but I'd rather have a power like invisibility or telekinesis... You should have the power to:

☐ **Recognise powers of 10.** ☐ **Calculate with powers of 10.**



Standard Form

1. Which of these numbers is 1.2×10^3 as an ordinary number? Circle your answer.

1.2000 | 12 | 120 | 1200 | 12 000

2. Fill in the boxes to write these numbers in standard form.

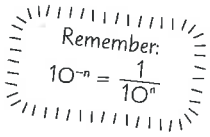
200 000 = ☐ × 10☐ 54 000 = ☐ × 10☐ 127 000 = ☐ × 10☐

3. The Earth is approximately 149 000 000 km away from the Sun.

Write this distance in standard form.

..... km

4. Convert these numbers from standard form to ordinary decimals.



The first one has been done for you.

1.8×10^{-1} = 0.18 2.5×10^{-2} = ... 3.84×10^{-3} = ...

5. Write these numbers in standard form.

0.05 = ... 0.807 = ... 0.00261 = ...

6. The world's smallest known insect* has been known to have a body length of as little as 0.000139 m.

Write this length in standard form.

..... m

7. Stanley is throwing a number party. Only numbers in standard form are allowed in.

a) Circle the numbers that are **not** written in standard form.

0.6×10^6 8×10^{-5} 0.54×10^{-12} 8.6×10^9 10×10^3 44×10^7 1×10^2

b) Write each number that you've circled above in standard form.

.....

*A male *dicopomorpha echmepterygis* fairyfly

Standard Form

8. Write these numbers in order from smallest to largest.

Leave each number in standard form.

1.2×10^5 1.2×10^{-5} 1.2×10^6 2.1×10^5 2.1×10^{-6}

....., ..., ..., ..., ...

9. The colour of light depends on its wavelength.

You don't need to know the science to answer this question. Work with the given numbers.

a) Fill in this table showing the wavelength of different colours.

Colour	Wavelength	Standard Form
Red (R)	0.000000685 m	..... m
Green (G)	..... m	5.2×10^{-7} m
Blue (B)	0.00000046 m	..... m

b) Yellow (Y) light has a wavelength of 5.8×10^{-7} m. Which of these sequences is the correct order of these colours, from the smallest to largest wavelength? Circle your answer.

B Y G R B G Y R R G Y B R Y G B

10. Work out these calculations.

$(3 \times 10^2) \times (2 \times 10^3) =$ ..... $\times 10^{\cdots\cdots}$ $(6 \times 10^6) \div (2 \times 10^3) =$ ..... $\times 10^{\cdots\cdots}$

11. Riad wants to calculate 0.002×0.0004.

a) Use power laws to write $10^{-3} \times 10^{-4}$ as a single power of 10. .....

b) (i) Calculate $(2 \times 10^{-3}) \times (4 \times 10^{-4})$. Write your answer in standard form. .....

(ii) Write down 0.002×0.0004 as a decimal number. .....

How did you do?

From zero to hero — you're all done. Standard form is useful for writing down very big and very small numbers, as well as for doing calculations with such numbers. You should be able to:

- ☐ **Change between ordinary and standard form for large numbers.**
- ☐ **Change between ordinary and standard form for small numbers.**
- ☐ **Compare and order numbers in standard form.**
- ☐ **Calculate with numbers in standard form.**

Standard form

B 1 (a) Write 67 000 in standard form.

Exam questions similar to this have proved especially tricky – be prepared! ResultsPlus

Guided 67 000 = ... × 10.....

(1 mark)

EXAM ALERT

(b) Write 2×10^{-5} as an ordinary number.

Guided 2×10^{-5} = ...

(1 mark)

(c) Write 760×10^4 in standard form.

Guided 760×10^4 = ...

First write the number as an ordinary number.

= ..... × 10.....

(1 mark)

B 2 (a) Write 0.54 in standard form. ..... (1 mark)

(b) Write 7×10^6 as an ordinary number. ..... (1 mark)

B 3 Write these numbers in order of size.
Start with the smallest number.

Write all the numbers in standard form first.

3×10^8 32×10^6 0.031×10^{10} 3400×10^5

.... (2 marks)

A 4 Work out the value of $5 \times 10^7 \times 9 \times 10^3$
Give your answer in standard form.

Guided $5 \times 10^7 \times 9 \times 10^3 = (5 \times .....) \times (10^7 \times 10.....)$

= ..... × 10.....

= ..... × 10.....

(2 marks)

A 5 Work out the value of $1.04 \times 10^3 \div 2 \times 10^{-5}$
Give your answer in standard form.

..... (2 marks)

A 6 Work out the value of $7 \times 10^5 \times 3000$
Give your answer in standard form.

..... (2 marks)

A 7 The number of atoms in one kilogram of helium is 1.51×10^{26}
Calculate the number of atoms in 30 kilograms of helium.
Give your answer in standard form.

..... (2 marks)

Recurring decimals

A 1 Express $0.\dot{1}\dot{5}$ as a fraction in its simplest form. You must use algebra.

Guided

Let $x = 0.\dot{1}\dot{5}$

$100x = 15.151515\ldots$

$-\quad x = 0.151515\ldots$

$99x = \ldots\ldots\ldots$

$x = \frac{\ldots\ldots\ldots}{99}$

$x = \frac{\ldots\ldots\ldots}{\ldots\ldots\ldots}$ **(3 marks)**

A 2 Change the recurring decimal $0.\dot{8}$ to a fraction. You must use algebra.

..... **(2 marks)**

A 3 Convert the recurring decimal $2.\dot{4}1\dot{7}$ to a fraction. You must use algebra.

..... **(3 marks)**

A 4 Convert the recurring decimal $0.4\dot{7}$ to a fraction. You must use algebra.

Guided

Let $x = 0.4\dot{7}$

$10x = 4.777\,7777\ldots$

$-\quad x = 0.477\,7777\ldots$

$9x = \ldots\ldots\ldots$

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

$x = \frac{\ldots\ldots\ldots}{\ldots\ldots\ldots}$

Multiply the top and bottom of the fraction by 10.

(3 marks)

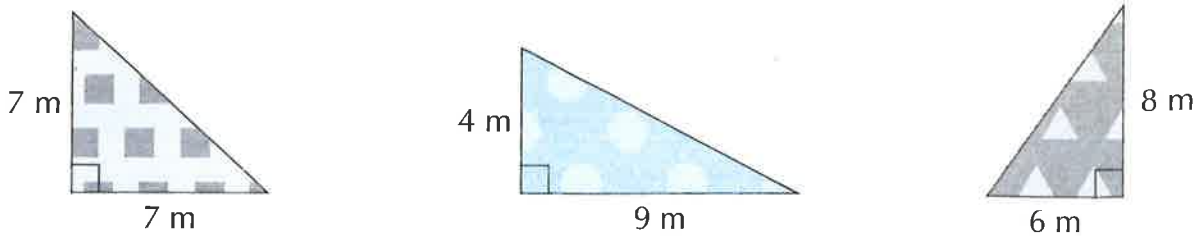
A 5 Convert the recurring decimal $3.0\dot{1}\dot{2}$ to a fraction. You must use algebra.

..... **(3 marks)**

Pythagoras' Theorem

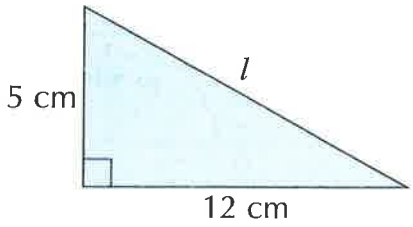
1. Circle the triangle with a hypotenuse of 10 m.

None of the diagrams on this page are drawn accurately.



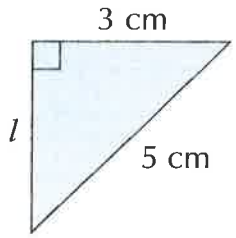
2. Find the missing length, l, in each right-angled triangle below.

a)



l = ... cm

b)



l = ... cm

3. Bailey's front door is 0.4 m above the horizontal ground.
Bailey uses a 6 m long ramp to get from the front door to the ground.

How far does the ramp extend horizontally from the front door? Give your answer to 2 d.p.

Sketch a diagram of the ramp first to help you.

..... m

How did you do?

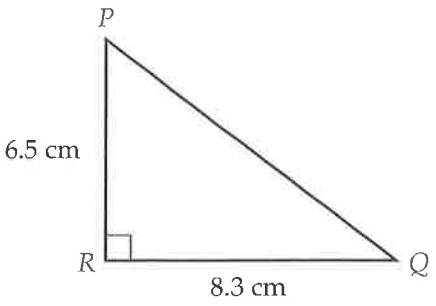
When Pythagoras was playing around with this theorem way back in the 6th century BC, I wonder if he knew it'd be the best thing about school* for so many teenagers one day... See if you can now:

☐ **Use Pythagoras' theorem to find any missing side length of a right-angled triangle.**

*based on my own experience

Pythagoras' theorem

C **1** Work out the length of PQ.
Give your answer correct to 3 significant figures.



Guided

$PQ^2 = 6.5^2 +$ .....

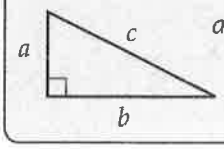
$PQ^2 =$ .....

$PQ = \sqrt{}$ .....

$PQ =$ .....

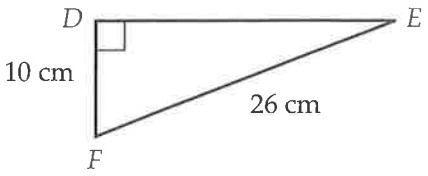
$PQ =$ ..... cm correct to 3 s.f. **(3 marks)**

Pythagoras' theorem



$a^2 + b^2 = c^2$

C **2** Work out the length of DE.



Guided

$DE^2 +$ ..... $= 26^2$

$DE^2 = 26^2 -$ .....

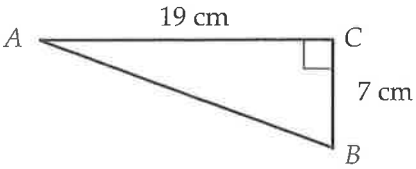
$DE^2 =$ .....

$DE = \sqrt{}$ .....

$DE =$ ..... cm **(3 marks)**

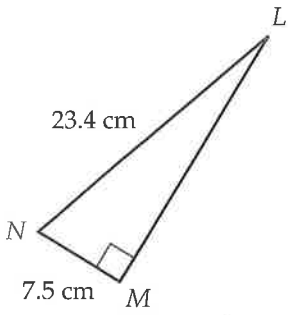
The hypotenuse is 26 cm so you are finding one of the shorter sides.

C **3** Work out the length of AB.
Give your answer correct to 3 significant figures.



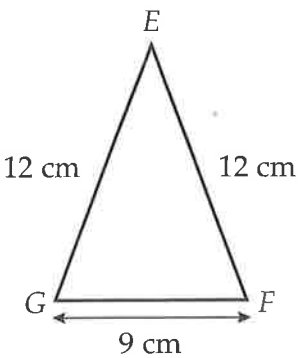
..... cm **(3 marks)**

C **4** Work out the length of LM.
Give your answer correct to 3 significant figures.



..... cm **(3 marks)**

C **5** Work out the height of the isosceles triangle.
Give your answer correct to 1 decimal place.



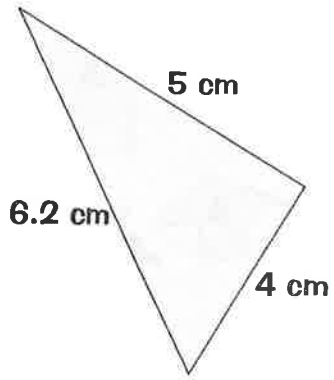
..... cm **(3 marks)**

Pythagoras' Theorem

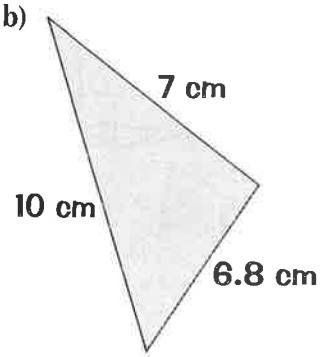
There's only one formula to learn for this whole page — $a^2 + b^2 = c^2$. It's a really important one though, so make sure you know exactly how to use it. Remember — it only works on right-angled triangles.

Q1 Use Pythagoras' Theorem to decide which of these is a right-angled triangle. Say whether the other triangles have their biggest angles greater or less than 90°.

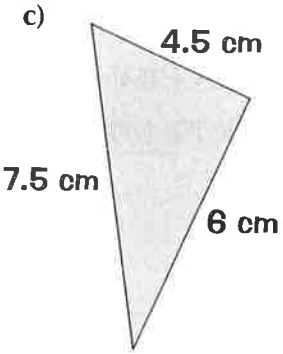
a)



b)

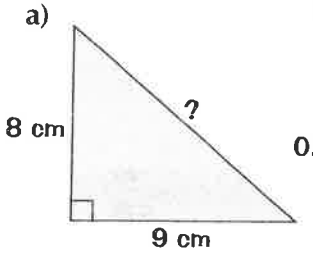


c)

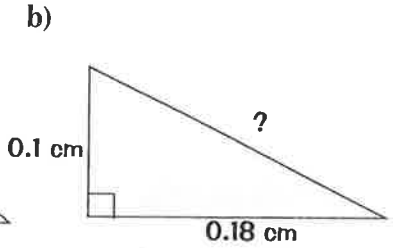


Q2 Find the missing sides. Give your answers to 3 significant figures.

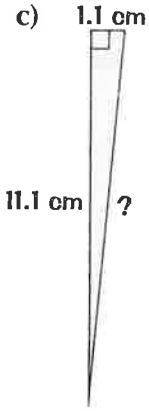
a)



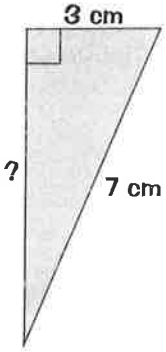
b)



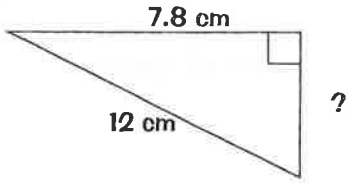
c)



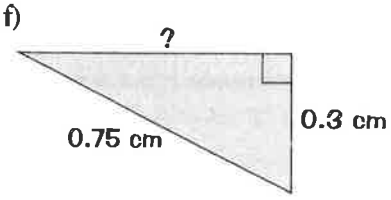
d)



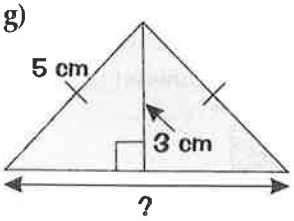
e)



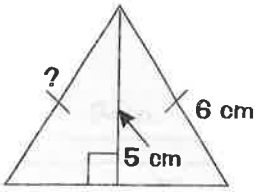
f)



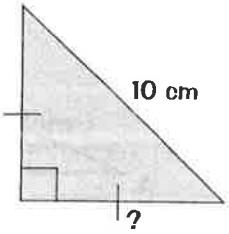
g)



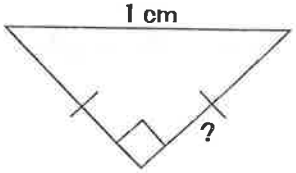
h)



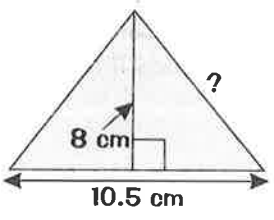
i)



j)



k)



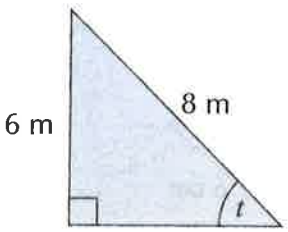
Trigonometry

1. Use trigonometry to calculate the lettered angle in each triangle.

Give your answers to 1 d.p.

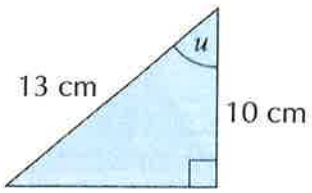
None of the diagrams on this page are drawn accurately.

a)



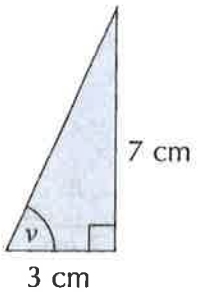
t = ... °

b)



u = ... °

c)

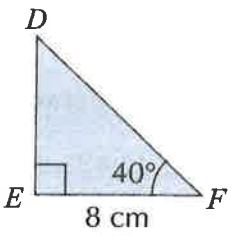


v = ... °

2. Calculate the length DE in each triangle below.

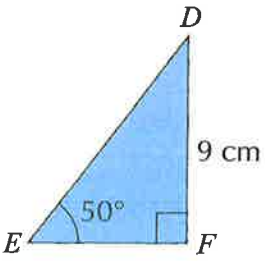
Give your answers to 1 d.p.

a)



DE = ... cm

b)



DE = ... cm

3. A cyclist approaches a hill and sees the sign on the right.
It means that for every 3 m horizontally, the hill rises by 1 m vertically.

Find the angle that the hill makes with the horizontal to 1 d.p.

Draw a sketch of the hill as the hypotenuse of a right-angled triangle.

..... °

How did you do?

Trigo-YES-metry, more like... (Sorry, I should have *angled* that pun a little better.)
When you've finished the page, make sure you can use trigonometry to:

- ☐ **Find angles in right-angled triangles.**
- ☐ **Find side lengths of right-angled triangles.**

Trigonometry

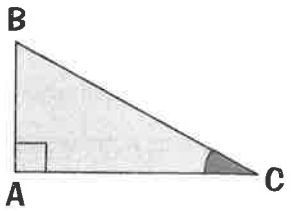
Here it is — the big daddy of the geometry world. It might be difficult to get your head round at first, but it's worth persevering. You may as well write down the 'SOH', 'CAH', 'TOA' triangles now — they'll come in dead handy over the next couple of pages.

Q1 Copy and complete this table using your calculator. Give your answers to 3 decimal places.

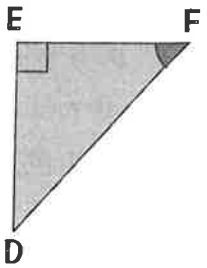
Angle a	Cos a	Sin a	Tan a
0°	1		
10°			
15°			
		0.5	
45°			
	0.5		
80°			
88°			
90°			

Q2 Label each side as "hypotenuse", "adjacent" and "opposite" relative to the angle marked:

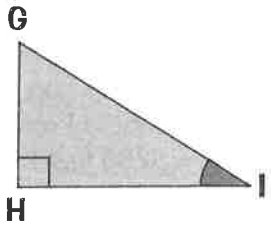
a)



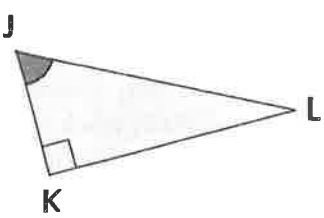
b)



c)



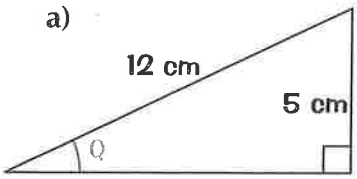
d)



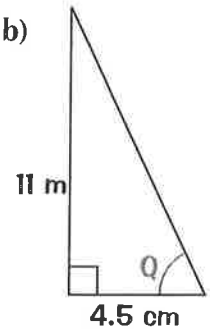
Make sure you know how to use inverse sin, cos etc. on your calc too — you'll need them here...

Q3 Calculate the unknown angles to 1 decimal place:

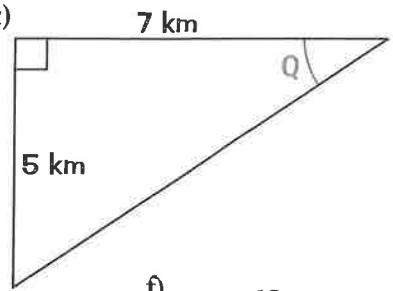
a)



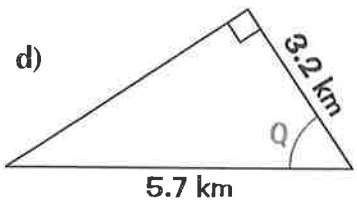
b)



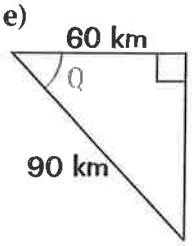
c)



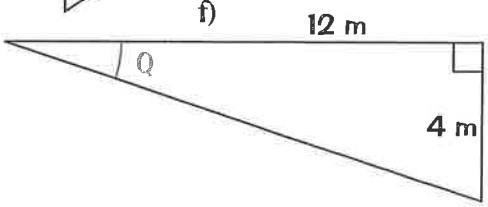
d)



e)

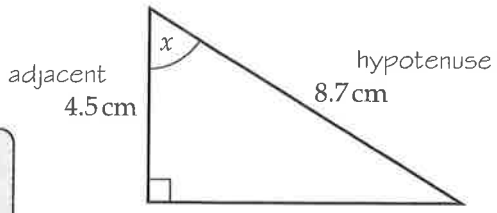


f)



Trigonometry 1

B **1** Work out the value of x.
Give your answer correct to 1 decimal place.



Guided

$\cos x = \frac{\text{adj}}{\text{hyp}}$

$\cos x = \frac{\ldots\ldots\ldots}{\ldots\ldots\ldots}$

$x = \cos^{-1}\left(\frac{\ldots\ldots\ldots}{\ldots\ldots\ldots}\right)$

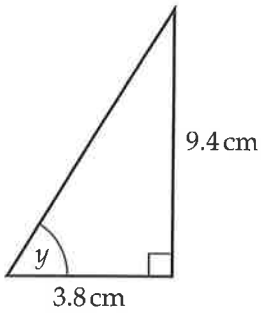
$x = \ldots\ldots\ldots\ldots\ldots$

$x = \ldots\ldots\ldots\ldots\ldots^\circ$ correct to 1 d.p.

Start by labelling the sides of the triangle that you have been given. Then write down the trig ratio that uses these two sides.

(3 marks)

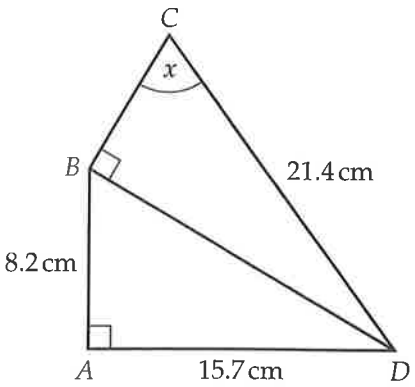
B **2** Calculate the size of angle y in this right-angled triangle.
Give your answer correct to 3 significant figures.



$y = \ldots\ldots\ldots\ldots\ldots^\circ$ **(3 marks)**

B **3** Work out the value of x.
Give your answer correct to 1 decimal place.

First use triangle *DAB* and Pythagoras' theorem to work out the length of *BD*.



$x = \ldots\ldots\ldots\ldots\ldots^\circ$ **(5 marks)**

B **4** A ladder is 3.5 m long.
It leans against a vertical wall when placed on horizontal ground.
The ladder rests at a point on the wall that is 3 m above the ground.
What angle will the ladder make with the horizontal?

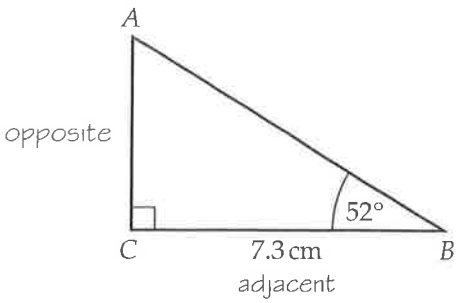
Start by sketching a right-angled triangle to represent the ground, wall and ladder. Mark the known lengths on the triangle.

$\ldots\ldots\ldots\ldots\ldots^\circ$ **(3 marks)**

Trigonometry 2

B 1 Work out the length of AC.
Give your answer correct to 3 significant figures.

Start by labelling the side of the triangle that you have been given and the side that you want to find. Then write down the trig ratio that uses these two sides.



Guided

$\tan x = \frac{\text{opp}}{\text{adj}}$

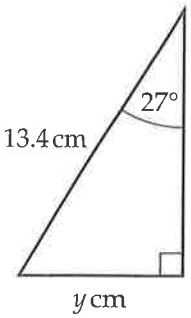
$\tan(.....) = \frac{AC}{.....}$

$AC =$ ..... $\times \tan(.....)$

$AC =$ .....

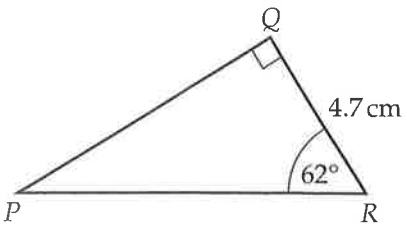
$AC =$ ..... cm correct to 3 s.f. **(3 marks)**

B 2 Calculate the value of y.
Give your answer correct to 1 decimal place.



$y =$ ..... cm **(3 marks)**

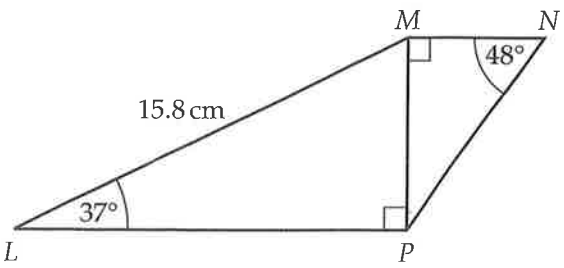
B 3 Work out the length of PR.
Give your answer correct to 3 significant figures.



$PR =$ ..... cm **(3 marks)**

A 4 The diagram shows two right-angled triangles.
Calculate the length of NP.
Give your answer correct to 3 significant figures.

First use triangle LMP to find the length of MP.

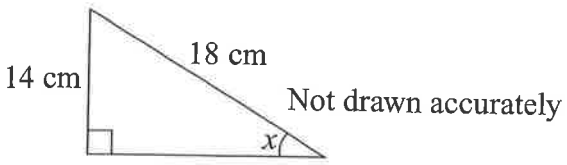


$NP =$ ..... cm **(4 marks)**

Trigonometry — Sin, Cos, Tan

1 The diagram shows a right-angled triangle. (B)

Find the size of the angle marked x.
Give your answer to 1 decimal place.

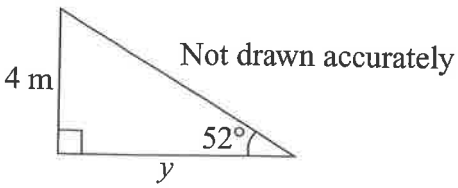


..... °

[Total 3 marks]

2 The diagram shows a right-angled triangle. (B)

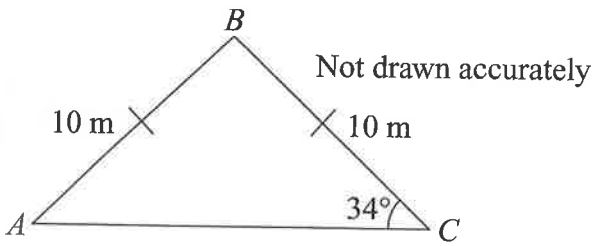
Find the length of the side marked y.
Give your answer to 3 significant figures.



..... m

[Total 3 marks]

3 In the triangle below, $AB = BC = 10$ m and angle $C = 34°$. (B)



a) Calculate the length AC.
Give your answer to 2 decimal places.

..... m

[3]

b) Calculate the height of the triangle.
Give your answer to 2 decimal places.

..... m

[3]

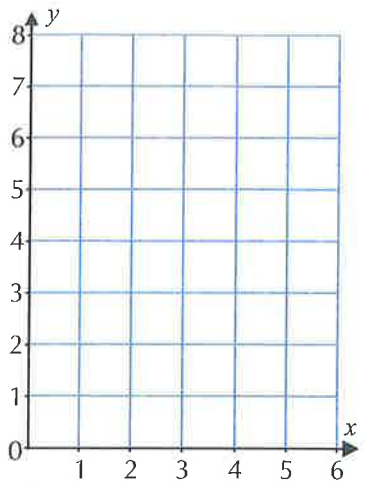
[Total 6 marks]

Plotting Straight Line Graphs

1. The graph of $y = x + 2$ is a straight line.

a) Complete this table of values for the equation $y = x + 2$.

x	0	2	4	6
y		4		



b) (i) Plot each pair of x and y values from your table as coordinates on the axes.

(ii) Plot the graph of $y = x + 2$ by drawing a straight line through these points.

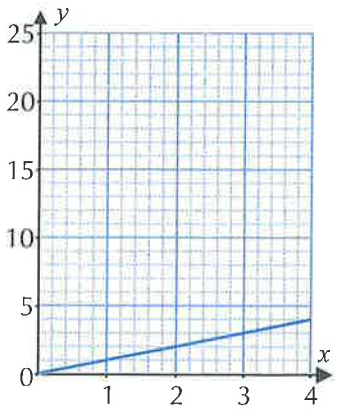
c) Write down the coordinates of the point where the line $y = x + 2$ intersects the y-axis.

(....., ...)

2. The graph of $y = x$ has been drawn on the axes on the right.

a) Complete this table of values for the equations $y = 3x$ and $y = 6x$.

x	0	1	2	3	4
$y = 3x$	0	3	6		
$y = 6x$	0	6			



b) Use your table of values to plot the graphs of $y = 3x$ and $y = 6x$.

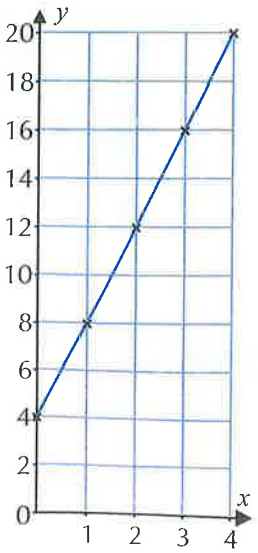
c) Which equation has the steepest graph? Circle your answer.

$y = x$ $y = 3x$ $y = 6x$

3. Alasdair has plotted a straight line graph on the axes on the right.

a) Complete this table of values for the equation $y = 4x + 2$.

x	0	1	2	3	4
y	2				



b) Use your table of values to plot the graph of $y = 4x + 2$.

c) (i) What does your graph have in common with Alasdair's graph?

.....

(ii) Write the coordinates of where the graph crosses the y-axis for...

Your line: (....., ...) Alasdair's line: (....., ...)

(iii) Which equation describes Alasdair's line? Circle your answer.

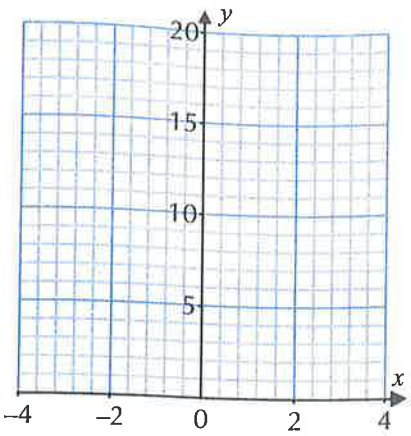
$y = 4x$ $y = 4x + 2$ $y = 4x + 4$

Quadratic Graphs

1. Consider the quadratic equation $y = x^2 + 1$.

a) Complete this table of values for the equation.

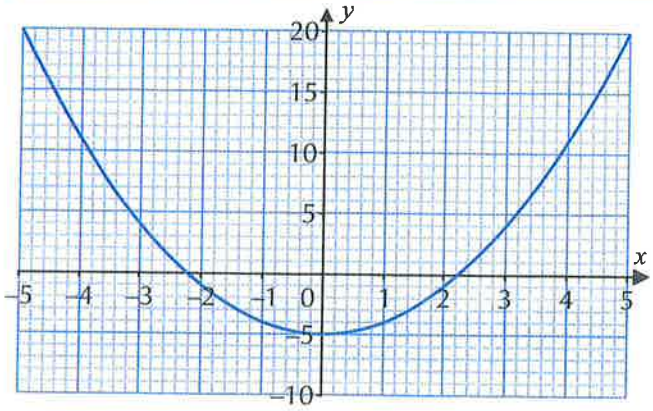
x	–4	–2	0	2	4
x^2	.....	.....	.....	.....	.....
$y = x^2 + 1$	.....	.....	.....	.....	.....



b) (i) Plot each pair of x- and y-values from your table as coordinates on the axes on the right.

(ii) Sketch the graph of $y = x^2 + 1$ by drawing a smooth curve joining up the points.

2. Noel has plotted the graph of the equation $y = x^2 - 5$ on the axes below.



a) (i) Complete this table of values for the equation $y = x^2 - 9$.

x	–5	–3	0	3	5
x^2	.....	.....	.....	9	25
$x^2 - 9$	.....	.....	.....	0	16

(ii) Use your table to plot the graph of the equation $y = x^2 - 9$ on the same axes.

b) (i) What are the coordinates of the y-intercept of Noel's graph? (....., ...)

(ii) What feature of your graph is related to the '– 9' in the equation $y = x^2 - 9$?

.....

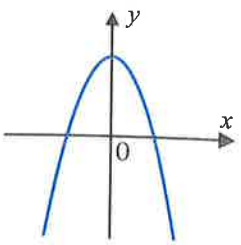
(iii) Where does the graph of the equation $y = x^2 + x + 2$ cross the y-axis? (....., ...)

c) Does the graph of $y = x^2 - 9$ ever intersect Noel's graph? Explain your answer.

.....

.....

3. Gail has sketched a graph on the right.



Which of these equations could represent Gail's graph? Tick your answer.

$y = x^2 + 3$ ☐ $y = -x^2 + 3$ ☐

$y = x^2 - 3$ ☐ $y = -x^2 - 3$ ☐

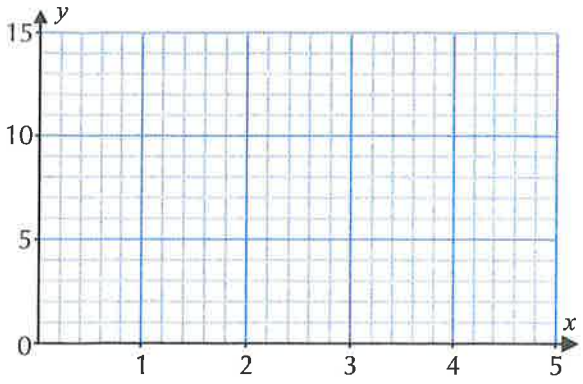
Quadratic Graphs

4. Consider the quadratic equation $y = x^2 - 6x + 9$.

a) Complete this table of values for the equation.

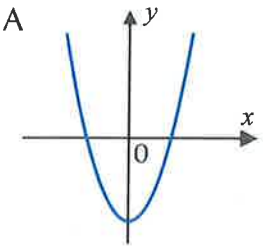
x	0	1	2	3	4	5
y	9	4	.....	.....	.....	.....

b) Use your table of values to plot the graph of $y = x^2 - 6x + 9$ for values of x from 0 to 5.

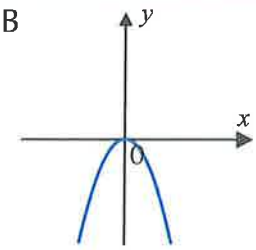


5. Imran has sketched the graphs of four quadratic equations below.

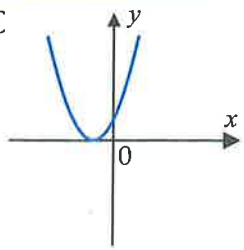
A



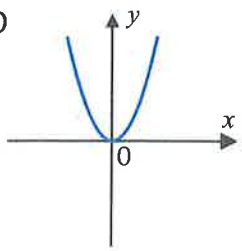
B



C



D



Write A, B, C or D in the boxes below to match each graph with its equation.

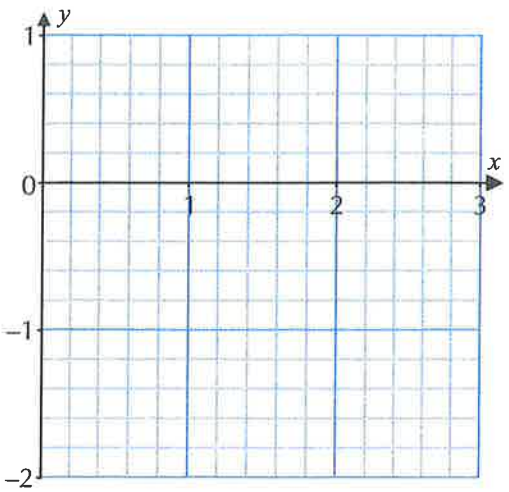
$y = x^2$ ☐ $y = -x^2$ ☐ $y = x^2 - 2$ ☐ $y = x^2 + 2x + 1$ ☐

6. Consider the equation $y = -x^2 + 3x - 2$.

a) Complete this table of values for the equation.

x	0	1	1.5	2	3
y	.....	.....	.....	.....	.....

b) Use your table to sketch a graph of the equation on the axes on the right.



How did you do?

Plot your points carefully — a misplaced point can easily result in a wonky curve. Quadratics should never have lumps or spikes. If all your curves are looking nice and smooth, then you should be able to:

☐ **Recognise the general shape of quadratics.** ☐ **Sketch and plot quadratic graphs.**



Harder Graphs

1 This question is about the function $y = x^3 - 4x^2 + 4$. (B)

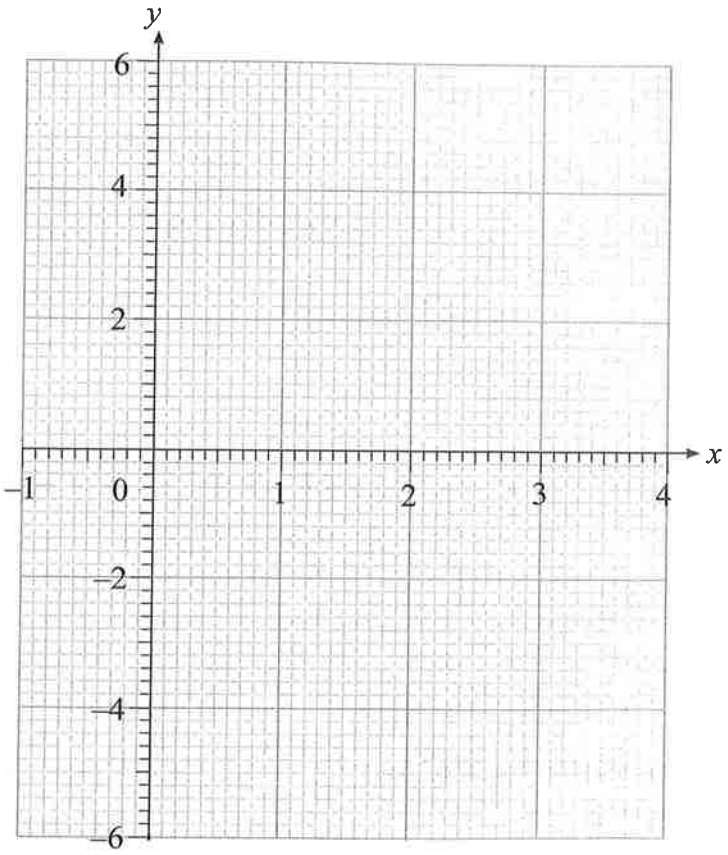
a) Complete the table below.

x	–1	–0.5	0	0.5	1	1.5	2	2.5	3	3.5	4
y	–1	2.875	4	3.125	1	–1.625	–4				

[2]

b) Use your table to draw the graph of $y = x^3 - 4x^2 + 4$ on the grid, for values of x in the range $-1 \leq x \leq 4$.

[2]



Don't use a ruler to join up the dots in curved graphs.

c) Estimate the solutions of the equation $x^3 - 4x^2 + 4 = 0$. Give your answers to 1 d.p.

.....

[1]

d) By drawing a straight line on the grid, estimate the solutions to the equation $x^3 - 4x^2 + 2 = 0$. Give your answers to 1 d.p.

.....

[2]

[Total 7 marks]