Co-ordinates

Component Knowledge

- Recognise the different axis on a graph
- To be able to plot a coordinate in positive and negative quadrants

Key Vocabulary

Horizontal	Going side-to-side, like the horizon. This is the x axis
Vertical	In an up-down direction or position. This is the y axis
Co-ordinates	A set of values that show an exact position. On graphs it is usually a pair of numbers

Co-ordinates:

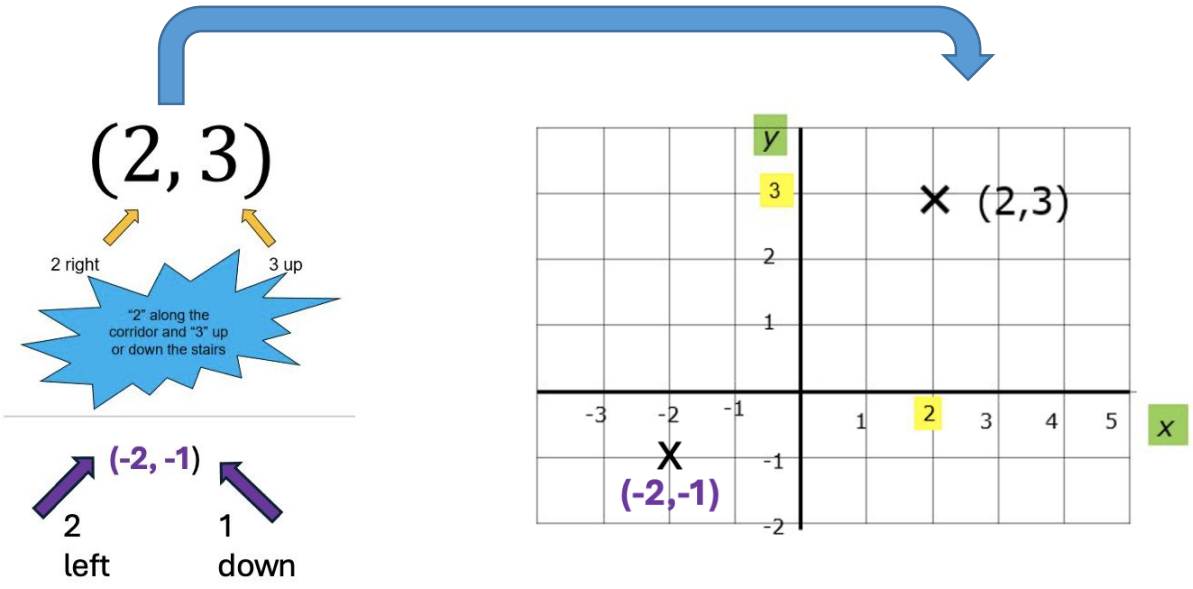
Coordinates are a set of instructions to get to a location from the origin $(0, 0)$.

The first number (x) tells us how far we go 'along the corridor' HORIZONTAL

The second number (y) tells us how far we go 'up (or down) the stairs'. VERTICAL

$$(x, y)$$

Co-ordinates example



Online Clip

M618

Straight line graphs

Component Knowledge

- Recognise and sketch horizontal and vertical graphs
- Complete a table of values
- Plot straight line graphs
- Identify gradients/intercepts from a graph
- Identify gradients/intercepts from an equation

Key Vocabulary

Axis	A fixed reference line a grid to help show the position of coordinates
Gradient	How steep a graph is at any point
Y intercept	Where the graph cuts through the y axis
Coordinate	A set of values that show an exact position
Quadrant	Any of the 4 areas made when we divide up a plane by an x and y axis
Vertical	In an up and down position. The y axis is the vertical axis
Horizontal	Going side to side. The x axis is the horizontal axis
Graph	A diagram showing the relationship between two quantities

Completing a table of values and plotting a graph

To plot a straight line graph, you may be given a table or you may need to draw one.

Example: Plot the graph of $y = 4x - 2$ for the values of x from -3 to 3.

1) Draw a table of values if you have not been given one.

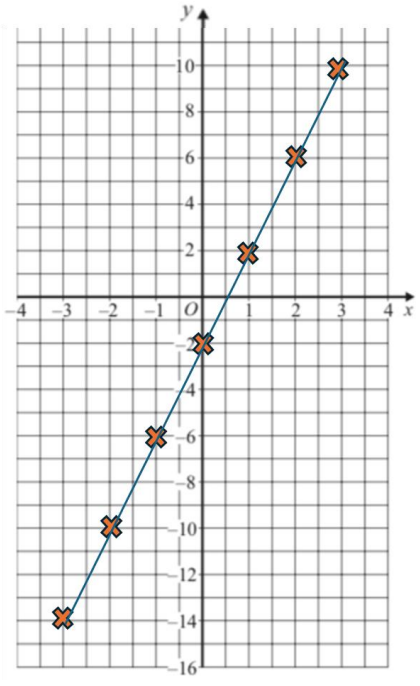
x	-3	-2	-1	0	1	2	3
y							

2) Substitute in your x values to $y = 4x - 2$, this will give the corresponding y values.

x	-3	-2	-1	0	1	2	3
y	-14	-10	-6	-2	2	6	10

3) Plot the points on the graph.

E.g. (-3, -14), (-2, -10), (-1, -6), (0, -2), …. etc



4) Join up with a straight line.

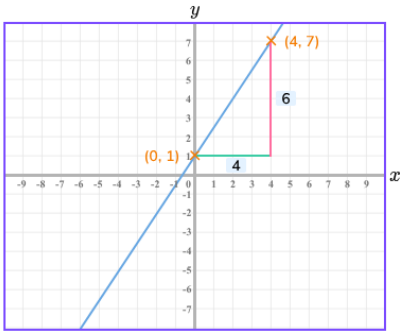
The equations of all straight lines can be written in the form:

$$y = mx + c$$

Gradient – The number in front of the x. This tells us how steep the line is.

Intercept – The number on its own. Shows where the line cuts the y axis.

The gradient of a line tells us how steep the line is, the greater the gradient the steeper the line.



You can find the gradient using the graph by picking 2 points on the line and using

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

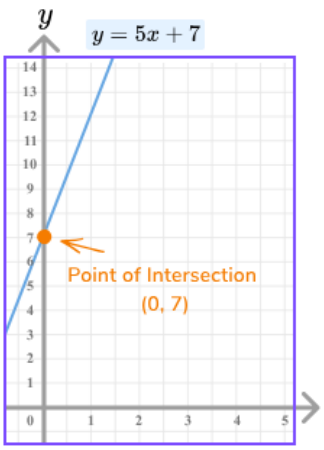
The change in y is equal to $y_2 - y_1 = 7 - 1 = 6$

The change in x is equal to $x_2 - x_1 = 4 - 0 = 4$

$$m = \frac{6}{4}$$

The y intercept is where the line crosses the y axis

You can find the y intercept from the equation by putting x equal to 0



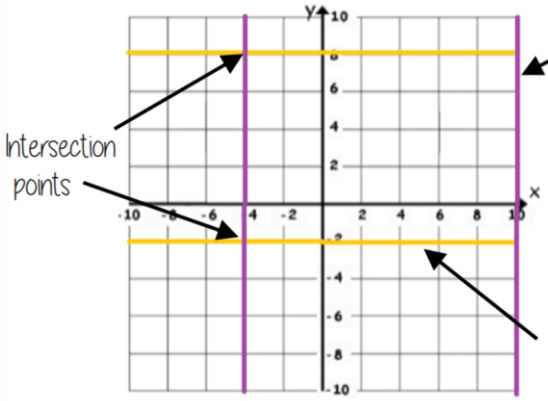
The gradient and intercept of a straight line can also be identified form the formula.

Example: Find the gradient and intercept of the following lines.

1) $y = 5x - 2$ — Grad = 5, Intercept = - 2
2) $2y = 4x + 5$ — $y = 2x + 2.5$ — Grad = 2, Intercept = 2.5
3) $x + y = 10$ — $y = -x + 10$ — Grad = - 1, Intercept = 10

Rearrange all equations so they are in the form y = mx + c (the y must be isolated)

Lines parallel to the axis (Horizontal and Vetical lines)



All the points on this line have a x coordinate of 10

'a' can be ANY positive or negative value including 0

Lines parallel to the **y axis** take the form **x = a** and are **vertical**

Lines parallel to the **x axis** take the form **y = a** and are **horizontal**

All the points on this line have a y coordinate of -2

e.g. (3, -2) (7, -2) (-2, -2) all lay on this line because the y coordinate is -2

Online clips

M797, M932, M544, M888

Angles

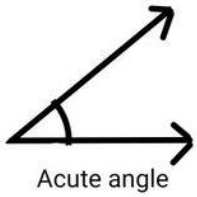
Component Knowledge

- To be able to identify the different types of angles
- To be able to use a protractor to measure angles
- To draw angles accurately

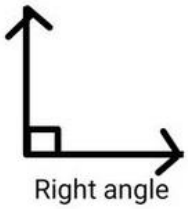
Key Vocabulary

Angle	The amount of turn between two lines and their common point.
Vertex	The corner of the angle where the lines meet.
Arms	The lines used to create the angle.
Protractor	Tool used to measure or draw angles in degrees.

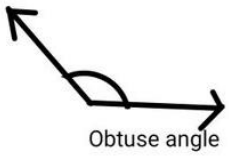
Types of angles



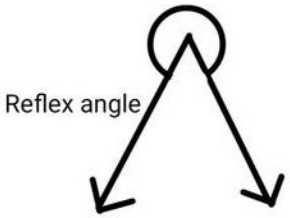
Less than 90°



90°angle



greater than 90°
and less than 180°

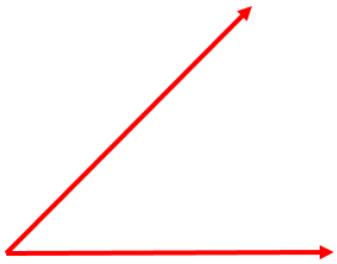


greater than 180°
and less than 360°

Measuring angles

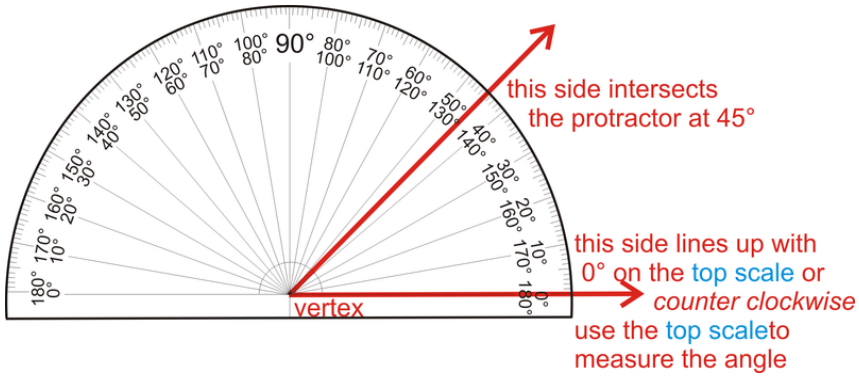
Before we measure an angle accurately, we can estimate it's size using the types of angle above.

Measure this angle:



We know it is less than a right angle so it must be acute (Less than 90°).

We now place the protractor over the angle and measure it, using the scale on the protractor.



The centre of the protractor sits directly over the vertex of the angle.

The protractor is lined up with one arm of the angle at 0°.

We use the scale where the protractor starts at 0°, NOT 180°.

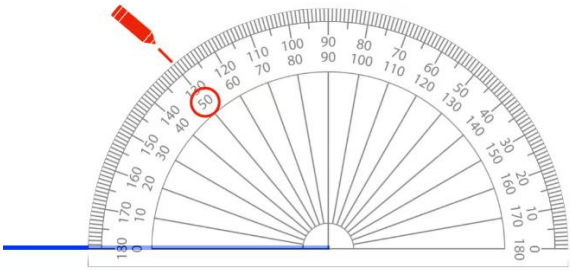
Drawing angles

Before we draw an angle accurately, we can estimate it's size using the types of angle above.

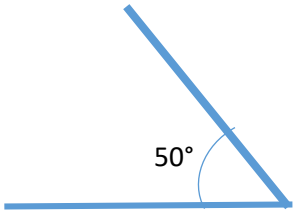
Draw a 50° angle:

1) Draw a line (usually horizontally) of any length.

2) Choose one of the ends to be the vertex of the angle and line up your protractor as you would do to measure an angle and mark a point at 50°. **Remember to use the scale that starts at 0°!**



3) Now join up the point marked and the end of the line to create the angle. Mark the angle drawn.

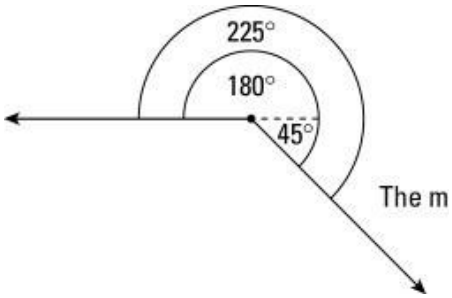


Drawing angles- greater than 180°

As most protractors only measure up to 180°, we have to be creative when drawing angles greater than 180°. We can choose to:

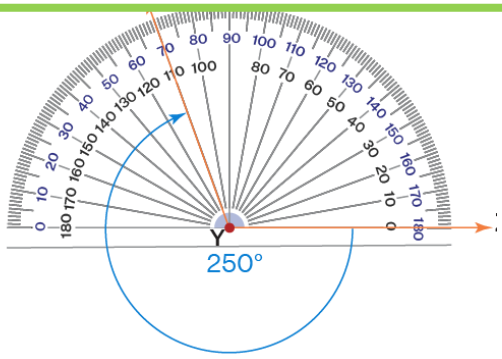
Split the angle into 2 parts- 180° and whatever is left over from 180°

e.g 225° = 180° + 45°. We would draw a 180° and then the 45° after it.



A whole turn = 360°. We can subtract the angle from 360° and draw the related acute/obtuse angle. We can then identify the reflex angle by drawing in its arc.

e.g. Draw 250°. So, 360° – 250° = 110°. We draw 110° and then place the arc around the outside of this angle to create 250°.



Online clips: M502, M541, M780, M331

Angles

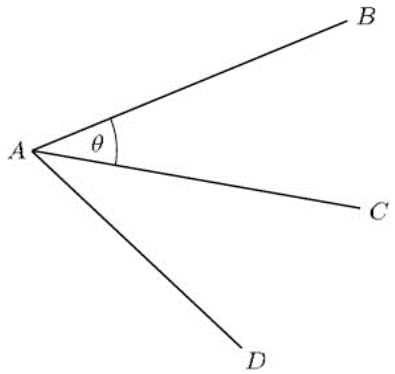
Component Knowledge

- To be able to identify the different types of angles
- To be able to calculate missing angles on a straight line
- To be able to calculate missing angles around a point
- To be able to calculate missing angles in a triangle
- To recognise vertically opposite angles

Key Vocabulary

Angle	The amount of turn between two lines and their common point.
Vertically Opposite	Angles formed when two or more straight lines cross at a point.
Notation	The mathematical way of writing something.

Angle Notation



We can show an unknown angle as θ (Greek symbol theta)

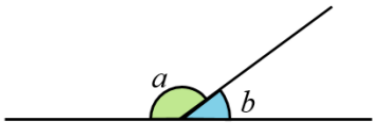
The shown angle, θ, can also be described using letters.

$B\hat{A}C$, ∠BAC, angle BAC

The outer letters refer to the arms and the middle letter is the vertex.

Angles on a straight line

Angles on a straight line add up to $180°$

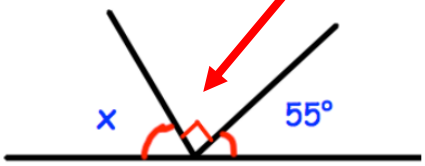


$a + b = 180°$

Example:

Find the value of x

This is a right angle worth 90°



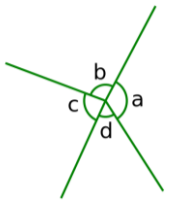
$90 + 55 = 145°$

$180 - 145 = 35°$

$x = 35°$

Angles around a point

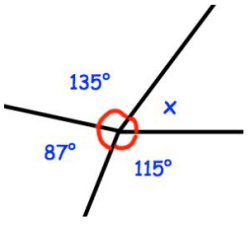
Angles around a point add up to $360°$



$a + b + c + d = 360°$

Example:

Find the value of x

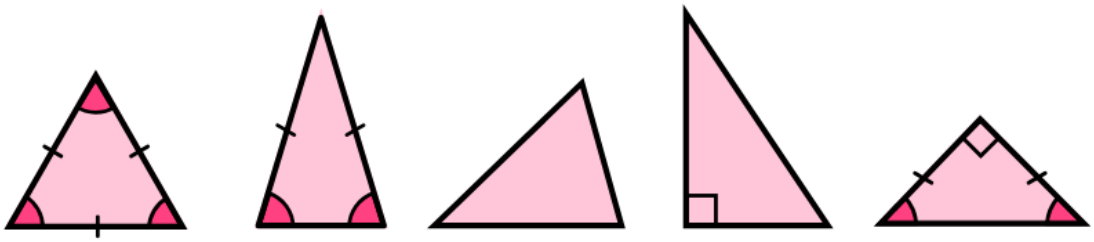


$87 + 135 + 115 = 337°$

$360 - 337 = 23°$

$x = 23°$

Types of triangle



Equilateral Triangle
All sides and angles are equal

Isosceles Triangle
Two sides and base angles are equal

Scalene Triangle
No sides or angle are equal

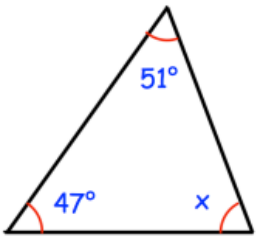
Right Angle Triangle
Has a 90° angle inside

Right Angle Isosceles Triangle
Has a 90° angle inside and 2 equal sides

Angles in a triangle

Angles in a triangle add up to 180°

Examples

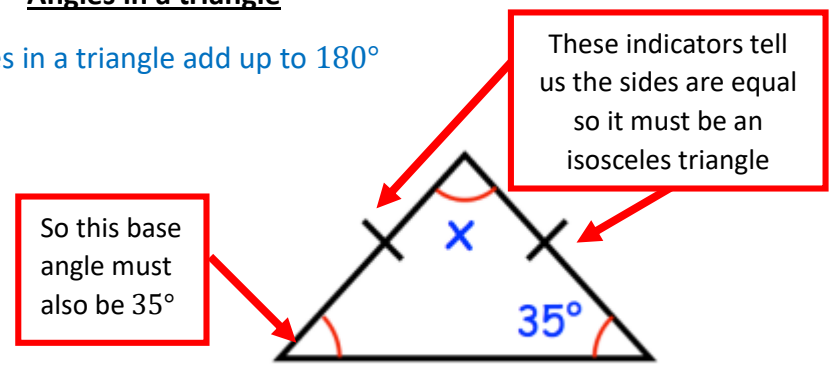


This is a scalene triangle so all the angles are different

$47 + 51 = 98°$

$180 - 98 = 82°$

$x = 82°$



This is an isosceles triangle so the 2 base angles are equal

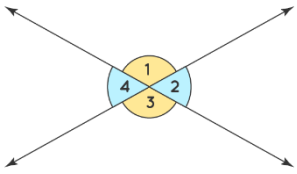
$35 + 35 = 70°$

$180 - 70 = 110°$

$x = 110°$

Vertically opposite angles

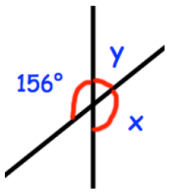
Vertically opposite angles are equal



Angle 1 = Angle 3

Angle 2 = Angle 4

Example



x is vertically opposite $156°$

So therefore $x = 156°$ as well.

Then we can use angles around a point add up to $360°$

$360 - 156 - 156 = 48°$

$48° \div 2 = 24°$

$y = 24°$

Online clips

M818, M163, M351, M319

Standard Ruler Constructions

Component Knowledge

- To be able to use a ruler accurately to draw/measure straight lines.
- To use a compass to draw an arc with an accurate radius
- To construct triangles accurately given lengths and/or angles.

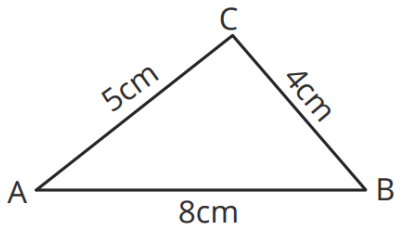
Key Vocabulary

Accurate	Exact measurement from given information.
Arc	A part of the circumference of a circle.
Construct	Accurately draw a line, angle or shape.
Intersection	The points at which 2 or more lines meet/cross.

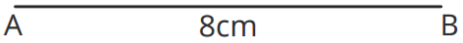
Constructing a Triangle- all 3 sides SSS

Construct the triangle ABC where AB = 8cm, BC = 4cm and AC = 5cm.

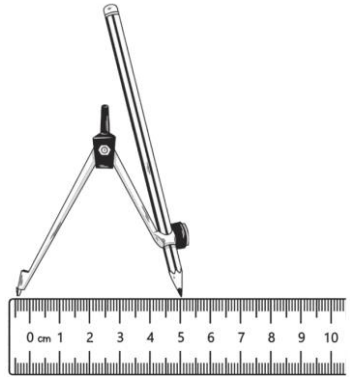
1. First of all, sketch and label a triangle so you know, roughly, what's needed. It doesn't matter which line you make the base line.



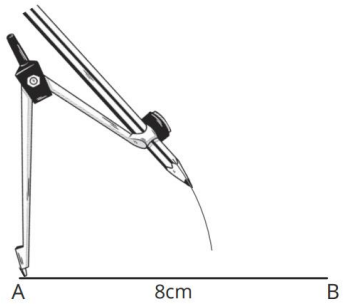
2. Measure out and draw the base line using a ruler and label the end points.



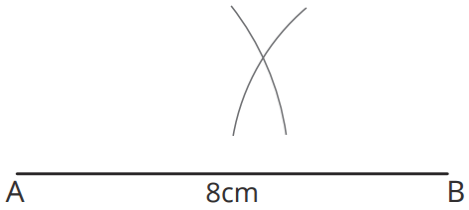
3. You are told that the length from A to C is 5cm. Open the pair of compasses and, using your ruler, set them to 5cm.



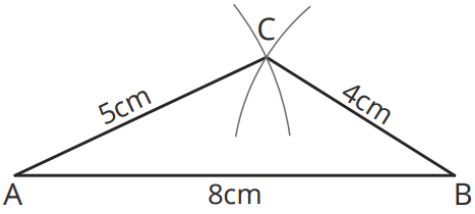
4. Place the point of the compasses on point A and draw an arc.



5. For the line BC, set the compasses to 4cm, place the point on B and draw an arc.



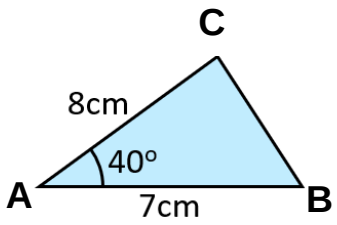
6. The point where the arcs cross is point C. Draw in the lines using a ruler. It's important that you leave the arcs on the diagram - do not erase them. These are your construction lines and are something that an examiner must see. Don't forget that to finish the construction, you should label the triangle.



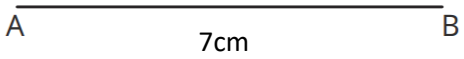
Constructing a Triangle- 2 sides and the angle between them SAS

Construct the triangle ABC where AB=7cm, AC=8cm and angle BAC=40°

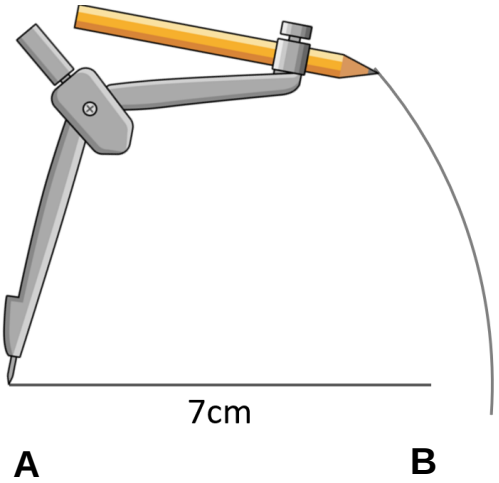
1. Roughly draw the triangle, if a sketch is not already given.



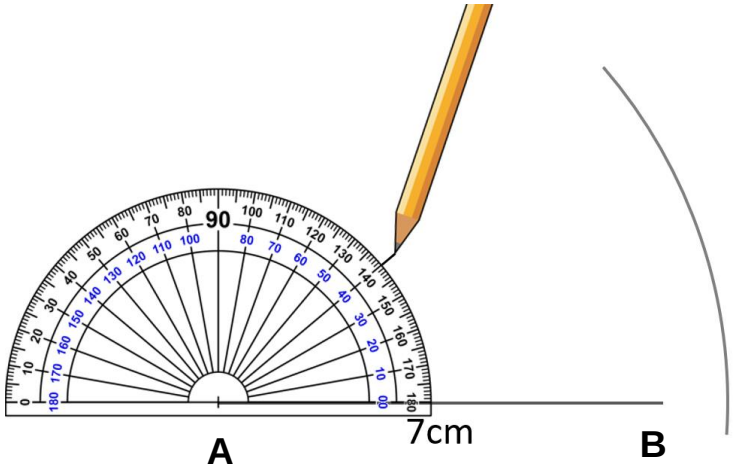
2. Draw a 7cm line using a ruler. Label it AB.



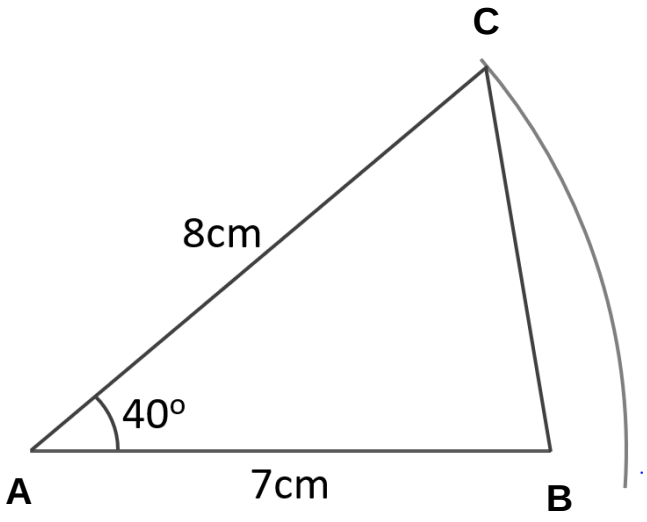
3. You are told that the length from A to C is 8cm. Open the pair of compasses and, using your ruler, set them to 8cm. Place the point of the compasses on point A and draw an arc.



4. Measure the angle of 40° using a protractor from point A. Remember to use the scale that starts from 0°.



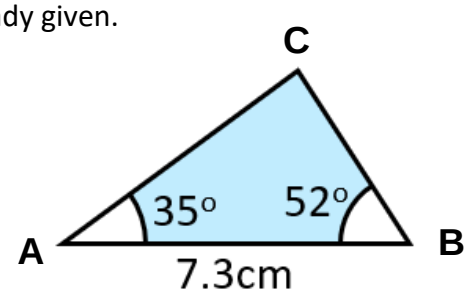
5. Draw a line through the angle to the arc. This will be point C. Join C to B to create the final side. Do not erase your construction lines!



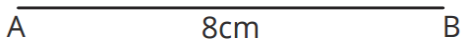
Constructing a Triangle- 2 angles and the side between them ASA

Construct the triangle ABC where AB=7cm, AC=8cm and angle BAC=40°

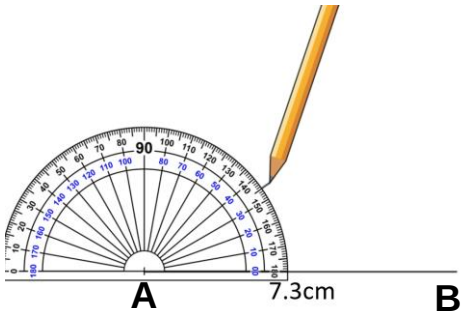
1. Roughly draw the triangle, if a sketch is not already given.



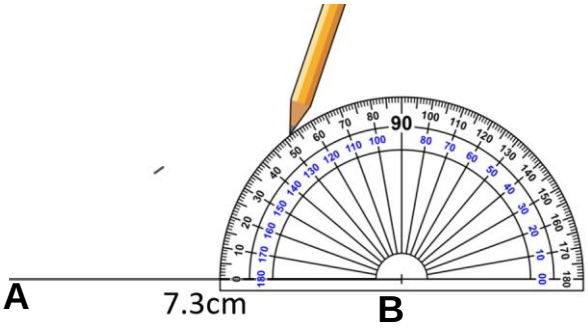
2. Draw a 7.3cm line using a ruler. Label it AB.



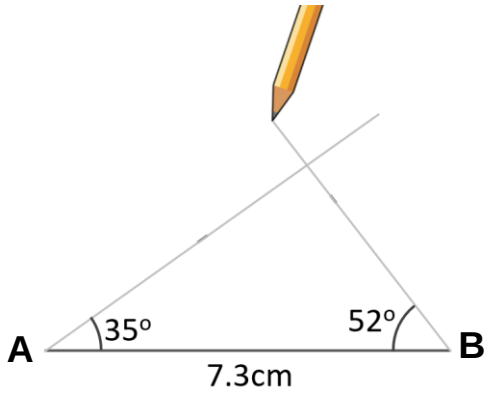
3. Measure the angle of 35° using a protractor from point A. Remember to use the scale that starts from 0°.



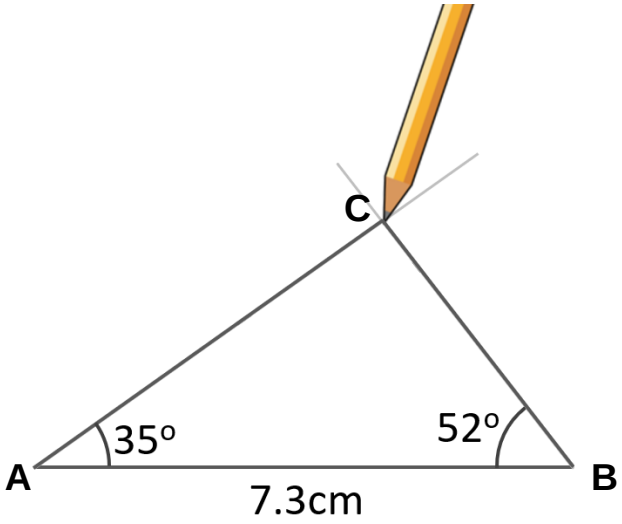
4. Measure the angle of 52° using a protractor from point B. Remember to use the scale that starts from 0°.



5. Draw a feint line through the angles drawn in 3) and 4).



6. Draw a solid line over each feint line up to the intersection. Label the triangle to complete it.



Online clips

M985, M196, M565

Bisections

Component Knowledge

- To be able to construct the perpendicular bisector of a straight line.
- To be able to construct an angle bisector.

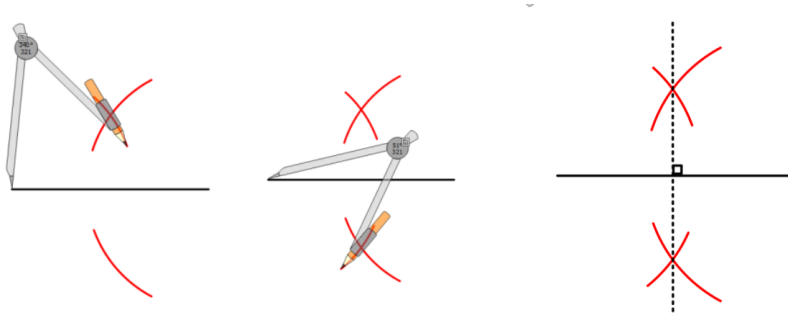
Key Vocabulary

Compass	An instrument for drawing circles and arcs.
Arc	A part of a curve, (part of the circumference of a circle) can be drawn using a compass.
Bisector	A line which divides something into two parts.
Perpendicular	Two lines that intersect at right angles.
Equidistant	Equal distances from two points or lines.
Vertex	A point where two straight lines meet.

Perpendicular Bisector

This cuts a line in half at right angles.

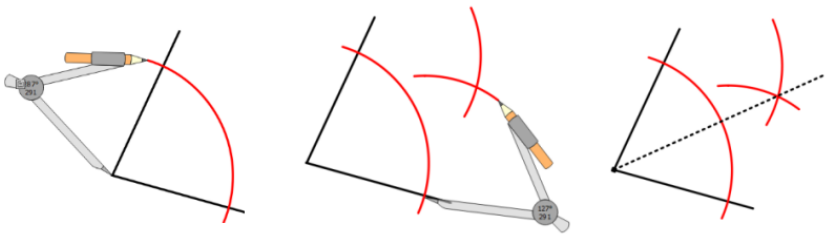
1. Put a sharp point of a pair of compasses on one of the end points.
2. Open the compass over half-way on the line.
3. Draw an arc above and below the line.
4. Without changing the compass, repeat from the second end point.
5. Draw a straight line through the two intersecting arcs.



Angle Bisector

This cuts an angle exactly in half.

1. Place the sharp end of a compass on the vertex.
2. Draw an arc, marking a point on each line.
3. Without changing the compass put the compass on each point and mark a centre point where two arcs cross over.
4. Use a ruler to draw a line through the vertex and centre point.



Online clips

M239, M232

Frequency Tables

Component Knowledge

- Read and interpret frequency tables.
- Construct frequency tables for discrete and continuous data.

Key Vocabulary

Frequency	The rate at which something occurs
Table	A logical way of displaying facts and figures
Tally	A way of displaying values using lines and dashes
Data	A collection of facts and figures
Inequality	An expression where the sides are not equal.
Discrete	Data that can only be set values e.g. you cannot have half of a person so counting people would be discrete data
Continuous	Data that can be any value e.g. height and time.
Mode	The value that occurs most frequently in a set of data
Modal Class	A set of values that occur most frequently in a set of data.

When we are dealing with a large amount of data, it is sometime impractical to display the data as a simple list. Frequency tables are a logical way of displaying large amounts of data which makes the data easier to analyse.

Frequency Tables

Below some data on eye colour for a class of students is shown:

Brown, Blue, Blue, Grey, Green, Hazel, Hazel, Brown, Brown, Blue, Green, Green, Grey, Grey , Hazel, Blue, Blue, Grey, Hazel, Brown, Brown, Hazel, Blue, Brown, Blue, Blue.

Having a large list of data like this can be hard to read. For situations like this it is better to display the data in a frequency table as shown below.

Tally marks are used to help count things. Each vertical line represents one unit. The fifth tally mark goes down across the first four to make it easier to count. The frequency column is completed after all the data has been collected.

You must represent 5 like this.

Eye Colour	Tally	Frequency
brown	𝍸 |	6
blue	𝍸 |||	8
green	|||	3
grey	||||	4
hazel	𝍸	5

Grouped Frequency Tables

20 students took a science test.
Place the data shown below in the grouped frequency table.
What is the modal class for the data?

25	32	31	52	45
27	55	28	42	44
46	23	51	48	26
20	51	49	33	41

Marks, *m*	Tally	Total
20-29	𝍸 |	6
30-39	|||	3
40-49	𝍸 ||	7
50-59	||||	4

When we have a large range of values like this it is better to group the data so the table is easier to read.
Note: You must ensure there is no overlap in the groupings.

The values with the highest frequency show the modal class for the data. E.g. The modal class is 40-49.

Frequency Tables with Inequalities

The data below shows the average time taken, in seconds, to run the 100m at last years sports day:
11.2, 12.6, 13.1, 12.9, 13.2, 12.2, 11.8, 12.9, 13.7, 14.2, 15.1, 11.1, 12.5, 13.5, 14.5
Display this in the frequency table below:

Time (seconds)	Tally	Total
$11 < t \leq 12$	|||	3
$12 < t \leq 13$	𝍸	5
$13 < t \leq 14$	||||	4
$13 < t \leq 15$	||	2
$15 < t \leq 16$	||	1

When we are dealing with continuous data, such as times like shown above, we must use inequalities to define the groups to ensure every decimal value is included.

Online clips

M945, M899, M441

Frequency Polygons

Component Knowledge

- To be able to construct a frequency polygon.
- To be able to read and interpret frequency polygons.

Key Vocabulary

Frequency	The number of times something occurs over a particular period of time or in a given sample.
Frequency polygon	A frequency polygon is a type of line graph that displays grouped data.
Midpoint	The middle point in a group of data or a line.

Frequency Polygons- constructing

A Frequency Polygon allows us to represent the shape of a data set's distribution.

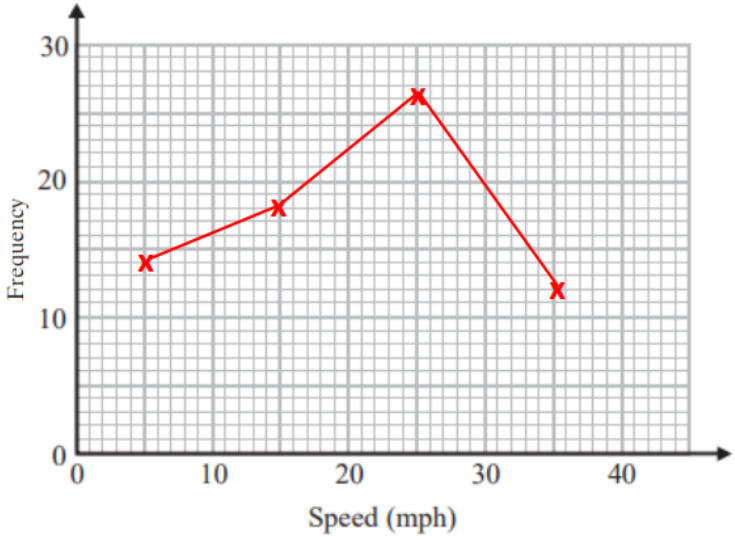
- Frequency is plotted on the vertical axis
- The data is grouped so plot the midpoint on the horizontal axis.
- The horizontal axis should be a linear scale and the vertical axis should start from 0.

We need a frequency table to help us to construct the frequency polygons.

E.g. This table gives information about the speeds of 70 cars.

Speed (s mph)	Frequency (f)	Midpoint
$0 < L \leq 10$	14	5
$10 < L \leq 20$	18	15
$20 < L \leq 30$	26	25
$30 < L \leq 40$	12	35

a) Draw a frequency polygon for this information.



Step 1 – Find the midpoint of each class interval
Step 2 – Label your axes and choose an appropriate scale
Step 3 – Plot each point at the midpoint for that interval
Step 4 – Connect each point with a straight line

Do not extend the line beyond the points you have

Frequency Polygons- interpreting

To interpret frequency polygons, we look at the graph to identify the overall pattern shown by the graph.

In the question above, we can see the that the most common speed is between 20 and 30 mph and no cars travelled above 40mph. We can infer the cars are travelling on a suburban road rather than a motorway, for example.

Online clip

U840