

Year 9 Term 3

Angles and bearings

What do I need to be able to do?

By the end of this unit you should be able to:

- Understand and represent bearings
- Measure and read bearings
- Make scale drawings using bearings
- Calculate bearings using angle rules
- Solve bearings problems using Pythagoras and trigonometry

Keywords

Cardinal directions: the directions of North, South, East, West

Angle: the amount of turn between two lines around their common point

Bearing: the angle in degrees measured clockwise from North

Perpendicular: where two lines meet at 90°

Parallel: straight lines always the same distance apart and never touch. They have the same gradient

Clockwise: moving in the direction of the hands on a clock

Construct: to draw accurately using a compass, protractor and or ruler or straight edge

Scale: the ratio of the length of a drawing to the length of the real thing

Protractor: an instrument used in measuring or drawing angles

Measure angles to 180°



Read from 0° on the base line. Remember to use estimation. This is an obtuse angle so between 90° and 180°

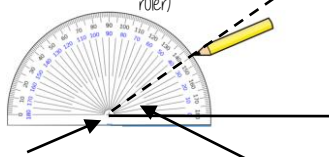
The base line follows the line segment

Make sure the cross is at the point the two lines meet

Draw angles up to 180°

Draw a 35° angle

Make a mark at 35° with a pencil. And join to the angle point (use a ruler)



Make sure the cross is at the end of the line (where you want the angle)

The angle

Angle notation

The letter in the middle is the angle. The arc represents the part of the angle



Angle Notation: three letters $\angle ABC$. This is the angle at $B = 113^\circ$

$\angle ABC$ is also used to represent the angle at B

Scale drawings

1 : 20

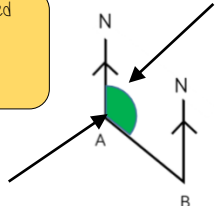
For every 1cm on the model there are 20cm in real life

Remember: Scale drawings **ONLY** change lengths and distances. Angles remain the same

Understand and represent bearings

- A bearing is always measured from **NORTH**
- It is always given as three figures

The bearing of B from A is calculated by measuring the highlighted angle



The angle indicated starts from the North line at A and joins the path connecting A to B

This angle shows the bearing of B from A

The sentence... "Bearing of ____ from ____" is really important in identifying the bearing being represented

Using **estimation** it is clear this angle is between 090° and 180°

Directions



Clockwise



Anti-Clockwise

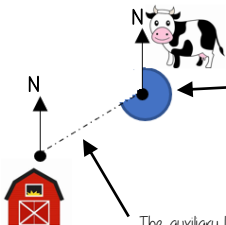


Measure and read bearings

The bearing of the cow to the barn

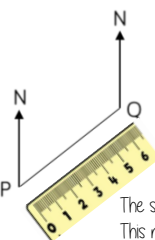
This angle is measured from **NORTH**. It is measured in a clockwise direction. **Estimation** indicates this angle is between 180° and 270° . Use a protractor to measure accurately. Remember: bearings are written as three figures.

The auxiliary line is drawn to help you measure and draw the angle that is measured to represent the bearing



Scale drawings using bearings

Remember — angles **DO NOT** change size in scaled drawings



The bearing measurements do not change from "real life" to images

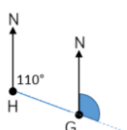
The units in the ratio scale are the same

The scale may need to be calculated from the image. This represents 30km from P to Q

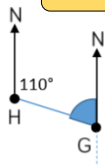
6cm = 30km
6:30,000,000

Bearings with angle rules

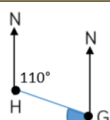
Because two North lines are **PARALLEL**....



They form **corresponding angles** and therefore are the same size



They form **co-interior angles** and add up to 180°



They form **alternate angles** and therefore are the same size

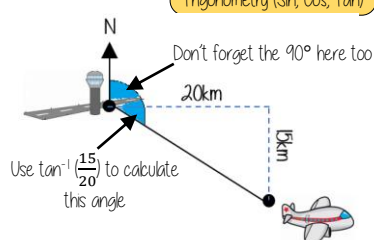
Bearings with right-angled geometry

Look for Right-angles
Pythagoras
Trigonometry (Sin, Cos, Tan)

"Due West" bearing of 270° makes a 90° angle

"Due East" bearing of 090° makes a 90° angle

A plane flies East for 20km then turns South for 15km. Find the bearing of the plane from where it took off



Year 9 Term 3

Similarity & Congruence

What do I need to be able to do?

By the end of this unit you should be able to:

- Enlarge by a positive scale factor
- Enlarge by a fractional scale factor
- Identify similar shapes
- Work out missing sides and angles in similar shapes
- Use parallel lines to find missing angles
- Understand similarity and congruence

Keywords

Enlarge: to make a shape bigger (or smaller) by a given multiplier (scale factor)

Scale Factor: the multiplier of enlargement

Centre of enlargement: the point the shape is enlarged from

Similar: when one shape can become another with a reflection, rotation, enlargement or translation

Congruent: the same size and shape

Corresponding: items that appear in the same place in two similar situations

Parallel: straight lines that never meet (equal gradients)

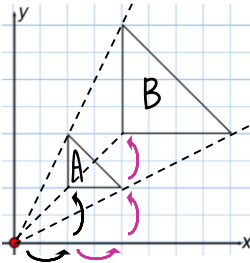
Positive scale factors

Enlargement from a point

Enlarge shape A by SF 2 from (0,0)

The shape is enlarged by 2

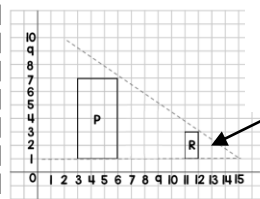
The distance from the point enlarges by 2



Fractional scale factors

Fractions less than 1 make a shape **SMALLER**

R is an enlargement of P by a scale factor $\frac{1}{3}$ from centre of enlargement (15,1)



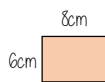
SF: $\frac{1}{3}$ - R is three times smaller than P

Identify similar shapes



Angles in similar shapes do not change.
e.g. if a triangle gets bigger the angles can not go above 180°

Similar shapes

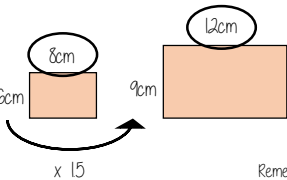


Scale Factor:
Both sides on the bigger shape are 1.5 times bigger

Compare sides: $6:9$ and $8:12$
 $2:3$ and $2:3$

Both sets of sides are in the same ratio

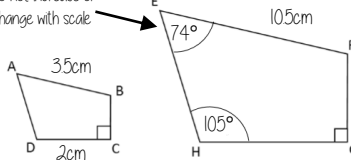
Information in similar shapes



Compare the equivalent side on both shapes

Scale Factor is the multiplicative relationship between the two lengths

Remember angles do not increase or change with scale

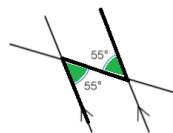


Notation helps us find the corresponding sides

OB and EF are corresponding

Angles in parallel lines

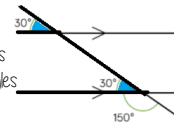
Alternate angles



Because alternate angles are equal the highlighted angles are the same size

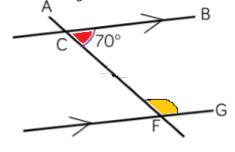
Corresponding angles

Because corresponding angles are equal the highlighted angles are the same size



Co-interior angles

Because co-interior angles have a sum of 180° the highlighted angle is 110°

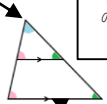


As angles on a line add up to 180° co-interior angles can also be calculated from applying alternate/ corresponding rules first

Similar triangles

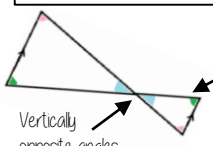
Shares a vertex

Because corresponding angles are equal the highlighted angles are the same size



Parallel lines - all angles will be the same in both triangle

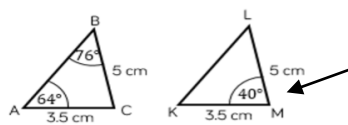
As all angles are the same this is similar - it only one pair of sides are needed to show equality



All the angles in both triangles are the same and so similar

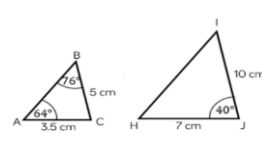
Congruence and Similarity

Congruent shapes are identical - all corresponding sides and angles are the same size



$\triangle ABC \cong \triangle KLM$

Because all the angles are the same and $AC = KM$ $BC = LM$ triangles ABC and KLM are **congruent**



Because all angles are the same, but all sides are enlarged by 2 $\triangle ABC$ and $\triangle HIJ$ are **similar**

Conditions for congruent triangles

Triangles are congruent if they satisfy any of the following conditions

Side-side-side

All three sides on the triangle are the same size

Angle-side-angle

Two angles and the side connecting them are equal in two triangles

Side-angle-side

Two sides and the angle in-between them are equal in two triangles (it will also mean the third side is the same size on both shapes)

Right angle-hypotenuse-side

The triangles both have a right angle, the hypotenuse and one side are the same

Handling Data

- Draw and interpret scatter graphs
- Describe correlation and relationships
- Identify different types of non-linear relationships
- Design and complete an ungrouped frequency table
- Read and interpret grouped tables (discrete and continuous data)
- Represent data in two way tables

Frequency: the number of times a particular data value occurs.

Interleaving: Use your fraction, decimal percentage equivalence knowledge

Year 9 Term 3

Vectors

What do I need to be able to do?

By the end of this unit you should be able to:

- Understand and represent vectors
- Use and read vector notation
- Draw and understand vectors multiplied by a scalar
- Draw and understand addition of vectors
- Draw and understand addition and subtraction of vectors

Keywords

Direction: the line our course something is going

Magnitude: the magnitude of a vector is its length

Scalar: a single number used to represent the multiplier when working with vectors

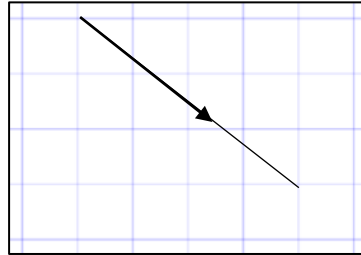
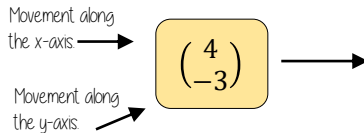
Column vector: a matrix of one column describing the movement from a point

Resultant: the vector that is the sum of two or more other vectors

Parallel: straight lines that never meet

Understand and represent vectors

Column vectors have been seen in translations to describe the movement of one image onto another



Vectors show both direction and magnitude

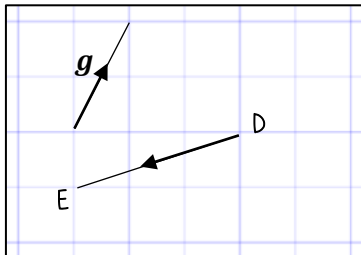
The arrow is pointing in the direction from starting point to end point of the vector.

The direction is important to correctly write the vector

The magnitude is the length of the vector (This is calculated using Pythagoras theorem and forming a right-angled triangle with auxiliary lines)

The magnitude stays the same even if the direction changes

Understand and represent vectors



Vector notation $\overrightarrow{DE}$ is another way to represent the vector joining the point D to the point E

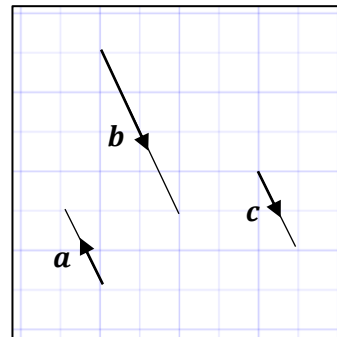
$$\overrightarrow{DE} = \begin{pmatrix} -3 \\ -1 \end{pmatrix}$$

The arrow also indicates the direction from point D to point E

Vectors can also be written in bold lower case so $\mathbf{g}$ represents the vector $\mathbf{g} = \begin{pmatrix} 1 \\ 2 \end{pmatrix}$

Vectors multiplied by a scalar

Parallel vectors are scalar multiples of each other



$$\mathbf{b} = 2 \times \mathbf{c} = 2\mathbf{c}$$

Multiply $\mathbf{c}$ by 2 this becomes $\mathbf{b}$.
The two lines are parallel

$$\mathbf{a} = -1 \times \mathbf{c} = -\mathbf{c}$$

The vectors $\mathbf{a}$ and $\mathbf{c}$ are also parallel. A negative scalar causes the vector to reverse direction

$$\mathbf{b} = -2 \times \mathbf{a} = -2\mathbf{a}$$

$$\mathbf{a} = \begin{pmatrix} -1 \\ 2 \end{pmatrix} \quad \mathbf{b} = \begin{pmatrix} 2 \\ -4 \end{pmatrix} \quad \mathbf{c} = \begin{pmatrix} 1 \\ -2 \end{pmatrix}$$

Addition of vectors

$$\overrightarrow{AB} = \begin{pmatrix} 3 \\ 1 \end{pmatrix}$$

$$\overrightarrow{BC} = \begin{pmatrix} 2 \\ -4 \end{pmatrix}$$

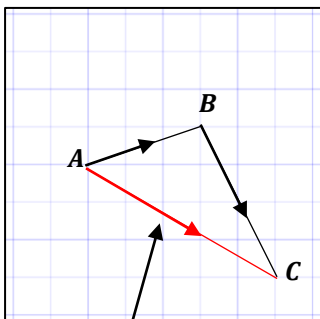
$$\overrightarrow{AB} + \overrightarrow{BC}$$

$$= \begin{pmatrix} 3 \\ 1 \end{pmatrix} + \begin{pmatrix} 2 \\ -4 \end{pmatrix}$$

$$= \begin{pmatrix} 3+2 \\ 1+(-4) \end{pmatrix}$$

$$\overrightarrow{AC} = \begin{pmatrix} 5 \\ -3 \end{pmatrix}$$

Look how this addition compares to the vector $\overrightarrow{AC}$



The resultant

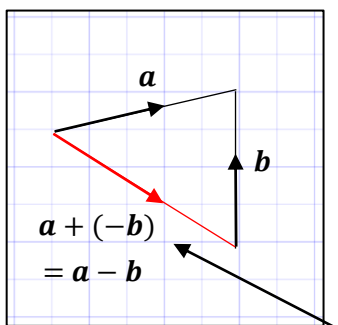
$$\overrightarrow{AB} + \overrightarrow{BC} = \overrightarrow{AC} = \begin{pmatrix} 5 \\ -3 \end{pmatrix}$$

Addition and subtraction of vectors

$$\mathbf{a} = \begin{pmatrix} 5 \\ 1 \end{pmatrix}$$

$$\mathbf{b} = \begin{pmatrix} 0 \\ 4 \end{pmatrix}$$

$$\mathbf{a} + (-\mathbf{b}) = \begin{pmatrix} 5 & -0 \\ 1 & -4 \end{pmatrix} = \begin{pmatrix} 5 \\ -4 \end{pmatrix}$$



$$\mathbf{a} + (-\mathbf{b}) = \mathbf{a} - \mathbf{b}$$

The resultant is $\mathbf{a} - \mathbf{b}$ because the vector is in the opposite direction to $\mathbf{b}$ which needs a scalar of -1