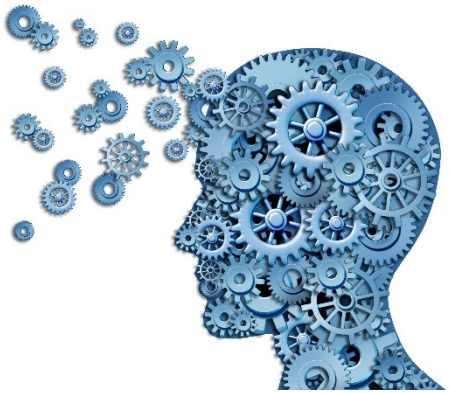
Kettlethorpe HIGH SCHOOL

MATHS

Year 11 | Pi

Name:

Set:



Unit	Topic	Complete
1	Statistics and sampling	
2	Averages	
3	Circles	
4	Quadratics equations	
5	Plans and elevations	
6	Constructions, loci and bearings	
7	Similarity and congruence	
8	Vectors	
9	Mixed numbers	

Pi Unit 1: Statistics and sampling

Essential knowledge:

The **population** of a survey is everyone who can be questioned in relation to that survey

A **sample** is a small selection of the population

Key Words:

Primary data, secondary data, qualitative, quantitative, biased, population, survey, discrete, continuous

Prior Knowledge:

- A data collection sheet (tally chart) can be used to collect data

Pet	Tally	Frequency
Dog	~~IIII~~ II	7
Cat	~~IIII~~ IIII	9
Rabbit	III	3
Other	~~IIII~~ I	6

- Data that is collected from more than one category is shown in a two-way table

	maths	art	total
Boys	37	21	58
Girls	25	29	54
total	62	50	112

Types of data:

primary data - data that has been collected from the original source for a specific purpose, for example, if a school wanted to know what their students thought of the school canteen service they would question the pupils directly

secondary data - data that is not originally collected by a group for a specific purpose, for example, finding out the average cost of cars in a car park by using national statistics

qualitative data - data that can only be written in words, not numbers, for example, the colours of cars in a car park

quantitative data - data that can be written in numbers, for example, the heights of children

discrete data - numerical data that cannot be shown in decimals, for example, the number of children in a classroom

Sources of bias:

Bias shows prejudice or favour to one person, group, or opinion if it does not fairly represent the full population. You must ensure all data collected and used is fair, e.g. to find out if people like pasta, don't only ask people in an Italian restaurant.

LITERACY

Explain the difference between discrete and continuous data.

What does the term ‘biased’ mean?

REASONING

Is eye colour discrete or continuous data?
Tick a box.

Discrete ☐ Continuous ☐

Give a reason for your answer.

.....

.....

FLUENCY

A car salesman records information about the cars he is selling.

Here is a list of words.

Qualitative **Continuous** **Discrete**

Use a word from the list to complete each sentence.

(a) The number of doors is ..... data.

(b) The age of each car is ..... data.

(c) The colour of the car is ..... data.

A shop owner records information about his customers.

Put a cross in the box to indicate whether each of the following is qualitative or quantitative data.

(a) The distance travelled to get to the shop

Qualitative ☐ Quantitative ☐

(b) The method of transport

Qualitative ☐ Quantitative ☐

(c) The average amount of money spent

Qualitative ☐ Quantitative ☐

PROBLEM SOLVING

Robert says he is 13 years old.
Alan says Robert’s response is continuous data.
Hannah says Robert’s response is discrete data.

Who do you agree with?
Explain your answer.

.....

.....

.....

.....

Pi Unit 2: Averages

Essential knowledge:

Calculate the mean from a table or tables
Compare two data sets using averages and ranges

Key Words:

Mean, median, mode, range, average, discrete, continuous, estimate

Prior Knowledge:

Calculate the basic averages

Mode – The number which appears the most

Median – The middle value when the values are in size order

Mean – The value calculated when they are added together and divide by the number of values in the data set.

Calculate measures of spread for consistency

Range – The difference between the smallest and largest values

To be able to read and plot Stem and Leaf diagrams

Median and Mode from frequency table

Here is a table showing the number of goals scored in 10 football matches

Number of goals	Frequency
0	2
1	2
2	5
3	1

Mode = 2 (the class with highest frequency)

The **median** is the class containing the 5,5th data point

Number of goals	Frequency	Cumulative
0	2	2
1	2	2+2 = 4
2	5	4 + 5 = 9
3	1	9 + 1 = 10

The 5.5th data is set is the category for 2, therefore the median is 2

Mean from frequency table

To find the mean, you need to find the total number of goals scored

Number of goals, g	Frequency, f	F x g
0	2	0
1	2	2
2	5	10
3	1	3

Total goals 0 + 2 + 10 + 3 = 15

Mean = 15/10 = 1.5 goals per game

Remember
When the data is grouped like below, we estimate the mean using the midpoint for the classes

Mass (m grams)	Frequency	Midpoint
10<m≤20	10	15
20<m≤40	30	30
40<m≤50	20	45

Comparing data sets

In order to compare data sets, make 2 comparisons:

Compare an Average: Use the median, mode or mean to show which is higher/lower

Compare the range: A smaller range means that the data is more consistent.

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MATHS

Year 11 | Half-term 1: *Unit 2 Averages*

LITERACY

Explain the following words:

Estimated mean-

Modal class interval-

REASONING

A football team played six games.

Here are the number of goals they scored in each game:

6 0 3 2 2 5

The football team play one more game.
The mean number of goals scored increases to 4.

(c) Work out the number of goals scored in the seventh game.

FLUENCY

4. Timothy asked 30 people how long it takes them to get to school.

The table shows some information about his results.

Time (t minutes)	Frequency
$0 < t \leq 10$	2
$10 < t \leq 20$	8
$20 < t \leq 30$	12
$30 < t \leq 40$	7
$40 < t \leq 50$	1

Work out an estimate for the mean time taken.

.....minutes

PROBLEM SOLVING

Shown below are five cards which are arranged in order from smallest to largest

5				

The range of the cards is 4.
The median of the cards is 8.
The mean of the cards is 7.

Work out the 4 missing numbers.

Pi Unit 3: Circles

Essential knowledge:

- Know the parts a circle
- Know how to find area and circumference of a circle
- Know how to find volume of a cylinder
- Find the surface area of a cylinder

Key Words:

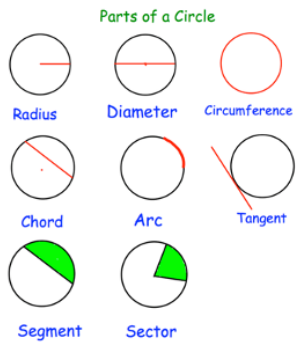
Area, perimeter, formula, length, width, measurement, volume, circle, segment, arc, sector, cylinder, circumference, radius, diameter, pi, sphere, cone, hemisphere, segment, accuracy, surface area

Prior Knowledge:

- Understand and find area and perimeter of 2-d shapes, including rectangles
- Understand and find volume and surface are of 3-d shapes
- Use formulae
- Use a calculator efficiently, specifically the π button

Parts of a circle

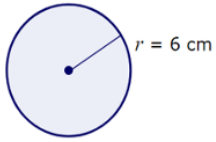
You must be able to identify, label and draw the following parts of a circle



Area and Circumference of Circles:

$Area = \pi r^2$ $\qquad$ $Circumference = \pi d$

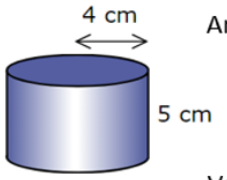
Area = $\pi \times r^2$
$= \pi \times 6^2$
$= 113cm^2$



Circumference = $\pi \times d$
$= \pi \times 12$
$= 37.7cm$

Volume of a cylinder

$Volume = Area\ of\ cross\ section \times Length$



Area of cross section = πr^2
$= \pi \times 4^2$
$= 50.3cm^2$

Volume= $50.3 \times 5 = 251cm^3$

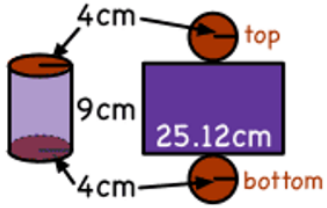
Surface area of cylinder

The net of cylinder is made up of 2 circles and a rectangle

The rectangle has a width which is the circumference of the bases

Example

Height = 9cm
Radius = 4cm



$A_{\blacksquare} = 226.08cm^2$

$A_{top\bullet} = 50.24cm^2 = A_{bottom\bullet}$

S.A. = 226.08 + 50.24 + 50.24

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MATHS

Year 11 | Half-term 1: *Unit 2 Mostly circles*

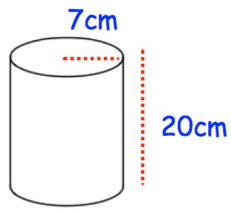
LITERACY

Write the definition of circumference

Explain how to convert between a radius and a diameter

REASONING

Carl is filling flowerpots with soil.



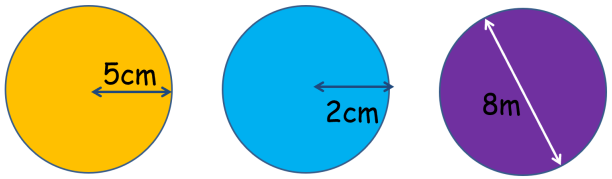
1litre = 1000cm^3

Each flowerpot is a cylinder with radius 7cm and height 20cm.
Carl has 50 litres of soil.

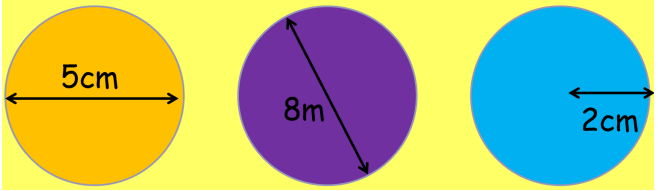
How many flowerpots can be filled?

FLUENCY

Calculate the area of the following circles.
Round your answer to 1dp.

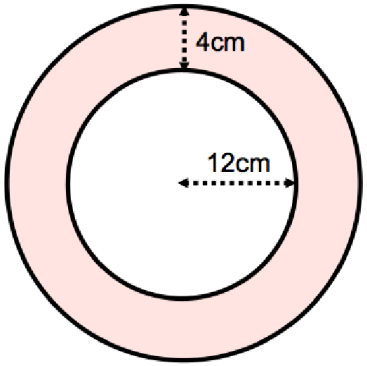


Calculate the circumference of the following circles. Round your answer to 1dp.



PROBLEM SOLVING

Shown below is a circular photo surrounded by a frame.



The photo has radius 12cm.
The frame has width 4cm.

Work out area of the frame.
This area is shaded in the diagram.

Pi Unit 4: Quadratic equations

Essential knowledge:

Expand a pair of brackets
Factorise a quadratic expression
Solve a quadratic equation

Key Words:

Quadratic, function, solve, expand, factorise, simplify, expression, graph, curve, factor, coefficient, bracket

Prior Knowledge:

- Find factors of numbers
- Simplify algebraic expressions
- Multiply algebraic terms
- Multiply terms over a single bracket
- Factorise a single bracket.
- Solve equations
- Plot a quadratic graph
- Understand the key points of a quadratic graph

Expanding double brackets:

Use a grid to multiply out the brackets. Remember to put the multiplication sign in the corner to remind you to multiply.

$(x+3)(x-5)$

Collect like terms

x	x	$+3$
x	x^2	$3x$
-5	$-5x$	-15

$= x^2 - 2x - 15$

Multiply into the grid

Solving Quadratic Equations

A quadratic equation will have 2 solutions. Factorising will give us 2 equations to solve.

Example: solve $x^2 + 5x - 24 = 0$

First factorise $x^2 + 5x - 24 - 0 \rightarrow (x+8)(x-3) = 0$

Either bracket can be equal to 0, these are the 2 solutions, so the two solutions are

$x + 8 = 0$ *or* $x - 3 = 0$
$x = -8$ *or* $x = 3$

Factorising a quadratic expression

A quadratic expression is one which involves a quadratic term e.g. $x^2 + 9x + 20$

Example: Factorise the expression $x^2 + 9x + 20$ You look for the 2 numbers which multiply to make 20 and add to make 9, these are 4 and 5. These are the factors and give the answer

$$x^2 + 9x + 20 = (x+4)(x+5)$$

Example 2: Factorise the expression $x^2 - 5x - 24$ You look for the 2 numbers which multiply to make -24 and add to make -5, these are -8 and 3. These are the factors and give the answer

$$x^2 - 5x - 24 = (x-8)(x+3)$$

Hint: Expanding the brackets can check your answers

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MATHS

Year 11 | Half-term 2: *Unit 4 Quadratic equations*

LITERACY

Write the definition of expand

Write the definition of factorise

REASONING

Sam says that when you expand $(x + 5)^2$ you get $x^2 + 25$
Explain why Sam is wrong

FLUENCY

1. Expand and simplify $(y + 3)(y + 5)$

2. Expand and simplify $(x + 5)(x - 1)$

3. Expand and simplify $(w - 2)(w - 7)$

4. Expand and simplify $(x - 10)(x + 3)$

1. Factorise $x^2 + x - 6$

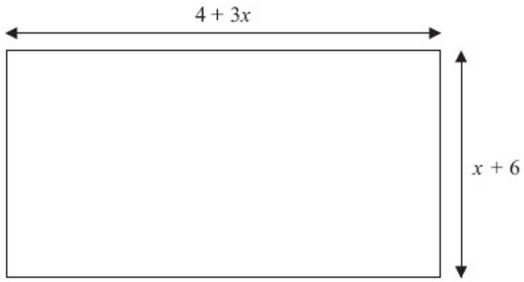
2. Factorise $x^2 + 5x + 6$

3. Factorise $x^2 + 9x + 20$

4. Factorise $x^2 + 10x + 9$

PROBLEM SOLVING

The diagram shows a garden in the shape of a rectangle.



All measurements are in metres.
The area of the garden is 117 metres^2.

Work out the value of x

Pi Unit 5: Plans and Elevations

Essential knowledge:

Draw plans and elevations
Identify Faces, Edges and vertices
Know the compass directions
Identify congruent shapes

Key Words:

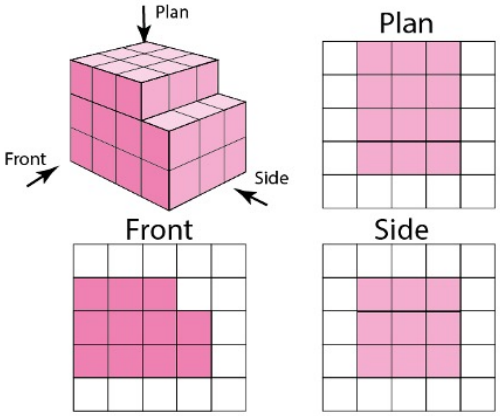
Construct, face, edge, vertex, two-dimensional, three-dimensional, solid, elevations, congruent, angles, regular, irregular

Prior Knowledge:

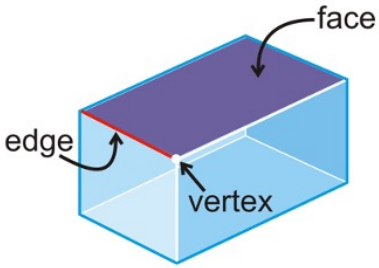
- Draw and measure angles accurately using a protractor
- Draw and measure lines accurately to the nearest mm using a ruler
- Draw accurate 2-d drawings of shapes

Plans and Elevations

Plans are accurate 2-d drawings of 3-d shapes from different elevations. The measurements must be accurate.



Faces, Edges and Vertices

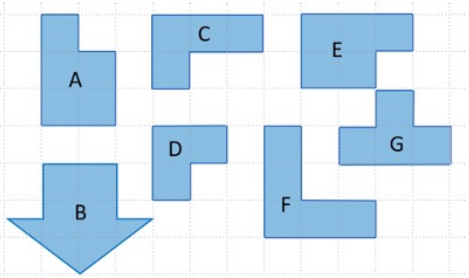


Cuboid has: 6 faces, 8 Vertices. 12 Edges

Faces + vertices – 2 = Edges

Congruent shapes

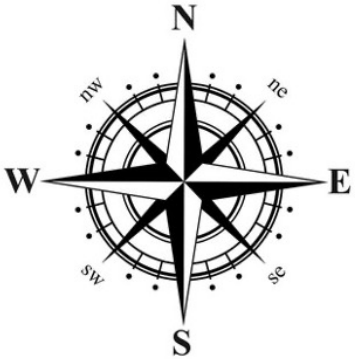
Congruent shapes are shapes which are the same, they have the same size angles and sides, however they can be rotated.



Example:

A and E are congruent shapes

Compass directions



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MATHS

Year 11 | Half-term 2: *Unit 5 Plans and elevations*

LITERACY

Write a definition of the following words:

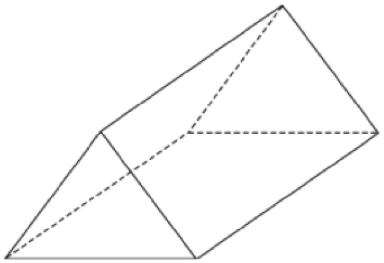
Face:

Edge:

Vertices:

REASONING

Shown below is a triangular prism.



Sketch a net for the triangular prism.

FLUENCY

The names of five solid shapes are given.

triangular prism sphere cube cuboid cylinder

Three of them are drawn below.

A B C

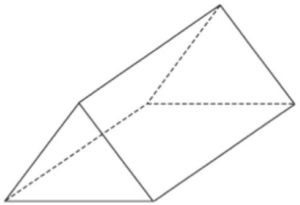
Complete these statements.

Shape A is called a .....

Shape B is called a .....

Shape C is called a .....

5. Below is a solid shape.



(a) What is the mathematical name for the shape?

.....

(b) Write down the number of vertices

.....

(c) Write down the number of faces

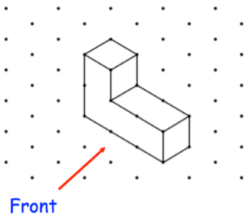
.....

(d) Write down the number of edges

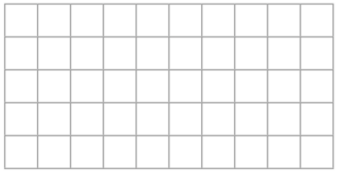
.....

PROBLEM SOLVING

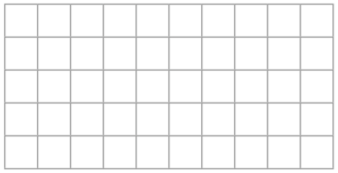
The diagram below shows a shape made with centimetre cubes.



(a) On the centimetre square grid, draw the front elevation.



(b) On the centimetre square grid, draw the plan view.



Pi Unit 6: Constructions, Loci and Bearings (1)

Essential knowledge:

Perform constructions
Construct Loci
Measure a bearing
Calculate a bearing

Key Words:

Construct, circle, arc, angles, bearing, degree, bisect, perpendicular, loci, map, scale, plan, region

Prior Knowledge:

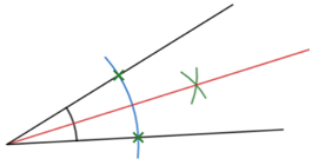
- Use a protractor accurately
- Use a compass accurately
- Construct triangles given SSS, SAS, ASA
- Draw circles
- Know and recall basic angle facts
- Know the rules for angles in parallel lines
- Use angle reasoning to solve problems

Constructions

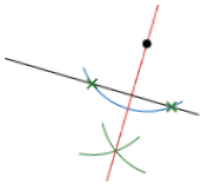
The three basic constructions using a compass

Perpendicular bisector

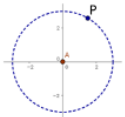
Angle Bisector



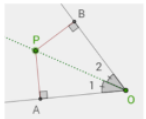
Perpendicular line to a point



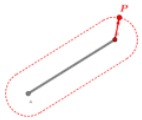
Locus of points



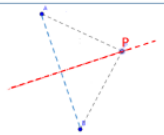
Locus of points equidistant from a point A will form a circle with center A.



Locus of points that are equidistant from two lines will bisect the angle formed by the two lines.



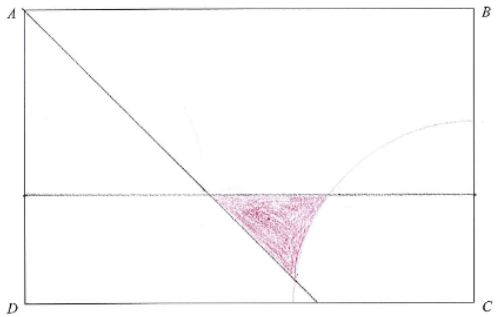
Locus of points equidistant from a line segment.



Locus of points equidistant from two points A and B forms a perpendicular bisector of the line AB.

Using Loci to find regions on diagrams

Here is a scale drawing of a rectangular garden *ABCD*.



Scale: 1 cm represents 1 metre.

Arc radius around C

Bisector of AB and AD to find points nearer AB than AD

Line as a loci from DC to show close enough to DC

Region shaded

Jane wants to plant a tree in the garden

at least 5 m from point *C*,
nearer to *AB* than to *AD*
and less than 3 m from *DC*.

On the diagram, shade the region where Jane can plant the tree.

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MATHS

Year 11 | Half-term 3: *Unit 6 Constructions, Loci and Bearings (1)*

Pi Unit 6: Constructions, Loci and Bearings (2)

Essential knowledge:

Perform constructions
Construct Loci
Measure a bearing
Calculate a bearing

Key Words:

Construct, circle, arc, angles, bearing, degree, bisect, perpendicular, loci, map, scale, plan, region

Prior Knowledge:

- Use a protractor accurately
- Use a compass accurately
- Construct triangles given SSS, SAS, ASA
- Draw circles
- Know and recall basic angle facts
- Know the rules for angles in parallel lines
- Use angle reasoning to solve problems

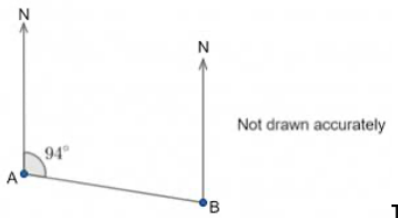
Bearings

There are 3 rules for bearings

- Always Measure from North
- Always measure clockwise
- Always use 3-digits

Remember: From indicates where you are stood, B from A, means you are stood at A

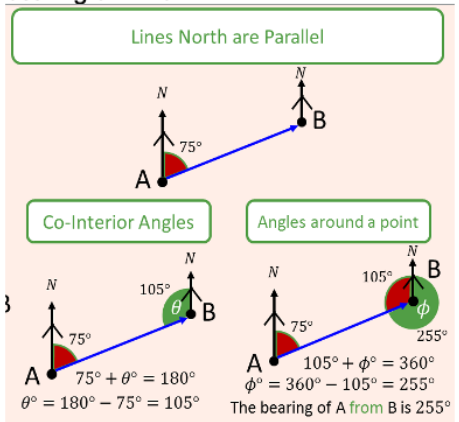
Example Bearing



The bearing of B from A is 094^0

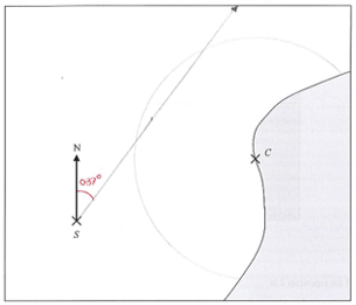
Calculating bearings

You need to be able to use angle reasoning to find missing bearings
Example, the bearing of B from a is 075^0, find the bearing of A from B



Bearings and Loci

Here is a map.
The position of a ship, S, is marked on the map.



Scale 1 cm represents 100 m

Point C is on the coast.
Ships must not sail closer than 500 m to point C.

The ship sails on a bearing of 037°

Will the ship sail closer than 500 m to point C?
You must explain your answer.

Yes, as the ship's course intersects with the region

Circle around C to represent the area close enough to the ship.

Then the bearing is shown as well.

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MATHS

Year 11 | Half-term 3: *Unit 6 Constructions, Loci and Bearings (2)*

LITERACY

Write the definition of construct

Write the definition of perpendicular

REASONING

Draw the locus of all points 2cm from the shape below.

FLUENCY

Use ruler and compasses to construct the perpendicular bisector of AB.
You **must** show clearly all your construction arcs.

PROBLEM SOLVING

In the space below, use ruler and compasses to construct an equilateral triangle with sides of length 5cm.

Pi Unit 7: Similarity and congruency

Essential knowledge:

- Find missing sides in similar shapes
- Understand congruence

Key Words:

Similar, congruence, side, angle, compass, construction, shape, volume, length, area, volume, scale factor, enlargement, perimeter,

Prior Knowledge:

- Understand enlargement of shapes
- Understand what similar means
  It means that one of the shapes is an enlargement of the other. They have the same angle sizes, and their sides are in the same ratio
- Find the scale factor linking two enlarged shapes
- Use a scale factor to enlarge a shape.
- Understand what congruency is
  It means the two shapes have the exact same properties, angle sizes and same length sides

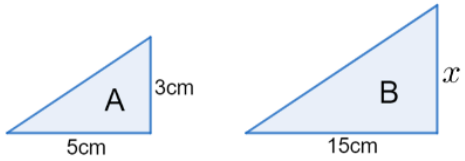
Similar Shapes

Similar shapes are an enlargement of one another and you can use this to calculate missing sides. You first need to work out the scale factor connecting them.

Example: shapes A and B are similar, find the side length of x

The scale factor for the 2 shapes is 15 ÷ 5 = 3

So x is 3 x 5 = 15

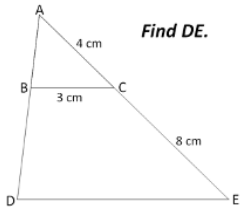


Tougher Example

Find DE. Here we have two similar triangles laid over one another Triangle ABC and Triangle ADE.

The scale factor is AE ÷ AC = 12 ÷ 4 = 3

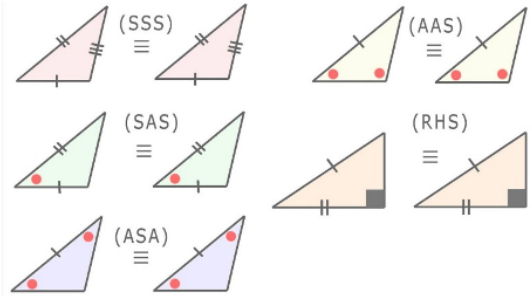
So DE = BC x 3 = 3 x 3 = 9cm



Congruency

If two shapes are congruent then they share all the same properties, same size angles and same size side lengths

The diagram shows congruent pairs and the reason for congruency.



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MATHS

Year 11 | Half-term 3: *Unit 7 Similarity and congruency*

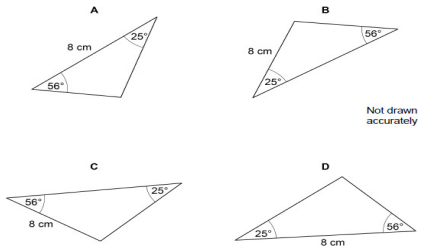
LITERACY

Explain what the word “similar” means in maths.

Describe what is meant by “congruent” shapes.

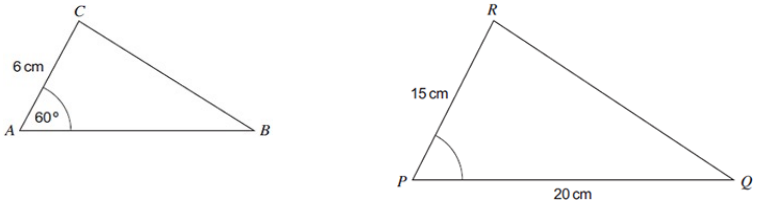
REASONING

Which **two** of the four triangles below are **congruent**?
Give reasons for your choice.

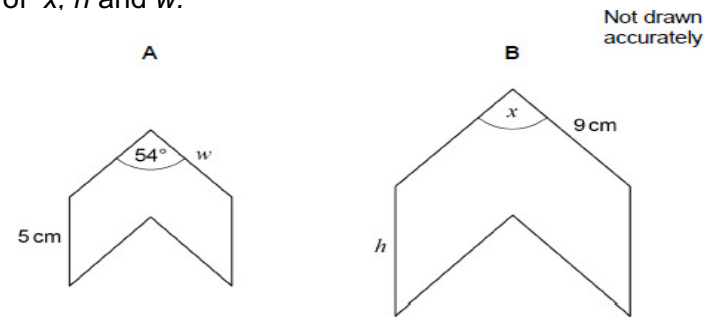


FLUENCY

1) PQR is an enlargement of ABC.
Work out the scale factor of the enlargement and the length AB

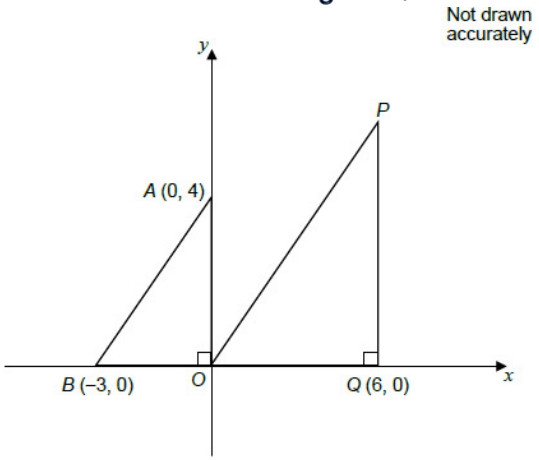


2) A and B are similar shapes.
B is an enlargement of A by scale factor 1.5.
Find the values of *x*, *h* and *w*.



PROBLEM SOLVING

AOB and *PQO* are similar triangles.
Work out the area of triangle *PQO*.



Pi Unit 8: Vectors

Essential knowledge:

- Write and draw column Vectors
- Identify parallel column vectors
- Add column vectors

Key Words:

Vector, magnitude, column, scalar, direction, parallel, ratio, combined

Prior Knowledge:

- Understand the notation of column vectors

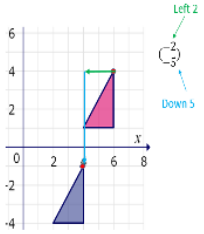
$\begin{pmatrix}3\\4\end{pmatrix}$

Means 3 left, 4 up

The top number means left (+) and right (-)

The bottom number represents up (+) and down (-)

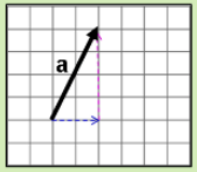
- Perform translations using column vectors



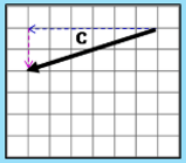
- Understand what parallel means

Writing and drawing vectors

Vectors have direction and magnitude. They can be visually represented as a line, like below.



$a = \begin{pmatrix}2\\4\end{pmatrix}$ Move 2 right, Then move 4 up



$c = \begin{pmatrix}-6\\-2\end{pmatrix}$ Move 6 left, Then move 2 down

You may be asked, either to write the column vector, or draw the corresponding vector on a grid. Remember you need to lace an arrow to show the direction of the vector.

Parallel vectors

Parallel vectors are ones which have the same direction.

Two Vectors are parallel if one is a multiple of the other.

E.g.

A = $\begin{pmatrix}2\\3\end{pmatrix}$ and B = $\begin{pmatrix}6\\9\end{pmatrix}$ are parallel as B = 3A

Here's some more parallel vectors

A = $\begin{pmatrix}1\\3\end{pmatrix}$ and B = $\begin{pmatrix}2\\6\end{pmatrix}$ are parallel, so is C = $\begin{pmatrix}-4\\-12\end{pmatrix}$

Combining vectors

Tw vectors can be combined to give a single vector

E.g.

A = $\begin{pmatrix}2\\3\end{pmatrix}$ and B = $\begin{pmatrix}1\\4\end{pmatrix}$, A + B = $\begin{pmatrix}2+1\\3+4\end{pmatrix} = \begin{pmatrix}3\\7\end{pmatrix}$

You can also add multiples of vectors

A = $\begin{pmatrix}3\\4\end{pmatrix}$ and B = $\begin{pmatrix}2\\-4\end{pmatrix}$ Find 2A + 3B

2A = $\begin{pmatrix}6\\8\end{pmatrix}$ and 3B = $\begin{pmatrix}6\\-12\end{pmatrix}$ 2A + 3B = $\begin{pmatrix}6+6\\8\pm12\end{pmatrix}$ = $\begin{pmatrix}12\\-4\end{pmatrix}$

Kettlethorpe HIGH SCHOOL

MATHS

Year 11 | Half-term 4: *Unit 8 Vectors*

LITERACY

Give an example to explain what a “column vector” is.

REASONING

A shape is translated by the vector $\begin{pmatrix} 0 \\ 4 \end{pmatrix}$

In which direction does the shape move: up/down/left/right?

Give a reason for your answer.

FLUENCY

Here are two column vectors $f = \begin{pmatrix} 4 \\ 5 \end{pmatrix}$ *and* $g = \begin{pmatrix} 5 \\ -2 \end{pmatrix}$

Work out

(a) $f + g$

(b) $f - g$

(c) $2f + g$

(d) $3f + 2g$

(e) $4f - 3g$

(f) $\frac{1}{2}(f + g)$

PROBLEM SOLVING

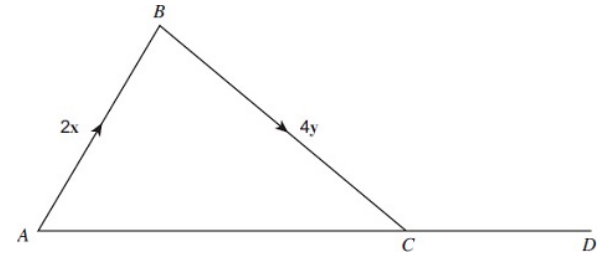
ACD is a straight line.

(a) Write down the vector $\overrightarrow{AC}$ in terms of x and y.

(b) AC : CD = 2 : 1.

Work out the vector $\overrightarrow{AD}$ in terms of x and y.

Give your answer as simply as possible.



Pi Unit 9: Mixed numbers

Essential knowledge:

- Use fractions in complicated exam questions
- Find the reciprocal of integers and fractions

Key Words:

Numerator, denominator, addition, subtraction, multiplication, division, fractions, mixed, improper, recurring, reciprocal

Prior Knowledge:

- Express a given number as a fraction of another
- Simplify and find equivalent fractions
- Find a fraction of amount
- Convert between improper fractions and mixed numbers
  Example: $\frac{11}{5} = 2\frac{1}{5}$
- Add/subtract fractions by finding a common denominator
  Example: $\frac{5}{8} + \frac{2}{3} = \frac{15}{24} + \frac{16}{24} = \frac{31}{24} = 1\frac{7}{24}$
- Multiply fractions
  Example: $\frac{3}{7} \times \frac{5}{8} = \frac{15}{56}$
- Divide fractions
  Example: $\frac{5}{7} \div \frac{3}{8} = \frac{5}{7} \times \frac{8}{3} = \frac{40}{21} = 1\frac{19}{21}$
- Perform the same 4 operations with mixed numbers, i.e. change them to improper first and then calculate
- Know whether a fraction will convert to a recurring decimal
  Example: $\frac{2}{15}$ will recur as the denominator is $15 = 3 \times 5$ when prime decomposition, they only terminate if 2 and 5 are the only primes in the prime decomposition of the denominator

Fractions of a fraction

One key thing to remember is that to find a fraction of amount you need to multiply. This includes finding a fraction of a fraction.

Example

$\frac{3}{10}$ of members in a tennis club are men $\frac{5}{6}$ of these men are right-handed

What fraction of the tennis club are left-handed men?

Answer: We need to find $\frac{3}{10}$ *of* $\frac{5}{6}$ which is $\frac{3}{10} \times \frac{5}{6} = \frac{15}{60} = \frac{1}{4}$

Example

$\frac{7}{12}$ of members in a badminton club are women $\frac{3}{8}$ of these women wear glasses

Work out the smallest number of members of the badminton club.

Answer: The answer needs to be a multiple of both 8 and 12, so that those fractions of amounts can exist!

The LCM of 8 and 12 is 24. S there must be at least 24 people in the club.

Reciprocals

A reciprocal of a number is the required number you would have to multiply to get 1.

E.g. the reciprocal of 4 is $\frac{1}{4}$ because $4 \times \frac{1}{4} = 1$ A way to get the reciprocal is to divide 1 by the number.

Other examples 5 has a reciprocal of $\frac{1}{5}$ $\frac{1}{7}$ has a reciprocal of 7. $\frac{3}{5}$ has a reciprocal of $\frac{5}{3}$

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MATHS

Year 11 | Half-term 4: *Unit 11 Mixed numbers*

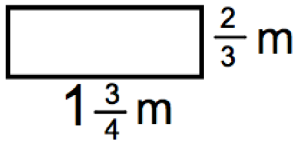
LITERACY

Explain how to convert between a mixed and improper fraction

What is the definition of a recurring decimal?

REASONING

Jessica wants to attach ribbon around her wardrobe.



She has 4 metres of ribbon.

How much more does she need?
Give your answer as a fraction.

FLUENCY

Work out

$1\frac{2}{5} + 2\frac{1}{2}$

Give your answer as a mixed number.

Work out

$1\frac{4}{7} \div 1\frac{1}{4}$

Give your answer as a mixed number.

Work out

$4\frac{1}{3} - 3\frac{4}{9}$

Give your answer as a fraction.

Work out

$5\frac{1}{2} \times 1\frac{2}{3}$

Give your answer as a mixed number.

PROBLEM SOLVING

Matthew is training for a race.
He runs 3 days in one week.

Matthew runs 1½ miles on Monday.
Then he runs 1⅔ miles on Thursday.
Finally he runs 2⅕ miles on Sunday.

Work out how far Matthew ran in total.