Year 10 Congruence, Similarity and Enlargement

Keywords

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

Scale Factor:
The multiplier of enlargement.
(This could be fractional or negative)

Centre of enlargement:
The point the shape is enlarged from

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)

Similar:
Two polygons have the same shape, but possibly have different sizes

Column Vector:
This is a way of writing a vector which gives information about the vector.
The horizontal component tells us how many spaces to the left or right and the vertical component tells us how many spaces up or down.

Dr Frost Key Skills

471 Proving Triangles Congruence Using SSS, SAS, ASA and RHS
294 &377 Describing an Enlargement
295 Enlargement by a positive Integer Scale Factor
376 Enlargement by a negative Scale Factor
324 Relationship between Scale Factors of Length, Area and Volume

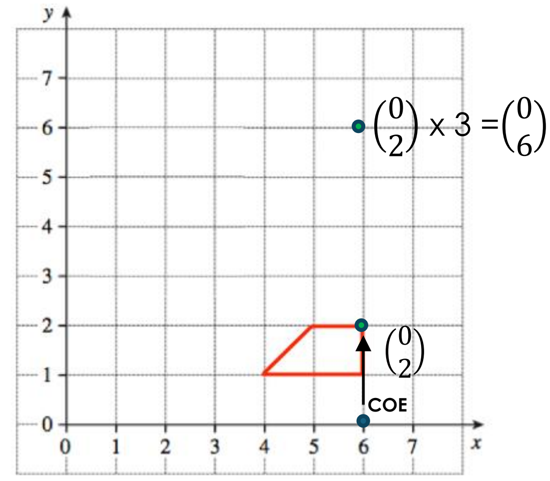
Learning Journey

Year 9
- Enlargement a shape by Positive Integer Scale Factor
- Enlarge a shape by a Positive Integer Scale factor from a point
- Enlarge a shape by Positive Fractional Scale Factor
- Enlarge a shape by a negative scale factor (H)
- Work out missing sides and angles in a pair of given similar shapes
- Solve problems with similar triangles (H)

Year 10 and 11
- Explore Areas of Similar Shapes
- Explore Volumes of Similar Shapes
- Understand and use Conditions for Congruent triangles
- Understand the difference between congruence and similarity

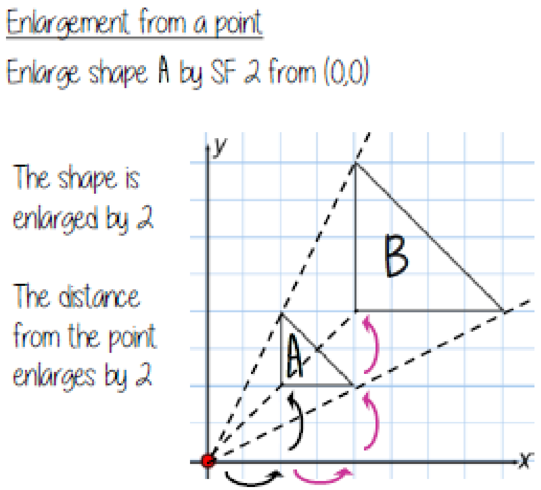
Key Knowledge

Counting Squares



Enlarge the trapezium by scale factor 3, centre (6, 0).

Using Ray Lines



1) Find the Centre of Enlargement (COE)
2) From the COE, count the squares required to go to each vertices of the shape and write this as a column vector
3) Multiply the column vector by the scale factor
4) From the COE, use the new column vector and plot your points. (Do this for all vertices)

Year 10 Trigonometry

Keywords

Cosine Ratio- The ratio of the adjacent side of a right triangle to the hypotenuse.

Sine Ratio- The ratio of the length of the opposite side to that of the hypotenuse.

Tangent Ratio- The ratio of the length of the opposite side to that of the adjacent side

Hypotenuse- The longest side in a right-angled triangle.

Opposite- The side facing the angle in a right-angled triangle.

Adjacent- The side next to the angle given in a right-angled triangle

Inverse operation: The operation that reverses the effect of another operation.

Square number- The result when you multiply a number by itself.

Angle- This is the space between two rays

Dr Frost Key Skills

288 Pythagoras Theorem in 2D

410 Pythagoras Theorem in 3D

321 Trigonometry to determine side lengths in a right-angle triangle

322 Trigonometry to determine angles in right- angle triangles

411 Trigonometry in 3D shapes (right angle only)**(H)**

469 Bearing problems involving non-right-angle triangles **(H)**

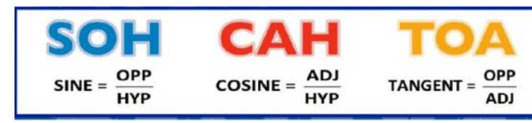
Learning Journey

Year 9
- Identify the hypotenuse of a right-angle triangle
- Determine whether a triangle is a right-angle
- Calculate the hypotenuse of a right-angle triangle
- Calculate missing angles in right angle triangles,
- Use Pythagoras in 3D shapes **(H)**

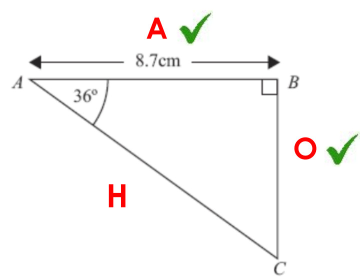
Year 10
- Use the Sine, Cosine, and Tangent ratios to find missing sides
- Use the Sine, Cosine, and Tangent ratios to find the missing angles
- Calculate sides in right angle triangle using Pythagoras' Theorem
- Work with key angles in right angle triangle
- **Use Trigonometry in 3D Shapes (H)**
- **Use the Sine rule to find missing sides and angles (H)**
- **Use the Cosine rule to find missing sides and angles (H)**
- **Solve Bearing problems involving Trigonometry, Pythagoras, and Sine and Cosine Rule (H)**

Key knowledge

Trigonometry Finding a missing side



1) Label the Sides you need as O, A and H
2) Use this to decide which ratio you need
3) Substitute the given values into the formula and solve



Find the length of BC

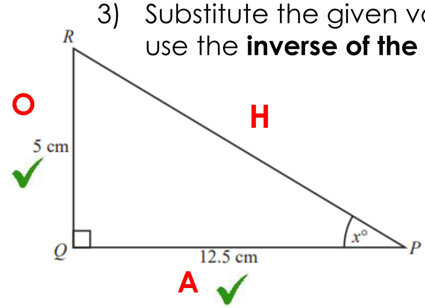
$$tan\theta = \frac{opp}{adj}$$

$$tan36° = \frac{opp}{8.7}$$

$$tan36° \times 8.7 = 6.32\ cm$$

Trigonometry Finding a missing angle

1) Label the Sides you need as O, A and H
2) Use this to decide which ratio you need
3) Substitute the given values into the formula and use the **inverse of the trig ratio to find the angle**



Find the missing angle x

$$tan\theta = \frac{opp}{adj}$$

$$tan\theta = \frac{5}{12}$$

$$\tan^{-1}\frac{5}{12} = 21.8°$$

The inverse of sin, cos and tan are sin^{-1}, tan^{-1}, cos^{-1}. They are found by pressing shift sin on your calculator.

Year 10
Representing Solutions of Equations and Inequalities

Keywords

Solution- A value that we can put to make the equation true

Equation- A mathematical statement that shows that two expressions are equal

Expression- Numbers, symbols, and operators grouped to show the value of something

Linear- An equation where both sides have variables that ca

Integer- A whole number

Solve- To get the solution or answer to the question

Inverse-This is another word for opposite. We complete the opposite operation to the one shown in the question.

Dr Frost's Key Skills

199 Solving Linear Equations where the variable appears on one side of the equation only

200 Solving equations involving integer powers and their roots as inverses

254 Solving Linear equations with brackets

257 Solving linear equations with unknowns on both sides

258 Solving Linear equations involving fractions

339 Solving linear inequalities in one variable

340 Solving linear inequalities with one variable on both sides

342 Forming and Solving linear inequalities from a given context

Learning Journey

Year 7
Solve One-Step Equations
Solve Two Step Equations

Year 8
Form algebraic expressions
Multiply out a single bracket
Form and Solve Equations with Brackets
Form and Solve inequalities
Solve equations and inequalities with unknowns on both sides
Form and Solve Equations and inequalities with unknowns on both sides

Year 9
One and two-step equations and inequalities
Equations and inequalities with brackets
Solve equations with unknowns on both sides
Solve inequalities with unknowns on both sides

Year 10
Form and solve one-step and two-step equations
Form and solve one-step and two-step inequalities
Show solutions to inequalities on a number line
Interpret representation on number lines as inequalities
Represent solutions to single inequalities on a graph (H)
Represent solutions to multiple inequalities on a graph (H)
Solve quadratic equations by factorization (H)
Solve quadratic inequalities in one variable (H)

Key Knowledge

Solve Two Step Equations & Inequalities

$6y + 2 = 20$

$-2 \quad -2$

Subtract first because the 2 is separate from y

$6y = 18$

$\div 6 \quad \div 6$

Divide because it is the inverse of multiplying

$y = 3$

$\frac{w-5}{3} < 6$

Multiply first because the entire expression is divided by 3

$\times 3 \quad \times 3$

$w - 5 < 18$

Add because it is the inverse of subtracting

$+5 \quad +5$

$w < 23$

Solve with unknowns on both sides

$5x - 20 > 3x + 4$

$-3x \quad -3x$

Subtract 3x from both sides because it is the smaller term of x

$2x - 20 > 4$

$+20 \quad +20$

Solve like a normal two step equation

$2x > 24$

$\div 2 \quad \div 2$

$x > 12$

Year 10
Simultaneous Equations

Keywords

Solution- A value we can put in place of a variable that makes an equation true

Substitute- Replace a variable with a numerical value

LCM- Lowest Common Multiple (The lowest multiple shared by two or more numbers)

Eliminate- To remove

Intersection- The point two lines cross or meet

Simultaneous Equations
More than one equation that involves more than one variable. The variables have the same value in each equation

Quadratic Equation
Equations which involve the second power of a variable e.g. $x^2 or\ y^2$

Dr Frost's Key Skills

275 Solving Linear Equations using Graphical Methods

276 Solving Linear Equations using Elimination or Substitution

419 Solve Non-Linear Equations by Substitution

362 Factorise Quadratic Expressions in the form $x^2 \pm bx \pm C$

Year 10

Learning Journey

Solve a pair of linear simultaneous equations by elimination
Solve a pair of linear simultaneous equations by substitution
Form and solve a pair of linear simultaneous equations from given information
Solve a pair of linear simultaneous equations using graphs
Solve a pair of simultaneous equations (one linear, one quadratic) using graphs (H)
Solve a pair of simultaneous equations (one linear, one quadratic) algebraically (H)

Key Knowledge

Two Linear Equations (Elimination)

Both unknowns have different coefficients, thus one or both equations **must** be multiplied to create a common coefficient.

$$3x + 2y = 18$$
$$3x - y = 9 \quad \times 2$$

SSS- Same Sign Subtract
DSA- Different Sign Add

$$3x + 2y = 18$$
$$+ \quad 6x - 2y = 18$$

$$9x = 36$$
$$x = 4$$

Substitute x = 4 into **an** original equation

$$3x + 2y = 18$$
$$3(4) + 2y = 18$$
$$12 + 2y = 18$$
$$2y = 6$$
$$y = 3$$

Substitute both values into the other equation to check your solution

Two Linear Equations

① $y = 2x$
② $x + y = 6$

1) Label the equations 1 and 2
2) Substitute what you know to the other equation and solve
3) Substitute your answer to work out the other unknown

$$x + \mathbf{2x} = 6$$
$$3x = 6$$
$$x = 2$$

$$y = 2x$$
$$y = 2(2)$$
$$y = 4$$

Year 10
Angles and Bearings

Year 10
Use cardinal directions and related angles (R)
Draw and interpret scale diagrams (R)
Understand and represent bearings
Measure and read bearings
Make scale drawings using bearings

Year 10
Calculate bearings using angle rules
Solve bearings problems using Pythagoras and trigonometry
Solve bearings problems using the sine and cosine rules (H)

Learning Journey

Keywords

Cardinal directions: The directions of North, South, East, and West

Angle: The amount of turns between two lines around their common point

Bearing: A bearing is an angle, measured clockwise from the north direction. It is given as a 3-digit number.

Perpendicular: where two lines meet at 90°

Parallel: Straight lines are 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: Draw accurately using a compass, protractor, ruler, or straight edge.

Scale: Scales are used to reduce real-world dimensions to a usable size.

Protractor: An instrument used in measuring or drawing angles

Dr Frost's Key Skills
264 Bearings (Excluding Trigonometry)

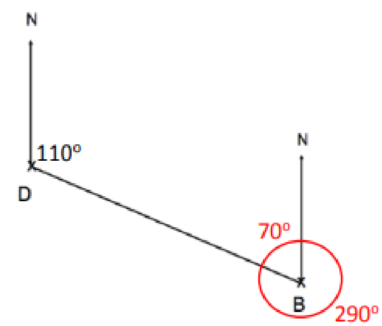
469 Bearings involving non-right-angled triangles **(H)**

465 Sine Rule and Cosine Rule to determine lengths in a non-right-angled triangle **(H)**

466 Sine rule and Cosine Rule to determine angles in a non-right-angled triangle **(H)**

Key Knowledge

The diagram shows the position of a boat B and dock D.



The scale of the diagram is 1cm to 5km.

a) Calculate the real distance between the boat and the dock.
$6cm = 6 \times 5$
$= 30km$

Measure the distance between the dock and the boat with a ruler

b) State the bearing of the boat from the dock.
110^o

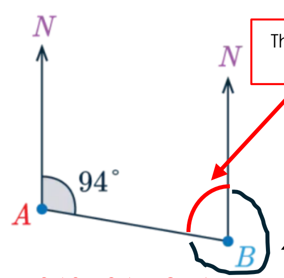
Always start from the point and bearings go CLOCKWISE!

c) Calculate the bearing of the dock from the dock.
$180^o - 110^o = 70^o$ because the angles are cointerior
$360^o - 70^o = 290^o$ because angles around a point equal 360°

Finding the bearing from a point

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

Find the bearing of A from B.



This angle is **86**° as co-interior angles add up to 180°

Remember bearings is measured from the clockwise direction!

360°-86°=274°

Year 10
Working with Circles

Keywords

Circumference:
The length around the outside of the circle –the perimeter

Area:
The size of the 2D surface

Diameter:
The distance from one side of a circle to another through the center

Radius:
The distance from the center to the circumference of the circle

Tangent:
A straight line that touches the circumference of a circle

Chord:
A line segment connecting two points on the curve

Hemisphere:
Half a sphere

Surface Area:
The total area of the surface of a 3D shape.

Arc Length : This is a fraction of the circumference

Sector: A pie-shaped part of a circle made of the arc along with its two radii

Dr Frost's Key Skills
209 Circumference of a circle
210 Area of full circle
318 Arc length of more general sectors
319 Area of more general sectors

Year 10
Use cardinal directions and related angles (R)
Draw and interpret scale diagrams (R)
Understand and represent bearings
Measure and read bearings
Make scale drawings using bearings

Year 10
Calculate bearings using angle rules
Solve bearings problems using Pythagoras and trigonometry
Solve bearings problems using the sine and cosine rules (H)

Learning Journey

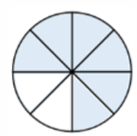
Key Knowledge
Fractional parts of a circle

A circle is made up of 360°

Formula to remember:
Area of a circle = πr^2
Circumference of a circle = πd or $2\pi r$

30° represents $\frac{30}{360}$ of a full circle

$\frac{30}{360} = \frac{1}{12}$



$\frac{270}{360}$ of a full circle (in degrees)

$\frac{6}{8}$ of a full circle (in equal parts)

$\frac{3}{4}$ of a full circle

The fraction of the circle is as $\frac{\theta}{360}$

θ represents the degrees in the sector

Finding the Area of the Sector

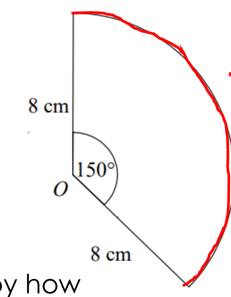
1) Find the Area of the circle

$$Area = \pi \times r^2$$
$$Area = \pi \times 8^2$$
$$Area = 64\pi \text{ or } 200.96\ldots$$

2) Use your answer and multiply by how much of a circle you have

$$Area = 64\pi \text{ or } 200.96 \times \frac{150}{360}$$

Area = 83.8 3 S.F



Finding the Arc Length

1) Find the circumference of the circle

$$\text{Circumference} = \pi \times d$$
$$\text{Circumference} = \pi \times 16$$
$$\text{Circumference} = 16\pi \text{ or } 50.24\ldots$$

2) Use your answer and multiply by how much of a circle you have

$$Circumference = 16\pi \text{ or } 50.24 \times \frac{150}{360}$$

Circumference = 20.9 3 S.F

Year 10 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

Translation: Translate means to move a shape. The shape does not change size or orientation.

Collinear Vectors: These are vectors that are on the same line.
To show that two vectors are collinear, **show that one vector is a multiple of the other (parallel) AND that both vectors share a point**

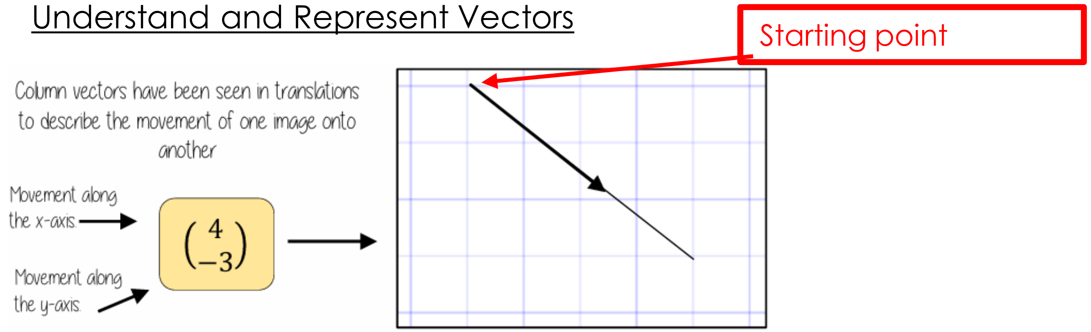
Dr Frost's Key Skills
372 Column Vector Notation
373 Adding, Subtracting and Scaling Column Vector
472 Magnitude of Column Vector
473 Vectors Using Variables
474 Parallel Vectors and Straight Lines proofs using vectors
475 Solving Vectors problems by introducing of a scalar

Year 10
Understand and represent vectors
Use and read vector notation
Draw and understand vectors multiplied by a scalar
Draw and understand addition and subtraction of vectors
Explore vector journeys in shapes (H)
Understand parallel vectors (H)
Explore co-linear points using vectors (H)
Use vectors to construct geometric arguments and proofs (H)

Learning Journey

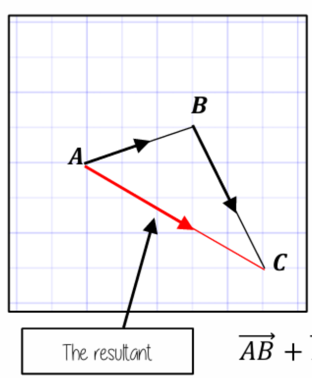
Key Knowledge

Understand and Represent Vectors



Addition of Column Vectors

$\overrightarrow{AB} = \begin{pmatrix}3\\1\end{pmatrix}$ $\quad \overrightarrow{BC} = \begin{pmatrix}2\\-4\end{pmatrix}$



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

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

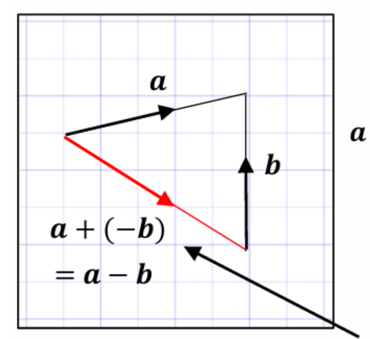
$$= \begin{pmatrix}3+2\\1+-4\end{pmatrix}$$

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

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

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

Addition and Subtraction of Column Vectors



$\boldsymbol{a} = \begin{pmatrix}5\\1\end{pmatrix}$ $\quad \boldsymbol{b} = \begin{pmatrix}0\\4\end{pmatrix}$

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

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

Year 10
Ratio and Fractions

Keywords

Ratio: Relationship between two or more numbers.
Simplify: Divide all parts of a ratio by the same number.
Equivalent: Equal in Value
Proportion: a statement that links two ratios
Integer: The whole number, can be positive, negative, or zero.
Fraction: Represents how many parts of a whole.
Denominator: the number below the line on a fraction. The number represents the total number of parts.
Numerator: The number above the line on a fraction. The top number. Represents how many parts are taken
Convert: Change from one form to another
Gradient: The steepness of a line
Exchange rate: The value of one currency for the purpose of conversion to another.

Dr Frost Key Skills

224a-j – Simplifying ratios and forming ratios from a given context

227a-j -Combining ratios and proportions into a single ratio

177 Exchange Rates

225- Finding a Quantity within a ratio where either the total amount, or a particular difference is given

464 Problem Solving with Ratio

176 Multiplicative Scaling and Numerical Proportion relationships

Year 10

Learning Journey

Compare quantities using a ratio
Link ratios and fractions
Share in a ratio
Use ratios and fractions to make comparison
Solve problems with currency conversion
Use and interpret ratios of the form 1 : n and n : 1
Solve best buy problems
Combine a set of ratios
Ratio in area problems (H)
Ratio in volume problems (H)

Key Knowledge

Combining Ratios

The ratio of Blue Counters to Red Counters is 5 : 3
The Ratio of Red Counters to Green Counters is 2 : 1

Find the ratio of Blue : Red : Green Counters

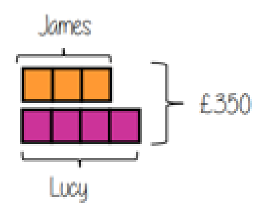
Before combining both statements, we need to find the **Lowest Common Multiple** that both ratio share

B	R	G
5 x 2	3 x 2	
	2 x 3	1 x 3
10	**6**	**3**

Sharing a whole into a given ratio

James and Lucy share £350 money in the ratio 3 : 4. Work out how much each person earns

1) Model the question

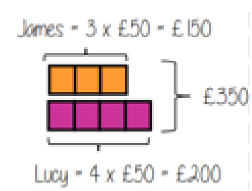


2) Find the value of one part

£350 ÷ 7 = £50

□ = one part = £50

3) Put back into question



Year 10
Using Numbers

Keywords

Truncate: to shorten, to shorten a number (no rounding), to shorten a shape (remove a part of the shape)
Round: Making a number simpler but keeping its place value close the what it originally was.
Credit: Money that goes into a bank account
Debit: Money that leaves a bank account
Profit: The amount of money after income - costs
Tax: The government collects money based on income, sales and other activities.
Balance: The amount of money in a bank account
Overestimate: Rounding up –gives a solution higher than the actual value
Underestimate: Rounding down –gives a solution lower than the actual value
Significant Figures– The number of digits in a value that carry a meaning to the size of the number.
Estimate– Find a value that is close to the right answer by rounding.

Dr Frost Key Skills

56 Adding and Subtracting Fractions with Same Denominator
99 Adding and Subtracting Fractions with Different Denominators
101 Converting Between Mixed Fractions and Improper Fractions
165,166 Multiplying and Dividing Proper Fractions
167,168 Multiplying and Dividing improper Fractions
334 Simplifying Surds
335 Multiplying and Dividng Surds
336 Expanding Brackets with Surds (H)
393 Rationalising the Denominator (H)

Year 10

Learning Journey

The four rules of fraction arithmetic
Rational and irrational numbers (H)
Understand and use surds (H)
Calculate with surds (H)
Rounding to decimal places and significant figures Break down and solve multi-step problems
Solve financial maths problems
Estimating answers to calculations
Understand and use limits of accuracy
Upper and lower bounds (H)

Key Knowledge

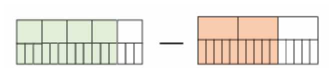
Four Operations with Fractions

Adding and Subtracting

Find the lowest common multiple for both denominators

Calculate

$$\frac{4}{5} - \frac{2}{3} \qquad \frac{4 \times 3}{5 \times 3} \quad \frac{2 \times 5}{3 \times 5} \qquad \frac{12}{15} - \frac{10}{15} = \frac{2}{15}$$

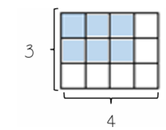


Significant Figure

Significant Figures
370 to 1 significant figure is 400
37 to 1 significant figure is 40
3.7 to 1 significant figure is 4
0.37 to 1 significant figure is 0.4
0.00000037 to 1 significant figure is 0.0000004

SF: Round to the first nonzero number

Multiplying Fractions



Calculate

$$\frac{3}{4} \times \frac{2}{3} = \frac{3 \times 2}{4 \times 3} = \frac{6}{12} = \frac{1}{2}$$

Calculate

$$\frac{2}{5} \div \frac{3}{4} = \frac{2}{5} \times \frac{4}{3} = \frac{8}{15}$$

Make sure you **multiply** the first fraction with the **reciprocal**

Estimation

$$\frac{348 + 692}{0.526} \approx \frac{300 + 700}{0.5} = \frac{1000}{0.5} = 2000$$

To estimate you should round each number in a calculation to 1 significant figure, then calculate.

This is an **underestimate** because both values were rounded down

Year 10
Types of numbers & sequences

Keywords

Factor: Numbers we multiply together to make another number

Multiple: The result of multiplying a number by an integer.

HCF: Highest common factor. The biggest factor that numbers share.

LCM: Lowest common multiple. The first multiple numbers share.

Arithmetic: A sequence where the difference between the terms is constant

Geometric: A sequence where each term is found by multiplying the previous one by a fixed nonzero number

Sequence: Items or numbers put in a pre-decided order

Prime Numbers:
A whole number greater than 1 that cannot be exactly divided by any whole number other than itself and 1

Nth Term:
The nth term refers to a term's position in the sequence,

Common Difference
This is the amount the sequence increases or decreases each time.

Dr Frost's Key Skills
162 Lowest Common Multiple or Highest Common Factor by Prime Factorisation
161 Prime Factorisation of a number
205 nth term formula for an arithmetic sequence
369 nth term formula for a quadratic sequence

Year 10 **Learning Journey**

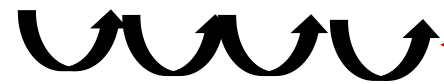
Understand the difference between factors and multiples
Understand primes and express a number as a product of its prime factors
Find the HCF and LCM of a set of numbers
Describe and continue sequences involving surds (H)
Find the rule for the nth term of a linear sequence
Find the rule for the nth term of a quadratic sequence (H)

Key Knowledge

Find the nth term

Find the nth term for the following sequence 3, 7, 11, 15, 19

3, 7, 11, 15, 19



+4 +4 +4 +4

The sequence is adding 4 every single time. Here we will start our sequence as **4n**

4n 4, 8, 12, 16, 20

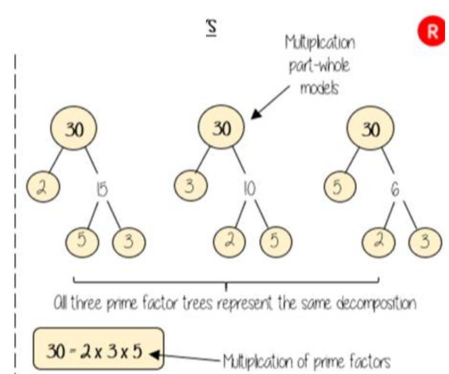
This has the same constant difference –but is 1 less than the original sequence

4n – 1

This is the constant difference between the terms in the sequence.

This is the **difference** between the original and new sequence

Product of Prime Factors



Finding the HCF and LCM

They have a few factors in common, but the biggest factor is 4.

Find the HCF of 12 and 20

The factors of 12 are 1,2,**4**,6 and 12

The factors of 20 are 1, 2,**4**, 5, 10, and 20

Find the LCM of 12 and 20

Multiples of 12
12 x 1 = 12
12 x 2= 24
12 x 3 = 36
12 x 4 = 48
12 x 5 = **60**
12 x 6 = 72

LCM = 60

Multiples of 20
20 x 1= 20
20 x 2 =40
20 x 3 = **60**
20 x 4 = 80

Year 10
Using Indices Rules

Keywords

Standard (index) Form:
A system of writing very big or very small numbers

Commutative:
An operation is commutative if changing the order does not change the result.

Base:
The number that gets multiplied by a power

Power/Indices
This tells you how many times a base will be multiplied by itself

Negative:
A value below zero.

Coefficient:
The number used to multiply a variable.

Square:
A square number is the result of multiplying a number by itself

Root: A root is the reverse of a power.

Dr Frost's Key Skills

88 Power notation and Calculate Simple Powers
157 Roots and Further Powers
158 Numerical Index Laws
194 Algebraic Index Laws
358 Expressing a Power using a different base (H)
298 Negative Indices (H)
394 Fractional Indices (H)

Learning Journey

Year 8
Adding and Subtracting expressions with indices
Using the addition and subtraction law for indices
Exploring Powers of Powers

Year 10
Square and Cube Numbers
Calculate higher powers and roots
The addition and subtraction rules for indices
Understand and use the power zero and negative indices (H)
Work with powers of powers
Understand and use fractional indices (H)

Key Knowledge

Laws of Indices

Multiplication Law:
When multiplying with the same base, **we add the powers.**

$$a^m \times a^n = a^{m+n}$$

Examples

$2^5 \times 2^7 = 2^{12}$ $\quad$ $a^3 \times a^5 = a^8$

Division law:
When dividing with the same base (number/letter) **we subtract the powers**.

$$a^m \div a^n = a^{m-n}$$

Examples

$2^{14} \div 2^9 = 2^5$ $\quad$ $a^3 \div a^5 = a^{-2}$

Brackets law:
When raising a power to another power **we multiply the powers together.**

Examples

$$(a^m)^n = a^{m \times n}$$

$(5^4)^2 = 5^{4 \times 2} = 5^8$ $\quad$ $(h^9)^3 = h^{9 \times 3} = h^{27}$

Different Example

$$(2x^3)^4 = 2x^3 \times 2x^3 \times 2x^3 \times 2x^3$$

The addition law applies ONLY to the powers.
The integers still need to be multiplied

$$(2x^3)^4 = 16x^{12}$$

Year 10
Percentages and Interest

Keywords

Compound interest:
Calculating interest on both the amount plus previous interest

Simple interest:
The amount of interest is fixed over period.

Depreciation: A decrease in the value of something over time.

Growth:
Where a value increases in proportion to its current value such as doubling.

Decay:
The process of reducing an amount by a consistent percentage rate over time.

Decimal Multiplier:
This is equivalent of the percentage.

Equivalent:
Of equal value.

Dr Frost's Key Skills

130 Calculate a simple percentage of an amount using chunking

214 Determine what percentage one number is of another

215 Percentage Change

219 Percentage of amount, using a decimal multiplier (Simple Interest)

222 Reverse Percentage problems

223 Reverse Percentage Problems using Decimal multipliers

359 Calculating values after compound percentage changes

Learning Journey

Year 9
Calculate percentage increase and decrease
Express a change as a percentage
Solve reverse percentage problems
Solve problems with repeated percentage change (H)
Calculate simple interest
Calculate compound interest
Solve problems with Value Added Tax

Year 10
Repeated percentage change
Solve problems involving growth and decay
Calculate simple and compound interest

Key Knowledge

Percentage of an amount (Non-Calculator)

To calculate any percentage, it is useful to start with 10%

30% of 120: 10% = 120 ÷ 10 = 12 ← To find 10% we divide by 10.
30% = 3 x 12 = 36 ← To find 30% we multiply 10% by 3.

Percentage of an amount (Calculator)

To calculate any percentage, we will use a decimal multiplier.

Change the percentage to a decimal multiplier and then multiply

83% of 120: 83% = 0.83

83% of 120= 0.83 x 120= 99.6

Percentage Increase and Decrease (Non-Calculator)

Increase:
To calculate a percentage increase we calculate the percentage and add the value on to the original amount

Increase 70 by 65%

10% = 70 ÷ 10 = 7 5%= 7 ÷ 2 = 3.5

60% = 6 x 7 = 42

65%= 60% + 5% = 42 + 3.5 = 45.5

70 +45.5 =115.5

Percentage Increase and Decrease (Calculator)

Increase:
To calculate a percentage increase, calculate 65% using the decimal multiplier and add it on

Increase 70 by 65%

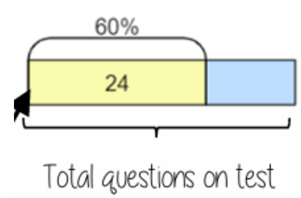
65% of 70 65% = 0.65
65% of 70= 0.65 x 70 = 45.5

70 + 45.5 = 115.5

Finding the original amount

In a test Lucy scored 60% of her questions correctly.
Her score was 24.
How many questions were on the test?

Always draw a bar model to illustrate the question



$60\% = 24$

÷ 60 ÷ 60

$1\% = 0.4$

× 100 × 100

$100\% = 40$

Year 10 Probability

Keywords

Probability: This tells us how likely something is to happen. This can be shown as decimals, percentages or fractions.

Event: One or more outcomes from an experiment

Intersection: Elements that are common to both sets

Union: The combination of elements in two sets

Product: The answer when two or more values are multiplied together

Mutually Exclusive: Two events are mutually exclusive if they cannot happen simultaneously

Independent Event: One event does not affect the probability of the other. Example – Flipping heads on a coin has no effect on rolling a 3 on a dice

Dependent events: One outcome affects another Example – choosing one red card reduces the chance of choosing another red card

Dr Frost Key Skills

247 Probabilities using worded terms
248 Theoretical probabilities using counts
249 Sample Space Diagram
250 Probability of mutually exclusive events
251 Experimental probabilities
353 Probabilities of independent events
354 Probability of dependent events
355 and 356 Probabilities from Venn diagram (Using Venn notation)

Year 8

Find probabilities from a sample space
Find probabilities from two-way tables
Find probabilities from Venn diagrams

Year 9

Single event probability
Relative frequency - including convergence
Expected outcomes
Independent events
Use tree diagrams
Use tree diagrams to solve without replacement problems

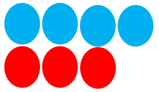
Year 10 — **Learning Journey**

Find probabilities using equally likely outcomes
Use the property that probabilities sum to 1
Using experimental data to estimate probabilities
Find probabilities from tables, Venn diagrams and frequency trees
Construct and interpret sample spaces for more than one event
Calculate probability with independent events
Use tree diagrams for independent events
Use tree diagrams for dependent events
Construct and interpret conditional probabilities (tree diagrams)

Key Knowledge

Sum to 1

Probabilities is always a value between 0 and 1



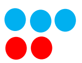
The probability of selecting a **blue counter** is $\frac{4}{7}$

The probability of selecting a **red counter** is $\frac{3}{7}$

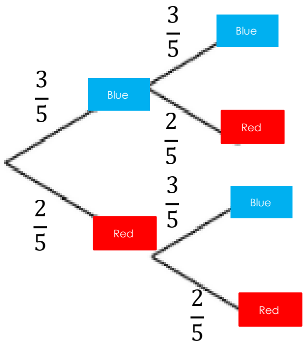
Tree Diagram for independent events

Isabel has a bag with 3 blue counters and 2 red counters.
She picks a counter and replaces it before the second pick.

Draw a tree diagram to represent this event.



Because they are replaced the second pick has the same probability.



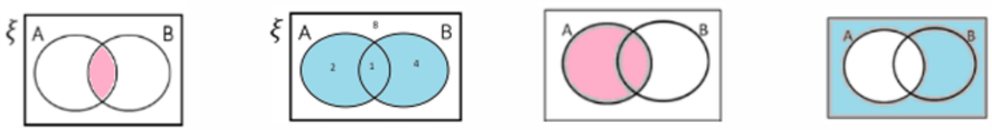
BB $\frac{3}{5} \times \frac{3}{5} = \frac{9}{25}$

BR $\frac{3}{5} \times \frac{2}{5} = \frac{6}{25}$

RB $\frac{2}{5} \times \frac{3}{5} = \frac{6}{25}$

RR $\frac{2}{5} \times \frac{2}{5} = \frac{4}{25}$

Venn diagram



in set A AND set B — $P(A \cap B)$

in set A OR set B — $P(A \cup B)$

in set A — $P(A)$

NOT in set A — $P(A')$

Year 10
Collecting, Representing and Interpreting

Keywords

Population: The whole group that is being studied

Sample: A selection taken from the population that will let you find out information about the larger group.

Representative: A sample group that accurately represents the population

Random sample: A group completely chosen by change. No predictability to who it will include.

Bias: A built-in error that makes all values wrong by a certain amount

Primary data: Data collected from an original source for a purpose.

Secondary data: Data taken from an external location. Not collected directly.

Outlier: A value that stands apart from the data set

Frequency: This refers to the number of times an event or outcome occurs

Mode or Modal Value: This refers to the number that occurs the most.

Median: The value in the center of the data when arranged in order.

Mean:
This refers to the average of a data set and is found by adding all numbers together then dividing by the sum of the numbers

Dr Frost Key Skills

207 Mode, median, range from listed data
238 Two-way tables
240 Stem and Leaf Diagrams
244 Scatter Graphs
245 Line of Best fit
312 Estimating the mean

Year 7
Solve Problems using the mean
Finding the range and the median
Year 8
Find and interpret the range

Year 9

Key Knowledge

Averages from List

$55 \div 5 = 11$

24, 8, 11, 4, 8

Mean

1) Find the sum of the data
2) Divide the overall total by how pieces of data there are

24 + 8 + 11 + 4 + 8 = 55

Median

1) Arrange the numbers in order
2) Find the value in the middle

4, 8, 8 ,11, 24

~~4~~, ~~8~~, (8), ~~11~~, ~~24~~

Mode

This is the number OR the item that occurs the most

8 is the answer here as the number appears TWICE!

NOTE:
If there is no single middle value find the mean of the two numbers left

Averages from Grouped Data

x Weight (g)	Frequency	Mid-Point	Mid-Point X Frequency
$40 < x \leq 50$	1	45	45
$50 < x \leq 60$	3	55	165
$60 < x \leq 70$	5	65	325

Total = 9

Total = 565

Mean

Overall Total ÷ Overall Frequency

565 ÷ 9 = 62.8 g

Modal Group

This is the group with the highest frequency

$50 < x \leq 60$

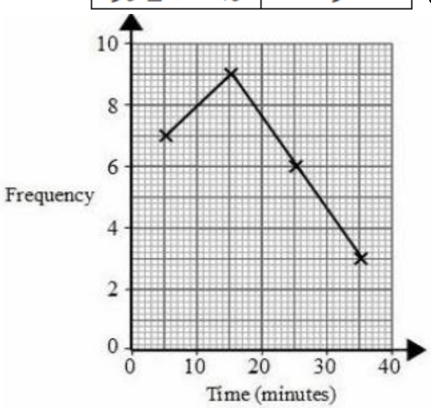
Year 10
Collecting, Representing and Interpreting

Dr Frost Key Skills
398 Cumulative Frequency Graphs
399 Box Plots
315 Frequency Polygon
396 Quartiles from Discrete Data
312 Estimating from grouped data
401 Histograms

Frequency Polygon (H)
A frequency polygon is a line graph which is joined using straight lines.

A Frequency Polygon is constructed by **plotting frequency on the vertical axis** and the **midpoint of the class intervals on the horizontal axis.**

Time	Frequency	
$0 \le t < 10$	7	(5, 7)
$10 \le t < 20$	9	(15, 9)
$20 \le t < 30$	6	(25, 6)
$30 \le t < 40$	3	(35, 3)



Histograms (H)
A histogram is similar to a bar chart, but where a bar chart is used for categorial or discrete data, **we use a histogram for continuous data e.g. heights, weights and time.**

Key Features
- There are no gaps between bars and bars may have different widths
- The vertical axis is labelled **frequency density**
- The **frequency** is represented by the **area of each bar.**

$$Frequency\ Density = \frac{Frequency}{Class\ Width}$$

Cumulative Frequency (H)
A cumulative frequency table shows a running total of the frequencies.

A cumulative frequency is constructed by plotting the **cumulative frequency** against the **upper boundary of the class interval** and then **joined together**.

Heights, h (cm)	Cumulative Frequency	
$150 < h \le 160$	13	(160, 13)
$160 < h \le 170$	46	(170, 46)
$170 < h \le 180$	81	(180, 81)
$180 < h \le 190$	92	(190, 92)