Year 9 Foundation:

1	You can use a calculator effectively.	
2	You can change the subject of a formula.	
3	You can use and apply the laws of indices.	
4	You can identify cube numbers.	
5	You can estimate the area of a given shape. You can state the correct units for an area.	
6	You can calculate the area of a triangle.	
7	You can find the volume of a cuboid. You can solve problems involving surface area and volume.	
8	You can find the volume of a triangular prism.	
9	You can use a calculator to find powers and roots.	
10	You can express a number as the product of prime factors. You can find the lowest common multiple (LCM) of two numbers.	
11	You can substitute into more complex formulae.	
12	You can use and interpret bar charts.	
13	You can increase by a given percentage.	
14	You can solve problems involving percentage reductions.	
15	You can solve problems involving angles on parallel lines.	
16	You can solve problems involving the interior/exterior angles of polygons.	

Changing the Subject of a Formula

Golden Rules

1) Always do the SAME thing to both sides of the formula.
2) To get rid of something, do the opposite.
   The opposite of + is – and the opposite of – is +.
   The opposite of × is ÷ and the opposite of ÷ is ×.
3) Keep going until you have the letter you want on its own.

EXAMPLE Rearrange $a = 3b + 4$ to make b the subject of the formula.

$a = 3b + 4$ — The opposite of +4 is –4, so take away 4 from both sides.

(–4) $a - 4 = 3b + 4 - 4$

$a - 4 = 3b$ — The opposite of ×3 is ÷3, so divide both sides by 3.

(÷3) $(a - 4) \div 3 = 3b \div 3$

$\frac{a-4}{3} = b$ OR $b = \frac{a-4}{3}$

Careful here — you divide the whole side by 3, not just one term.

Four Easy Rules: (4)

1) When MULTIPLYING, you ADD THE POWERS. e.g. $3^4 \times 3^6 = 3^{4+6} = 3^{10}$
2) When DIVIDING, you SUBTRACT THE POWERS. e.g. $c^4 \div c^2 = c^{4-2} = c^2$
3) When RAISING one power to another, you MULTIPLY THE POWERS. e.g. $(3^2)^4 = 3^{2\times4} = 3^8$
4) FRACTIONS — Apply the power to both TOP and BOTTOM. e.g. $\left(\frac{2}{3}\right)^3 = \frac{2^3}{3^3} = \frac{8}{27}$

Warning: Rules 1 & 2 don't work for things like $2^3 \times 3^7$, only for powers of the same number.

EXAMPLE $a = 5^9$ and $b = 5^4 \times 5^2$. What is the value of $\frac{a}{b}$?

1) Work out b — add the powers: $b = 5^4 \times 5^2 = 5^{4+2} = 5^6$
2) Divide a by b — subtract the powers: $\frac{a}{b} = 5^9 \div 5^6 = 5^{9-6} = 5^3 = 125$

Square and Cube Numbers (2)

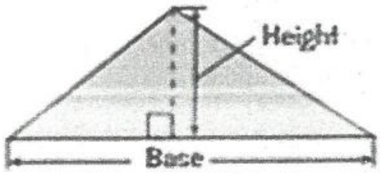
1) When you multiply a whole number by itself, you get a square number:

1^2	2^2	3^2	4^2	5^2	6^2	7^2	8^2	9^2	10^2	11^2	12^2	13^2	14^2	15^2
1	4	9	16	25	36	49	64	81	100	121	144	169	196	225
(1×1)	(2×2)	(3×3)	(4×4)	(5×5)	(6×6)	(7×7)	(8×8)	(9×9)	(10×10)	(11×11)	(12×12)	(13×13)	(14×14)	(15×15)

2) When you multiply a whole number by itself, then by itself again, you get a cube number:

1^3	2^3	3^3	4^3	5^3	10^3
1	8	27	64	125	1000
(1×1×1)	(2×2×2)	(3×3×3)	(4×4×4)	(5×5×5)	(10×10×10)

3) You should know these basic squares and cubes by heart — they could come up on a non-calculator paper, so it'll save you time if you already know what they are.

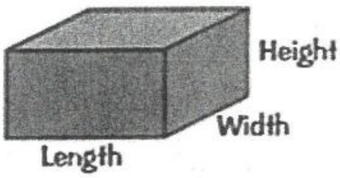


Area of triangle = ½ × base × vertical height

$$A = \frac{1}{2} \times b \times h$$

Volumes of Cuboids (2)

A cuboid is a rectangular block. Finding its volume is dead easy:



Volume of Cuboid = length × width × height

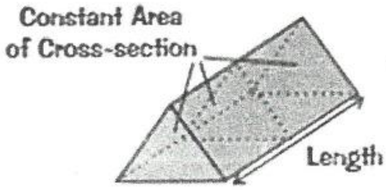
$$V = L \times W \times H$$

This is the formula for the volume of a cube too — where the length, width and height are all the same.

Volumes of Prisms (3)

A PRISM is a solid (3D) object which is the same shape all the way through — i.e. it has a CONSTANT AREA OF CROSS-SECTION.

Triangular Prism



Volume of Prism = cross-sectional area × length

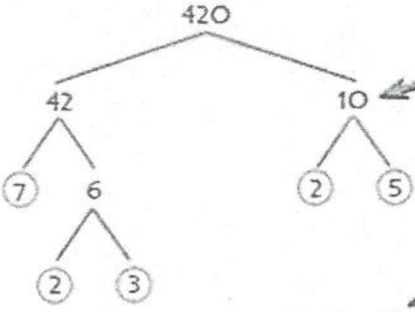
$$V = A \times L$$

This formula works for any prism.

Finding Prime Factors — The Factor Tree (4)

Any number can be broken down into a string of prime numbers all multiplied together — this is called 'expressing it as a product of prime factors', or its 'prime factorisation'.

EXAMPLE: Express 420 as a product of prime factors.



So $420 = 2 \times 2 \times 3 \times 5 \times 7 = 2^2 \times 3 \times 5 \times 7$

To write a number as a product of its prime factors, use the Factor Tree method:

1) Start with the number at the top and split it into factors as shown.
2) Every time you get a prime, ring it.
3) Keep going until you can't go further (i.e. you're just left with primes), then write the primes out in order. If there's more than one of the same factor, you can write them as powers.

No matter which numbers you choose at each step, you'll find that the prime factorisation is exactly the same. Each number has a unique set of prime factors.

LCM — 'Lowest Common Multiple' (3)

'Lowest Common Multiple' — sure, it sounds kind of complicated, but all it means is this:

The SMALLEST number that will DIVIDE BY ALL the numbers in question.

METHOD:
1) LIST the MULTIPLES of ALL the numbers.
2) Find the SMALLEST one that's in ALL the lists.
3) Easy peasy innit?

The LCM is sometimes called the Least (instead of 'Lowest') Common Multiple.

EXAMPLE Find the lowest common multiple (LCM) of 12 and 15.

Multiples of 12 are: 12, 24, 36, 48, (60), 72, 84, 96, ...

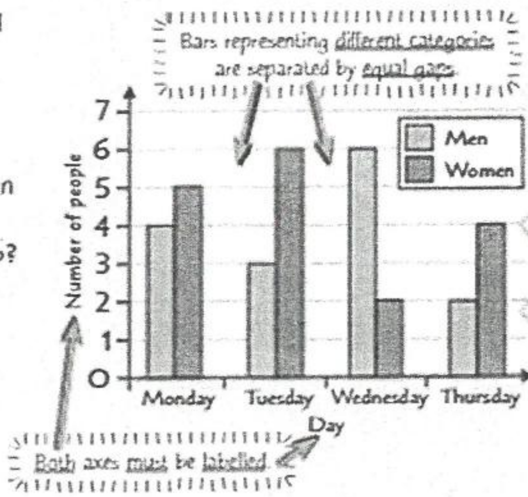
Multiples of 15 are: 15, 30, 45, (60), 75, 90, 105, ...

So the lowest common multiple (LCM) of 12 and 15 is 60.
Told you it was easy.

Bar Charts Show Frequencies Using Bars (1)

1) Frequencies on bar charts are shown by the heights of the different bars.
2) Dual bar charts show two things at once — they're good for comparing different sets of data.

EXAMPLE This dual bar chart shows the number of men and women visiting a coffee shop on different days.



a) How many men visited the coffee shop altogether?
Add up the numbers shown by the heights of the orange bars. 4 + 3 + 6 + 2 = 15 men

b) On which day did the most women visit the coffee shop?
Find the tallest blue bar. Tuesday

c) What fraction of the visitors on Wednesday were women? Give your answer in its simplest form.
There were 6 + 2 = 8 visitors on Wednesday — and 2 of them were women. $\frac{2}{8} = \frac{1}{4}$

Type 3 — New Amount After a % Increase or Decrease

(3)

There are two different ways of finding the new amount after a percentage increase or decrease:

1) Find the % then Add or Subtract.

Find the % of the original amount. Add this on to (or subtract from) the original value.

EXAMPLE A dress has increased in price by 30%.
It originally cost £40. What is the new price of the dress?

1) Find 30% of £40: 30% of £40 = 30% × £40
= 0.3 × 40 = £12
2) It's an increase, so add on to the original: £40 + £12 = £52

2) The Multiplier Method

This time, you first need to find the multiplier — the decimal that represents the percentage change.
E.g. A 5% increase is 1.05 (= 1 + 0.05) and a 26% decrease is 0.74 (= 1 – 0.26).
Then you just multiply the original value by the multiplier and voilà — you have the answer.

A % decrease has a multiplier less than 1,
a % increase has a multiplier greater than 1.

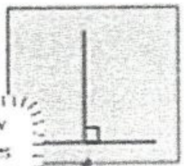
EXAMPLE A hat is reduced in price by 20% in the sales.
It originally cost £12. What is the new price of the hat?

1) Find the multiplier: 20% decrease = 1 – 0.20 = 0.8
2) Multiply the original value by the multiplier: £12 × 0.8 = £9.60 ← Voilà

Angles Around Parallel Lines

(3)

You also need to know what perpendicular lines are — they meet at 90°.

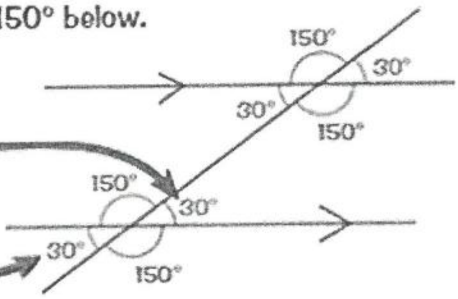


When a line crosses two parallel lines...

1) The two bunches of angles are the same.
2) There are only two different angles: a small one and a big one.
3) These ALWAYS ADD UP TO 180°. E.g. 30° and 150° below.

The two lines with the arrows on are parallel:

These are vertically opposite angles.
They're equal to each other.



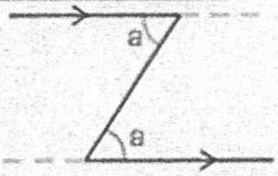
Alternate, Allied and Corresponding Angles

(Grade 3)

Watch out for these 'Z', 'C', 'U' and 'F' shapes popping up.
They're a dead giveaway that you've got a pair of parallel lines.

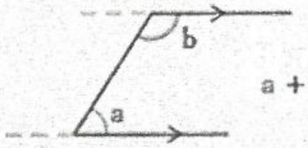
Don't call them Z, C, U and F angles in the exam — you'll need to use their proper names.

ALTERNATE ANGLES

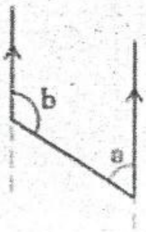


Alternate angles are the same.
They are found in a Z-shape.

ALLIED ANGLES

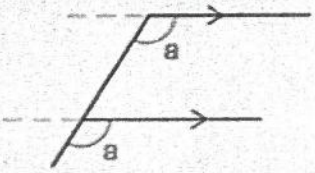


$a + b = 180°$



Allied angles add up to 180°.
They are found in a C- or U-shape.

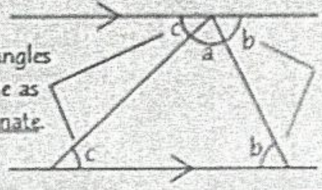
CORRESPONDING ANGLES



Corresponding angles are the same.
They are found in an F-shape.

EXAMPLE Prove that the angles in a triangle add up to 180°.

This is the proof of rule 1 from the previous page.
First, draw a triangle between two parallel lines.



These two angles are the same as they're alternate.

These two angles are the same as they're alternate.

Angles on a straight line add up to 180°,
so $a + b + c = 180°$.

Polygons

A polygon is a many-sided shape, and can be regular or irregular. A regular polygon (p.72) is one where all the sides and angles are the same. By the end of this page you'll be able to work out the angles in them. Wowzers.

Exterior and Interior Angles

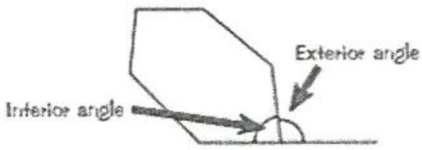
(Grade 3)

You need to know what exterior and interior angles are and how to find them.

For ANY POLYGON (regular or irregular):

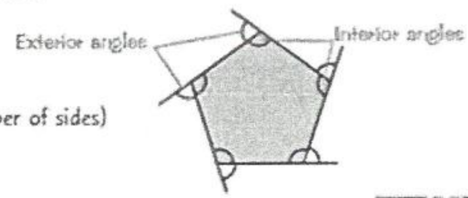
SUM OF EXTERIOR ANGLES = 360°

INTERIOR ANGLE = 180° – EXTERIOR ANGLE



For REGULAR POLYGONS only:

EXTERIOR ANGLE $= \frac{360°}{n}$ (n is the number of sides)



EXAMPLE Find the exterior and interior angles of a regular octagon.

Octagons have 8 sides: exterior angle $= \frac{360°}{n} = \frac{360°}{8} = 45°$

Use the exterior angle to find the interior angle: interior angle = 180° – exterior angle

$= 180° - 45° = 135°$

The exterior angles of Angela's house were a cause for concern.