Factors and Powers

1.	Factor	A number that divides into another number without a remainder	
2.	Multiple	The result of multiplying a number by an integer	
3.	Prime number	A number with exactly two factors; 1 and itself	
4.	Prime numbers	2, 3, 5, 7,11, 13,17, 19, 23, 29, 31, 37, 41, 43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89, 97	
5.	Product	The answer when two or more numbers are multiplied together	
6.	Prime factor decomposition	Writing a number as a product of its prime factors.	

7.	Highest common factor	HCF	The highest number that divides exactly into two or more numbers	e.g. the HCF of 12 and 14 is 12
8.	Lowest Common Multiple	LCF	The smallest positive integer that is a multiple of two or more numbers	e.g. the LCM of 12 and 24 is 24

9.	Combination	A collection of things, where the **order does not matter**. How many combinations of two ingredients can you make with apple, banana and cherry? Apple, Banana Apple, Cherry Banana, Cherry 3 combinations

For the prime factor trees:

$60 = 2 \times 2 \times 3 \times 5$

$60 = 2^2 \times 3 \times 5$

$72 = 2 \times 2 \times 2 \times 3 \times 3$

$72 = 2^3 \times 3^2$

| 10. | Permutation | A collection of things, where the **order does matter**.

You want to visit the homes of three friends, Alex (A), Betty (B) and Chandra (C) but haven't decided the order. What choices do you have?

ABC
ACB
BAC
BCA
CAB
CBA |
|---|---|---|
| 11. | Permutations with Repetition | When something has n different types, there are n **choices each time**.

Choosing r of something that has n different types, the permutations are:

$$n \times n \times \ldots (r \ times) = \boldsymbol{n^r}$$

How many permutations are there for a three-number combination lock?

10 numbers to choose from $\{1, 2, \ldots.10\}$ and we choose 3 of them $\rightarrow$
$10 \times 10 \times 10 = 10^3 = 1000$ permutations. |
| 12. | Permutations without Repetition | We have to **reduce the number of available choices each time**.

One you have chosen something, you cannot choose it again.

How many ways can you order 4 numbered balls?

$$4 \times 3 \times 2 \times 1 = 24$$ |
| 13. | Reciprocal | The reciprocal of a number is **1 divided by the number**.

The reciprocal of x is $\frac{1}{x}$

When we multiply a number by its reciprocal we get 1. This is called the 'multiplicative inverse'.

The reciprocal of 5 is $\frac{1}{5}$

The reciprocal of $\frac{2}{3}$ is $\frac{3}{2}$, because
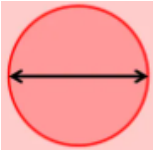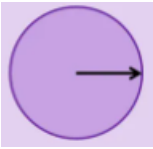
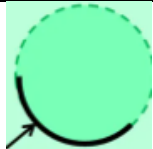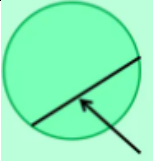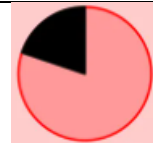$$\frac{2}{3} \times \frac{3}{2} = 1$$ |

14.	Square Number	The number you get when you **multiply a number by itself**. 1, 4, 9, 16, 25, 36, 49, 64, 81, 100, 121, 144, 169, 196, 225... $$9^2 = 9 \times 9 = 81$$
15.	Square Root	The **number you multiply by itself** to get another number. The reverse process of squaring a number. $$\sqrt{36} = 6$$ because $6 \times 6 = 36$
16.	Solutions to $x^2 = $	**Equations** involving **squares** have **two solutions**, one **positive** and one **negative**. Solve $x^2 = 25$ $$x = 5 \; or \; x = -5$$ This can also be written as $x = \pm 5$
17.	Cube Number	The number you get when you **multiply a number by itself and itself again**. 1, 8, 27, 64, 125... $$2^3 = 2 \times 2 \times 2 = 8$$
18.	Cube Root	The **number you multiply by itself and itself again** to get another number. The reverse process of cubing a number. $$\sqrt[3]{125} = 5$$ because $5 \times 5 \times 5 = 125$
19.	Powers of...	The powers of a number are that **number raised to various powers**. The powers of 3 are: $3^1 = 3$ $3^2 = 9$ $3^3 = 27$ $3^4 = 81$ etc.

20.	Multiplication Index Law	When **multiplying** with the same base (number or letter), **add the powers**. $$a^m \times a^n = a^{m+n}$$ $$7^5 \times 7^3 = 7^8$$ $$a^{12} \times a = a^{13}$$ $$4x^5 \times 2x^8 = 8x^{13}$$
21.	Division Index Law	When **dividing** with the same base (number or letter), **subtract the powers**. $$a^m \div a^n = a^{m-n}$$ $$15^7 \div 15^4 = 15^3$$ $$x^9 \div x^2 = x^7$$ $$20a^{11} \div 5a^3 = 4a^8$$
22.	Brackets Index Laws	When raising a power to another power, multiply the powers together. $$(a^m)^n = a^{mn}$$ $$(y^2)^5 = y^{10}$$ $$(6^3)^4 = 6^{12}$$ $$(5x^6)^3 = 125x^{18}$$
23.	Fractional indices	A fractional indice like 1/n means to take the nth root: $$x^{\frac{1}{n}} = \sqrt[n]{x}$$
24.	Negative indices	A negative power is often referred to as a reciprocal $$x^{-n} = \frac{1}{x^n}$$
25.	Notable Powers	$$p = p^1$$ $$p^0 = 1$$
26.	Lower bound	The smallest value that would round up the estimate value
27.	Upper bound	The smallest value that would round up to the next estimated value

Plans and elevations

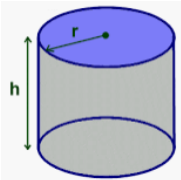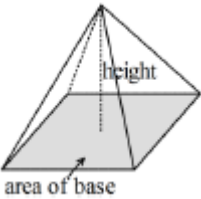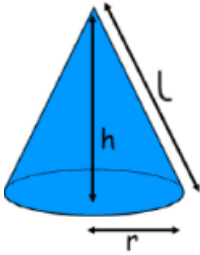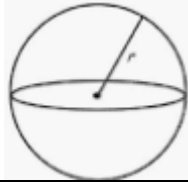| 1.	Plan	The view from above a solid	
2.	Front elevation	The view from the front of a solid	
3.	Side elevation	The view from a side of the solid	

Circles - definitions and formulae

4.	Diameter	A straight line from edge to edge passing through the centre	
		Double the size of the radius	
5.	Radius	A straight line from the centre to the edge	
		Half the size of the diameter	
6.	Radii	The plural of radius	
7.	Circumference	Distance around the outside of the circle	
8.	Arc	Part of the circumference	
9.	Chord	A line within a circle where each end touches the edge	
10.	Sector	The region created by two radii and an arc	

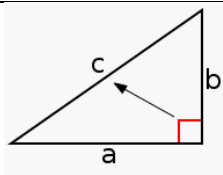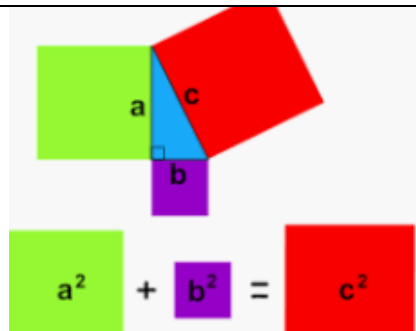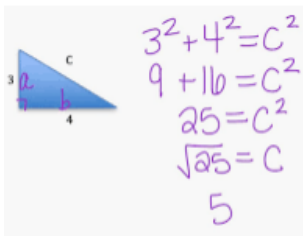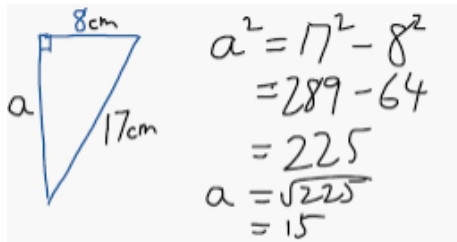| 11.	Segment	The region created by a chord and an arc	
12.	Tangent	A line outside the circle which only touches the circumference at one point	
13.	Semi -circle	Half a full circle	

Area and circumference of circles formulae

14.	Pi (π)	Constant ratio linking the circumference and diameter of a circle	
		3.14159265...	
15.	Circumference of a circle	$C = \pi d$	Alternatively, using relationship between r and d $$C = 2\pi r$$

Cylinders, pyramids, cones and spheres

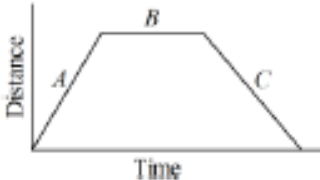| 16.	Volume of a cylinder	$V = \pi r^2 h$	
17.	Surface area of a cylinder	$Total\ surface\ area = 2\pi r^2 + \pi dh$	
18.	Volume of a pyramid	$V = \dfrac{1}{3} \times area\ of\ base\ \times perpendicular\ height$	
19.	Volume of a cone	$V = \dfrac{1}{3} \times \pi r^2 h$	
20.	Surface area of a cone	$Curved\ surface\ area = \pi rl$ $Total\ surface\ area = \pi r^2 + \pi rl$	
21.	Volume of a sphere	$V = \dfrac{4}{3} \times \pi r^3$	

Pythagoras' Theorem

22.	Hypotenuse	The longest side of a right-angled triangle	
		It is always opposite the right angle	
23.	Right- angled triangle	A triangle that contains a right angle	
24.	Pythagoras' Theorem	$$a^2 + b^2 = c^2$$	
		Where c is the hypotenuse	
		Where a and b are the two shorter sides	
25.	To find the hypotenuse (c)		• Square • Add • Square root
26.	To find a short side (a/b)		• Square • Subtract • Square root

Real life graphs

27.	Steady speed	Travelling the same distance each minute
28.	Velocity	Speed in a particular direction
29.	Rate of change	Shows how a variable changes over time
30.	Acceleration	How fast velocity changes; measured in m/s^2 or km/s^2 etc

	Distance - Time graphs
31.	Represent a journey
32.	Vertical axis represents the distance from the starting point
33.	Horizontal axis represents the time taken
34.	Straight lines mean constant speed
35.	Horizontal lines mean no movement
36.	Gradient = speed
37.	Average speed = $=\dfrac{total\ distance}{total\ time}$

A = steady speed,
B = no movement,
C = steady speed back to start