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Expanding Double Brackets

We can use the grid method to expand double brackets but there are other methods too. Multiply every term in the **first bracket** by every term in the **second bracket**.

Example: $(x+7)(x-3) = \mathbf{x^2 + 7x - 3x - 21}$

$= \mathbf{x^2 + 4x - 21}$

	x	-3
x	x^2	$-3x$
7	$7x$	-21

Substitution and Formulae

Formulae are used to link two or more **variables** – such as speed, distance and time or degrees Fahrenheit and degrees Celsius. To use a formula, we need to **substitute** in the values and follow BIDMAS.

Example: Given $v^2 = u^2 + 2as$, find v when $s = 12m$, $u = 2\text{ms}^{-1}$ and $a = 0.5\text{ms}^{-2}$.

$v^2 = (2)^2 + 2 \times (0.5) \times (12)$

$v^2 = 16$

$v = \sqrt{16}$

$\mathbf{v = 4ms^{-1}}$

Index Laws

There are some index laws that apply when working with powers of the same base:

When multiplying, we **add the powers**.

When dividing, we **subtract the powers**.

When the powers are separated by brackets, we **multiply the powers**.

Example: $a^3 \times a^7 = \mathbf{a^{10}}$

$x^8 \div x^3 = \mathbf{x^5}$

$(m^7)^3 = \mathbf{m^{21}}$

Factorising into Double Brackets

Every quadratic you will factorise can be written as $x^2 + bx + c$. Find a pair of numbers that **add** together to give the value of b and **multiply** to give the value of c.

Example: $a^2 + 7a + 12 = \mathbf{(a+3)(a+4)}$

$x^2 - 5x + 6 = \mathbf{(x-3)(x-2)}$

$m^2 - 9 = \mathbf{(m+3)(m-3)}$

Expanding Triple Brackets

To expand triple brackets, expand and simplify two of the brackets first and then multiply the result by the remaining bracket.

Example: $(2x+3)(x+7)(x-3)$

	x	$+7$
$2x$	$2x^2$	$+14x$
$+3$	$+3x$	$+21$

$(2x+3)(x+7)(x-3)$

	$2x^2$	$+17x$	$+21$
x	$2x^3$	$+17x^2$	$+21x$
-3	$-6x^2$	$-51x$	-63

$\mathbf{2x^3 + 11x^2 - 30x - 63}$

Solving Quadratics

You will be able to **factorise** every quadratic you are asked to solve. First, you need to write it in the form $x^2 + bx + c = 0$ and then factorise. Remember, you are looking for 2 numbers that multiply to give the value of c and add to give the value of b. Set each factor equal to 0 and solve each linear equation.

Example: $x^2 + 2x - 8 = 0$

$(x+4)(x-2) = 0$

$\mathbf{x = -4}$ and $\mathbf{x = 2}$

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Sharing in a Ratio

Use the **bar model** to share an amount in a ratio. Each part of the ratio gets 1 box, and we share the amount equally between the boxes.

Example: Suzi and Padma share some money in the ratio 5:7.

Find out how much each person gets if they share £72.

Suzi | 6 | 6 | 6 | 6 | 6 | = **£30** Padma | 6 | 6 | 6 | 6 | 6 | 6 | 6 | = **£42**

If they share £48 in the same ratio and Padma gets £8 more than Suzi, how much does Suzi get?

Suzi | 4 | 4 | 4 | 4 | 4 | = **£20** Padma | 4 | 4 | 4 | 4 | 4 | 4 | 4 | = **£28**

←£8→

Inverse Proportion Equations

Two or more quantities are **inversely proportional** if one increases at the same rate as the other decreases. If two variables, x and y, are inversely proportional we write $y \propto \frac{1}{x}$ or $y = \frac{k}{x}$ where k is the **constant of proportionality**.

Example: a is inversely proportional to the square root of b. When $a = 5$, $b = 25$. Find an equation for a in terms of b.

$a \propto \frac{1}{\sqrt{b}}$ so $a = \frac{k}{\sqrt{b}}$

$5 = \frac{k}{\sqrt{25}}$

$5 = \frac{k}{5}$

$k = 25$ $\boldsymbol{a = \frac{25}{\sqrt{b}}}$

Direct Proportion Equations

Two or more variables are **directly proportional** if they increase and decrease at the same rate. If two variables, x and y, are directly proportional, we write $y \propto x$ or $y = kx$ where k is the **constant of proportionality**.

Example: a is directly proportional to b^2. When $a = 12$, $b = 6$. Find an equation for a in terms of b.

$a \propto b^2$ so $a = kb^2$

$12 = k \times 6^2$

$12 = 36k$

$k = \frac{1}{3}$ $\boldsymbol{a = \frac{1}{3}b^2}$

Exchange Rates

The exchange rate is a ratio that gives the value of £1 in other currencies.

Example: Given £1 = \$1.27:

£15 = 15 × 1.27

= **\$19.05**

\$50 = 50 ÷ 1.27

= **£39.37**

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Multiplying and Dividing Numbers in Standard Form

To multiply or divide numbers in standard form, we multiply the **decimals** first and then use **index laws** to find the power of 10.

Example: $(1.5 \times 10^5) \times (4.2 \times 10^7) = (1.5 \times 4.2) \times (10^5 \times 10^4)$

$= \mathbf{6.3 \times 10^{12}}$

Adding and Subtracting Numbers in Standard Form

To add or subtract numbers in standard form, it's easiest to **convert** them to normal numbers then add or subtract as normal.

Example: $7.4 \times 10^5 - 8.3 \times 10^4 = 740\,000 - 83\,000$

$= 657\,000$

$= \mathbf{6.57 \times 10^5}$

Error Intervals

An **upper bound** is the upper limit of the set of values that round to a given number and the **lower bound** is the lower limit. Everything below the upper bound, and above or equal to the lower bound, will round to the given number.

Example:

A number, n, has been rounded to 1 decimal place. The result is 9.4. The **upper bound** of n is **9.45** and the **lower bound** is **9.35**. The error interval is $\mathbf{9.35 \le n < 9.45}$.

Bounds of Accuracy

The bounds of a calculation are the maximum (upper bound) and minimum (lower bound) the calculation can be. The most accurate answer we can give is the number that the upper and lower bound both round to.

Example: The mass of an object is 23.7g to 1 decimal place. Its volume is 13.78cm³ to 2 decimal places. By considering bounds, find the density, giving your answer to a suitable degree of accuracy.

max + max = max
min + min = min
max × max = max
min × min = min
max – min = max
min – max = min
max ÷ min = max
min ÷ max = min

$$d_{max} = \frac{\text{mass}_{max}}{\text{volume}_{min}} = \frac{23.75}{13.775} = 1.7241...$$

$$d_{min} = \frac{\text{mass}_{min}}{\text{volume}_{max}} = \frac{23.65}{13.785} = 1.7156...$$

Density = **1.72g/cm³** (2 d.p.)