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Trial & improvement

● Solving equations

Essential: you must show all your working.

► Q & A

The equation $x^3 + x = 75$ has a solution between 4 and 5. Use trial and improvement to find the solution to 2 d.p.

Answer

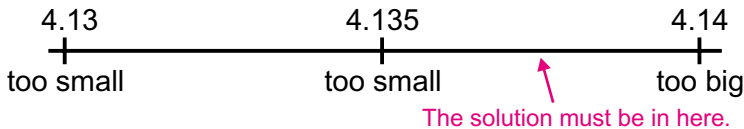
x	$x^3 + x$		
4.5	95.625	too big	x is between 4 and 4.5
4.2	78.288	too big	x is between 4 and 4.2
4.1	73.021	too small	x is between 4.1 and 4.2
4.15	75.623375	too big	x is between 4.1 and 4.15
4.13	74.574997	too small	x is between 4.13 and 4.15
4.14	75.097944	too big	x is between 4.13 and 4.14

To see if the solution is 4.13 or 4.14 you need to try the **mid-value**:

4.135	74.83616...	too small	x is between 4.135 and 4.14
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4.135 & 4.14 both round to 4.14, so the solution is $x = 4.14$ to 2 d.p.

The last step in the **Q & A** can be seen clearly on a number line:



● Finding roots

You can find values of roots, such as $\sqrt[3]{12}$, by trial and improvement. You start by taking a guess at the root. In the case of $\sqrt[3]{12}$, your first guess could be 2. Cubing this gives 8, which is smaller than 12 so your next guess needs to be bigger.

► Method

- 1 Make a **sensible guess** for x and substitute it into the equation.
- 2 If the left-hand side is **too big/small**, take a **smaller/larger guess**.
- 3 Stop when you have two numbers that bound x and **round to the same number**.

- 1 Find the solution of $x^3 - x = 50$ correct to 2 decimal places.
- 2 Find the value of $\sqrt[3]{12}$ correct to 1 decimal place.

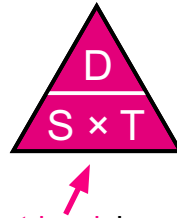
TEST

Compound measures

● **Speed** = $\frac{\text{Distance}}{\text{Time}}$

There are 3 ways of writing this formula:

$$S = \frac{D}{T} \quad T = \frac{D}{S} \quad D = S \times T$$



All 3 ways can be remembered using this 'formula triangle':

► Q & A

A car travels at 70 mph for 2.5 hours. How far does it go?

Answer

Distance is needed so cover up **D**.



This gives $D = S \times T$

$$D = 70 \times 2.5 = 175$$

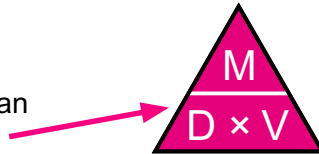
The car travels **175 miles**.

► Method

- 1 Cover up what you want on the formula triangle. Write down the formula this gives.
- 2 Write the formula with the numbers you know. (Make sure the units match. e.g. if the speed has hours in it, the time must be in hours.)
- 3 Solve to find the unknown.

● **Density** = $\frac{\text{Mass}}{\text{Volume}}$

Like the one for speed, this formula can also be written in a 'formula triangle':



► Q & A

A block has a density of 22 kg/m³. The mass of the block is 88 kg. What is the volume of the block?

Answer

Volume is needed so cover up **V**.



This gives $V = \frac{M}{D}$

$$\text{So } V = \frac{88}{22} = 4$$

The block has a volume of **4 m³**.

- 1 How long will a car travelling at 60 km/h take to travel 40 km?
- 2 Calculate the mass of 2 m³ of wood of density 500 kg/m³.

TEST