

one relationship held constant while the numbers are scaled up and down

What makes a relationship proportional

- two quantities are proportional when their ratio never changes. Triple one and the other triples too
- every proportional relationship can be written $y=kx$, where k is the constant of proportionality, the amount of y that goes with one unit of x
- a RATE is a ratio with different units on top and bottom: pages per minute, rupees per litre, people per square kilometre
- a UNIT rate is that ratio rewritten with 1 in the denominator, which is what makes it easy to scale to any other amount

Three ways to write the same thing

the equation form, k constant

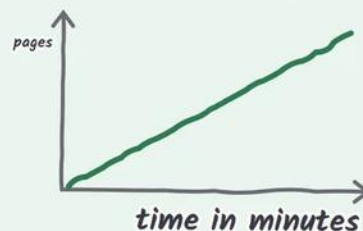
$$y=kx$$

the constant read off any one pair

$$k = \frac{y}{x}$$

the proportion form, then cross multiply

$$\frac{a}{b} = \frac{c}{d} \Rightarrow ad=bc$$



a constant rate draws a straight line rising from the origin: double the time and the count on the vertical axis doubles

all three say one thing: y divided by x gives the same number for every pair in the table

Worked: a constant rate

Q. a machine fills 84 bottles in 6 minutes. At the same rate, how many bottles does it fill in 15 minutes?

- unit rate first: $\frac{84}{6} = 14$ bottles per minute
- scale to the time asked for: $14 \times 15 = 210$
- or scale the whole block instead: 15 minutes is 2.5 times 6 minutes, so $2.5 \times 84 = 210$

Answer **210 bottles**

The three shapes this topic comes in *

Rate

an amount per one unit of something else. Find the unit rate, then multiply

Proportion

two ratios set equal with one unknown. Cross multiply and divide

Scale

a drawing, map or similar figure. Every matching length shares one scale factor

Sharing

a total split in a given ratio. Add the parts, divide the total by that