Unit 11: Multiplicative Reasoning

Growth and Decay

Depreciation

I buy a car for £20000.

It depreciates at a rate of 4% *per annum*

What will it be worth after 3 years?

Initial amount= £20000
Depreciation rate = 4%
Multiplier is x 0.96
It depreciated for 3 years

$20000 \times 0.96^3 = £17694$

Compound Interest

Initial amount x (1 + the rate of interest)^{years}

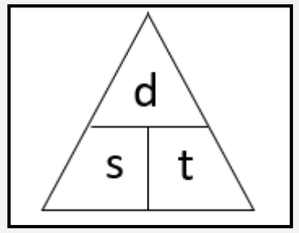
$A(1+r)^n$

You save £2000 in a savings account for 4 years.
The interest rate is 0.6% per annum.

Initial amount= 2000
Interest rate = 0.6%
Multiplier is x 1.006
It is in the bank for 4 years

2000×1.006^4
=£2048.43

Speed, Distance, Time



$$speed = \frac{distance}{time}$$

$$time = \frac{distance}{speed}$$

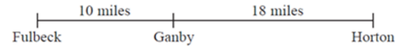
$$distance = speed \times time$$

Use the formulas to convert between compound measures

Speed	Distance	Time
2m/s	10m	5s
5m/s	24m	4.8s
0.2km/s	50km	250s
5km/h	10km	7200s

Compound Measures

The distance from Fulbeck to Ganby is 10 miles.
The distance from Ganby to Horton is 18 miles.



Raksha is going to drive from Fulbeck to Ganby.
Then she will drive from Ganby to Horton.

Raksha leaves Fulbeck at 10 00.
She drives from Fulbeck to Ganby at an average speed of 40mph.

Raksha wants to get to Horton at 10 35.

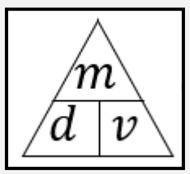
Work out the average speed Raksha must drive at from Ganby to Horton.

Use the rows for speed, distance and time, and the columns for each leg of the journey:

	F → G	G → H
Speed	40 mph	54 mph
Distance	10 miles	18 miles
Time	1/4 hr	1/3 hrs

Density, Mass and Volume

Density gives us a measure of how tightly packed matter is within a space.



$$density = \frac{mass}{volume}$$

$$volume = \frac{mass}{density}$$

$$mass = density \times volume$$

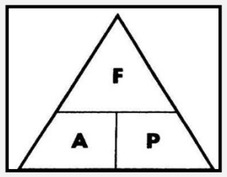
Again, the unit of g/cm³ allows you to work out the formula for density if you forget.

The density of a rock is 2.3 g/cm³.
Work out the mass of a piece of this rock with a volume of 20 cm³.

Intuitively, if there is 2.3 g for each cm³, then for 20cm³, mass must be

$$2.3 \times 20 = 46 \text{ g}$$

Pressure, Force and Area



$$Pressure = \frac{Force}{Area}$$

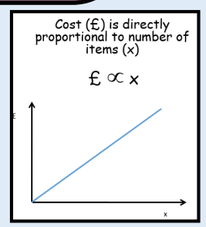
$$Area = \frac{Force}{Pressure}$$

$$Force = Pressure \times Area$$

What pressure does a chicken weighing 80N with feet area of 0.1m² put on the ground

$$\frac{80}{0.1m^2} = 8N/m^2$$

Direct Proportion



Where one quantity directly scales with another (e.g. as one doubles, the other doubles) we say they are **directly proportional**

Solving Proportion Problems

Steps:
1) Write the proportionality statement
2) Find the equation connecting d and t
3) Substitute the values of d and t to find k
4) Use K and the value given to find the answer

Y is directly proportional to x

When y = 12 x = 4

1) Find the equation linking y to x
2) Find the value of y when x = 6

1) $y \propto x$ $y = kx$ $12 = 4k$ $3 = k$ $y = 3x$

2) $y = 3x$ $y = 3(6)$ $y = 18$

Indirect Proportion

When one quantity increases as another decreases we say they are **indirectly or inversely proportional.**

$$s \propto \frac{1}{t}$$

p is inversely proportional to m

When p = 70 m = 2

1. Find the equation that connects y and m

2. Find p when m = 4

Steps:
1) Write the proportionality statement
2) Find the equation connecting d and t
3) Substitute the values of d and t to find k
4) Use K and the value given to find the answer

1) $p \propto \frac{1}{m}$ $p = \frac{k}{m}$ $70 = \frac{k}{2}$ $k = 140$ $p = \frac{140}{m}$

2) $p = \frac{140}{4}$ $p = 35$

Compound Measures

Proportion