## 16. Variation \& Proportion

1. A weight on the end of a string is spun in a circle on a smooth table.

The tension, $T$, in the string varies directly as the square of the speed, $v$, and inversely as the radius, $r$, of the circle.

a) Write down a formula for T in terms of $v$ and r .
b) The speed of the weight is multiplied by 3 and the radius of the string is halved.

What happens to the tension in the string.
2 RE
2. The electrical resistance, $R$, of copper wire varies directly as its length, $L$ metres, and inversely as the square of its diameter, $d$ millimetres .

Two lengths of copper wire, A and B, have the same resistance.
Wire A has a diameter of 2 millimetres and a length of 3 metres.
Wire $B$ has a diameter of 3 millimetres
What is the length of wire B.
3. A frictional force is necessary for a car to round a bend.

The frictional force, $F$ kilonewtons, varies directly as the square of the car's speed, $V$ metres per second, and inversely as the radius of the bend, $R$ metres.
a) Write down a relationship between F, V and R.

A frictional force of 20 kilonewtons is necessary for a car, travelling at a given speed to round a bend.
b) Find the frictional force necessary for the same car, travelling at twice the given speed, to round the same bend.
4. The table below shows the distances, in metres, $(d)$, travelled by a snowboarder in seconds $(t)$.

| Time in seconds $(t)$ | 1 | 2 | 3 | 4 |
| :--- | :---: | :---: | :---: | :---: |
| Distance in metres $(d)$ | 5 | 20 | 45 | 80 |

a) Explain why $d$ varies directly as $t^{2}$

1 RE
b) Write down the formula connecting $d$ and $t$.
c) How does the distance change when the time is multiplied by six ?
5. The time, $T$ minutes, taken for a stadium to empty varies directly as the number of spectators, $S$, and inversely as the number of open Exits, $E$.
a) Write down a relationship connecting $T, S$ and $E$.

It takes 12 minutes for a stadium to empty when there are 20000 spectators and 20 open exits.
b) How long does it take the stadium to empty when there are 36000 spectators and 24 open exits ?
6. The number of litres of petrol, $L$, used by a car on a journey varies directly as the distance, $D$ kilometres, travelled, and as the square root of the average speed, $S$ kilometres per hour.
a) Write down a relationship connecting $L, D$ and $S$.

The car uses 30 litres of petrol for a journey of 550 kilometres when it travels at an average speed of 81 kilometres per hour.
b) How many litres of petrol does the car use for a journey of 693 kilometres travelling at an average speed of 100 kilometres per hour.
7. The surface area of a planet, $A$ square kilometers, varies directly as the square of the diameter, $D$ kilometres of the planet.
The surface area of the Moon is $3.8 \times 10^{7}$ square kilometres.
Calculate the surface area of a planet with diameter double the diameter of the Moon.
Give your answer in scientific notation.
8. A table of pairs of values of $x$ and $y$ is shown below.

| $x$ | 1.5 | 2 | 2.5 |
| :---: | :---: | :---: | :---: |
| $y$ | 6 | 4.5 | 3.6 |

$\begin{array}{lll}\text { a) } & \text { Explain why } y \text { varies inversely as } x . & 2 \mathrm{KU} \\ \text { b) Write down the formula connecting } x \text { and } y & 1 \mathrm{KU}\end{array}$
9. The number of letters, $N$, which can be typed on a sheet of paper varies inversely as the square of the size, $s$, of the letters used.
a) Write down a relationship connecting $N$ and $s$.
b) The size of the letters used is doubled.

What effect does this have on the number of letters which can be typed on the sheet of paper.
10. The time, $T$ seconds, taken by a child to slide down a chute varies directly as the length, $L$ metres, of the chute and inversely square root of the height, $H$ metres, of the chute above the ground.

It takes 10 seconds to slide down a chute which is 3.75 metres long
 and 2.25 metres high.
a) Find a formula connecting $T, L$ and $H$.
b) How long does it take to slide down a chute which is 5 metres long and 2.56 metres high?

2 KU
11. The power, $P$ watts, produced by a windmill varies directly as the cube of the wind velocity, $V$ metres per second.

At 4 pm on a given day, the wind velocity was 4 metres per second and the windmill was producing 75 watts of electrical power.

By 10 pm the wind velocity had doubled.
How many watts of electrical power were now being produced?


