Direct Proportion
There is direct proportion between two variables when one variable is a simple multiple of the other
$y \propto x$ means $y$ is proportional to $x$

We write $y=k x$ for some constant $k$ Exercise 22A
$E \times 1 \quad T$ is directly proportional to $M$

$$
T=20 \text { when } M=4
$$

Find the relationship between $T$ and $M$

$$
\left.\begin{array}{ll}
T=20 \\
M=4
\end{array}\right\} \quad \begin{aligned}
T & =k M \\
20 & =4 k \\
\frac{20}{4} & =k \\
5 & =k
\end{aligned} \quad \therefore T=5 M .
$$

a) Find $T$ when $M=3$

$$
\begin{aligned}
& T=5 \times 3 \\
& T=15
\end{aligned}
$$

b) Find $M$ when $T=10$

$$
\begin{aligned}
& 10=5 \mathrm{~m} \\
& \frac{10}{5}=\mathrm{m}
\end{aligned}
$$

$$
M=2
$$

$E \times 2 \quad W$ is directly propostional to $F$ $W=45$ when $F=3$
Find relationship between $W$ and $F$

$$
\left.\begin{array}{ll}
W=45 \\
F=3
\end{array}\right\} \quad \begin{array}{ll}
W 5 & =3 K \\
& \frac{45}{3}=K \\
15 & =K
\end{array} \quad W=15 F
$$

a) Find $W$ when $F=5$

$$
\begin{aligned}
& w=15 \times 5 \\
& w=75
\end{aligned}
$$

b) Find $F$ when $W=90$

$$
\begin{aligned}
& 90=15 F \\
& \frac{90}{15}=F
\end{aligned}
$$

$$
F=6
$$

3) 

$$
\begin{array}{ll}
Q=k P & \left\{\begin{array}{l}
Q=100 \\
P=2 \\
100=2 k
\end{array}\right. \\
\frac{100}{2}=k & Q=50 P \\
50=k & Q
\end{array}
$$

a) Find $Q$ when $P=3$
b) Find $P$ when $Q=300$

$$
\begin{aligned}
& Q=50 \times 3 \\
& Q=150
\end{aligned}
$$

$$
\begin{array}{ll}
300 & =50 p \\
\frac{300}{50} & =p
\end{array} \quad p=6
$$

5) $D=$ Distance $\quad T=$ Time

$$
\begin{array}{rlrl}
D=K T & & \left\{\begin{array}{l}
D=1 \\
105
\end{array}\right) \\
\frac{105}{3}=k & \\
T 5 & =K & D=35 T
\end{array}
$$

Find $D$ when $T=5$ hrs

$$
\begin{aligned}
& D=35 \times 5 \\
& D=175 \text { miles }
\end{aligned}
$$

6) 

$$
\begin{array}{ll}
C=k W & \left\{\begin{array}{l}
W=250 \mathrm{~kg} \\
C=t 47.5 \Delta
\end{array}\right. \\
47.5=250 \mathrm{k} & \\
\frac{47.5}{250}=k & C=0.19 \mathrm{~W} \\
0.19 & =k
\end{array}
$$

Find $C$ when $\omega=35 \Delta \mathrm{~kg}$

$$
\begin{aligned}
& c=0.19 \times 350 \\
& c=266.50
\end{aligned}
$$

Find $T$ when $D=280 \mathrm{miles}$

$$
\begin{aligned}
& 280=35 T \\
& \frac{280}{35}=T \\
& T=8 \mathrm{hrs}
\end{aligned}
$$

Find $w$ when $c=\neq 33.25$

$$
\begin{aligned}
33.25 & =0.19 \mathrm{~J} \\
\frac{33.25}{0.19} & =w \\
w & =175 \mathrm{~kg}
\end{aligned}
$$

i) $T$ is directly proportional to $x^{2}$
$T=36$ when $x=3$
Find relationship between $T$ and $x$.

$$
\left.\begin{array}{rl}
T=36 \\
x=3
\end{array}\right\} \quad \begin{aligned}
T & =k x^{2} \\
36 & =k \times 3^{2} \\
36 & =9 k \\
\frac{36}{9} & =k \\
4 & =k
\end{aligned} \quad T=4 x^{2}
$$

a) Find $T$ when $x=5$
b) Find $x$ when $T=400$

$$
\begin{array}{rl}
T=4 \times 5^{2} & 400
\end{array}=4 x^{2}, ~ \begin{aligned}
400 & =x^{2} \\
100 & =x^{2} \\
\sqrt{100} & =x \\
x & = \pm 10
\end{aligned}
$$

3) $E$ varies directly $\sqrt{c}$

$$
E=40 \text { when } C=25
$$

Find relationship connecting $E$ to $C$

$$
E=k \sqrt{c} \quad\left\{\begin{array}{l}
E=40 \\
C=25
\end{array}\right.
$$

$$
\begin{aligned}
& 40=K \sqrt{25} \\
& 40 \\
& 40 \\
& \frac{40}{5}=K \\
& 8
\end{aligned} \quad K \quad E=8 \sqrt{C}
$$

a) Find $E$ when $C=49$
b) Find $c$ when $E=10.4$

$$
\begin{aligned}
& E=8 \sqrt{49} \\
& E=8 \times 7 \\
& E=56
\end{aligned}
$$

$$
\begin{aligned}
10.4 & =8 \sqrt{c} \\
\frac{10.4}{8} & =\sqrt{c} \\
1.3 & =\sqrt{c} \\
1.3^{2} & =c \\
c & =1.69
\end{aligned}
$$

