5

Direct Proportion

Rates

EXERCISE 5A

1. Yvonne wanted to buy some cherries. The cherries cost $12 per kg.
(a) Find the cost of the following quantities of cherries:
(i) 3 kg (ii) 4.5 kg (iii) 2.4 kg (iv) 600 g
(b) How many kilograms of cherries could be bought for the following amounts of money?
(i) $24 (ii) $18 (iii) $14.40 (iv) $4.80

2. Robyn loves chocolate. Her favourite chocolate costs $1.20 per 100 g.
(a) Find the cost of the following amounts of chocolate:
(i) 300 g (ii) 50 g (iii) 1 kg (iv) 1.6 kg
(b) How many grams of chocolate could be bought for the following amounts of money?
(Give answers to the nearest whole number)
(i) $2.40 (ii) $2 (iii) $5 (iv) $10.50

3. Kim bought 5 kg of fishing bait for $6.50.
(a) Find the cost of the following amounts of bait:
(i) 1 kg (ii) 3 kg (iii) 500 g (iv) 200 g
(b) How much bait could be bought for the following amounts of money?
(Give answer to two decimal places)
(i) $1 (ii) $1.60 (iii) $2.50 (iv) $12

4. Russell had to give some medicine to his dogs. The medicine had to be given at the rate of four tablets per kg.
Find how many tablets have to be given to each of his dogs.
(a) Yoda - 5 kg (b) Hubbsie - 3.5 kg (c) Pixie - 1.25 kg

5. Rashid has bought some water-cleaner for his fish tank. The water-cleaner has to be added to the fish tank at the rate of 5 mL per 100 litres. Rashid's fish tank is 550 litres.
How many mL of the water-cleaner should Rashid use?

6. Iona was on holidays overseas and was charged 40 cents per minute for her phone calls back home.
(a) Find the cost of the following phone calls:
(i) 3 minutes (ii) 40 minutes (iii) 8.5 minutes
(b) Find the length of the calls that cost the following amounts:
(i) $2 (ii) $1.28 (iii) $5.04

7. Yasmin was downloading some information from the internet. The download rate was 2.5 MB per second.
How long will it take Yasmin to download 600 MB?

8. Table 1 below shows how much energy (in kilojoules - kJ) is used in one hour of participation in certain activities.
Table 2 shows the approximate energy (kJ per 100 g) provided by certain foods.

Table 1

Activity	*kJ per hour*
Running	2800
Walking, easy	700
Walking, brisk	1200
Tennis	2000
Swimming	3000

Table 2

Food	*Energy (kJ) per 100 g*
Bread	1000
Peanuts	2500
Porridge	1500
Bananas	350
Chocolate	2100

Use this information to answer the questions below.
(a) How much energy (kJ) would be used in the following activities?
(i) half an hour of running
(ii) three hours of easy walking
(iii) 15 minutes of tennis
(iv) 40 minutes of swimming
(b) How many grams of bread would be needed to provide the energy for the following activities?
(i) one hour of swimming
(ii) two hours of tennis
(iii) five hours of easy walking
(iv) two hours of brisk walking

(c) Find the amount of energy (kJ) in the following amounts of food:
  (i) 200 g of porridge
  (ii) 50 g of chocolate
  (iii) 20 g of peanuts
  (iv) 150 g of bread
  (v) 120 g of bananas
(d) How many minutes of tennis would 100 grams of porridge provide the energy for?
(e) How many grams of bananas would provide enough energy to run for half an hour?
(f) How many grams of bread provide the same amount of energy as 20 grams of peanuts?

9. Kylie owned a car that had a fuel consumption of 8 litres per 100 kilometres.
(a) How many litres would the car use travelling the following distances?
  (i) 200 kilometres
  (ii) 50 kilometres
  (iii) 75 kilometres
  (iv) 320 kilometres
(b) How far could be driven on the following amounts of petrol?
  (i) 2 litres
  (ii) 24 litres
  (iii) 20 litres
  (iv) 50 litres

10. David and Ben are bricklayers. David can lay 120 bricks in an hour. Ben can lay 90 bricks in an hour.
(a) How many hours would it take David to lay 360 bricks?
(b) How many hours would it take Ben to lay 360 bricks?
(c) How many minutes would it take David to lay 100 bricks?
(d) How many minutes would it take Ben to lay 100 bricks?
(e) How many bricks would David lay in 20 minutes?
(f) How long would it take David and Ben working together to lay 3150 bricks?

Speed

The formulae below can be used to solve problems related to speed.

$$\textit{Speed} = \frac{\textit{Distance travelled}}{\textit{Time taken}} \qquad \textit{Time taken} = \frac{\textit{Distance travelled}}{\textit{Speed}}$$

$$\textit{Distance travelled} = \textit{Speed} \times \textit{Time taken}$$

Note the following abbreviations:
hour (**h**), minutes (**min**), seconds (**s**), metres per second (**m/s**), kilometres per hour (**km/h**)

Examples

1. What is the speed of someone who runs 200 metres in 25 seconds?

2. If a plane is flying at 600 km/h, how long will it take to fly 900 km?

3. If a car drives at 85 km/h for 3 hours, how far will it travel?

Answers

1. $\text{Speed} = \dfrac{\text{Distance travelled}}{\text{Time taken}}$

$\text{Speed} = \dfrac{200}{25}$

***Speed* = 8 m/s**

2. $\text{Time taken} = \dfrac{\text{Distance travelled}}{\text{Speed}}$

$\text{Time taken} = \dfrac{900}{600}$

***Time taken* = 1.5 hours**

3. Distance travelled = Speed × Time taken
= 85 × 3

***Distance travelled* = 255 km**

EXERCISE 5B

1. James ran 225 metres in 50 seconds.
At what speed (in m/s) was James running?

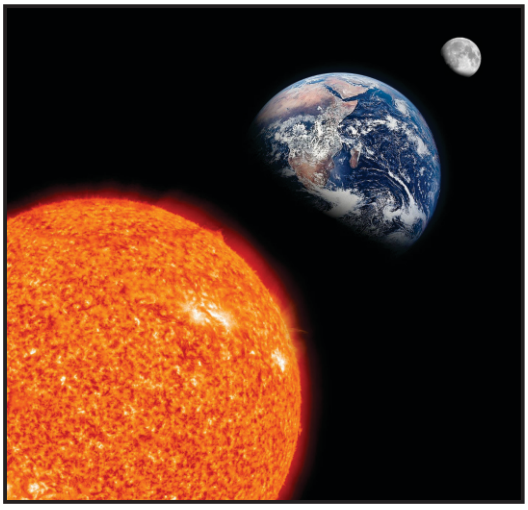
2. Katrina rode her bike at 15 m/s to her friend's house, 3.15 km away.
(a) How many metres did Katrina ride?
(b) How many seconds did it take Katrina to get to her friend's house?
(c) How many minutes did it take Katrina to get to her friend's house?

3. A marathon is approximately 42 km. Michael ran a marathon in $2\frac{1}{2}$ hours. (Give the following answers to one decimal place)
Find Michael's speed in:
(a) km/h (b) m/s (c) m/min

4. The record for running a marathon backwards (!!) is 3 hr 53 min 17 sec.
At what speed (m/s) was this person running?
(Give answer to the nearest whole number)

5. The fastest animal is a cheetah that can run at about 108 km/h.
(a) Convert 108 km/h to m/s.
(b) How long (in seconds) would it take a cheetah to run 300 metres?
(c) How far would a cheetah run in 12 seconds?

6. The Earth's orbit about the Sun is approximately 940 000 000 km.
The Earth takes 365.25 days to travel once around the Sun.
(a) How many seconds does it take the Earth to travel once around the Sun?
(b) Find the Earth's speed in km/s. (Give answer to one decimal place)



7. Pedro lives 1200 metres from school. He walks to school each day at a speed of 1 m/s.
Iain lives 4.5 kilometres from school. He rides his bike to school each day at a speed of 15 m/s.
(a) If they both arrive at school at 8:30 a.m., at what time did they each leave home?
(b) Pedro and Iain live 4.8 kilometres apart. They planned to meet each other one Saturday morning and both left their homes at 9.00 a.m.. If Pedro walked and Iain rode, at what time would they meet?

8. In baseball the batter stands about 18 m from the pitcher.
The fastest pitch in baseball is about 160 km/h.
At this speed how many seconds would it take the baseball to reach the batter?
(Give answer to three decimal places)

Direct Proportion

If two quantities are in ***direct proportion***, as one increases the other increases at the same rate. These two quantities are said to be in ***direct proportion*** or ***directly proportional*** to each other.
Another term used is that there is a ***direct variation*** between these two terms.
The ratio between any corresponding terms is equal.

Symbols used:

If x and y are in direct proportion then:

$y \propto x$ $\propto$ is the symbol for ***directly proportional***

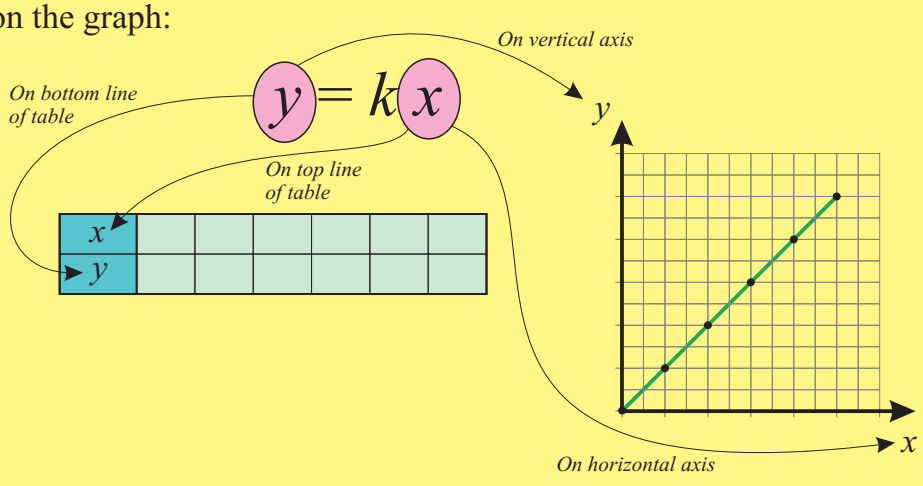
and $y = kx$ k is called the ***constant of proportionality***

There are two ways of checking if two quantities are directly proportional:

1. The ratio $\frac{y}{x}$ for all pairs of values (except 0,0) needs to be calculated and these must all be the same.
The value of this ratio is equal to the constant of proportionality.

2. A graph could be drawn displaying the information about the quantities.
This must be a straight line passing through the origin.

Note the correct way to write the equation and display the information on the graph:



Example 1

1. State if ***x*** and ***y***, from the table below, are directly proportional.
2. Find the constant of proportionality.
3. Write the equation relating the two terms.

x	0	2	4	6	8	10
y	0	6	12	18	24	30

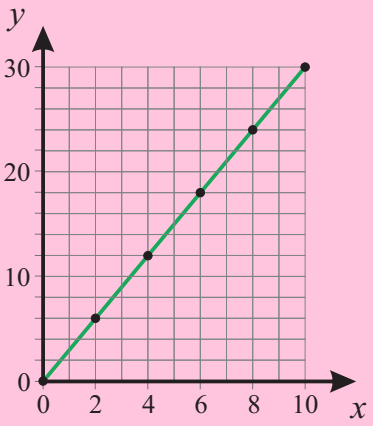
Answers

1. To find if y is directly proportional to x the ratio $\frac{y}{x}$ must be the same for all pairs of values (except 0,0) and the graph must be a straight line.

Checking this ratio: $\frac{6}{2} = \mathbf{3}$, $\frac{12}{4} = \mathbf{3}$, $\frac{18}{6} = \mathbf{3}$, $\frac{24}{8} = \mathbf{3}$, $\frac{30}{10} = \mathbf{3}$

The ratio is the same so y is directly proportional to x.

The graph could also have been drawn.
It can be seen that it is a straight line verifying that y is directly proportional to x.



2. The constant of proportionality (k) is equal to the ratio $\frac{y}{x} = \mathbf{3}$.

3. $y = kx$

therefore **$y = 3x$**

Example 2

State if ***A*** and ***B***, from the table below, are directly proportional.

A	0	5	10	15	20	25
B	0	20	40	50	60	100

Calculate the ratio, $\frac{B}{A}$, for each pair of values (except 0,0):

$$\frac{20}{5} = \mathbf{4}, \quad \frac{40}{10} = \mathbf{4}, \quad \frac{50}{15} = \frac{\mathbf{10}}{\mathbf{3}}, \quad \frac{60}{20} = \mathbf{3}, \quad \frac{100}{25} = \mathbf{4}$$

The values of this ratio are **NOT** all the same so ***B*** is **NOT** directly proportional to ***A***.

Example 3

State if ***P*** and ***Q***, from the table below, are directly proportional and if they are write the equation relating them.

P	0	4	10	12	18	30
Q	0	18	45	54	81	135

Calculate the ratio, $\frac{Q}{P}$, for each pair of values (except 0,0):

$$\frac{18}{4} = \mathbf{4.5}, \quad \frac{45}{10} = \mathbf{4.5}, \quad \frac{54}{12} = \mathbf{4.5}, \quad \frac{81}{18} = \mathbf{4.5}, \quad \frac{135}{30} = \mathbf{4.5}$$

The values of this ratio are the same so ***Q*** is directly proportional to ***P***.

$$Q = kP$$

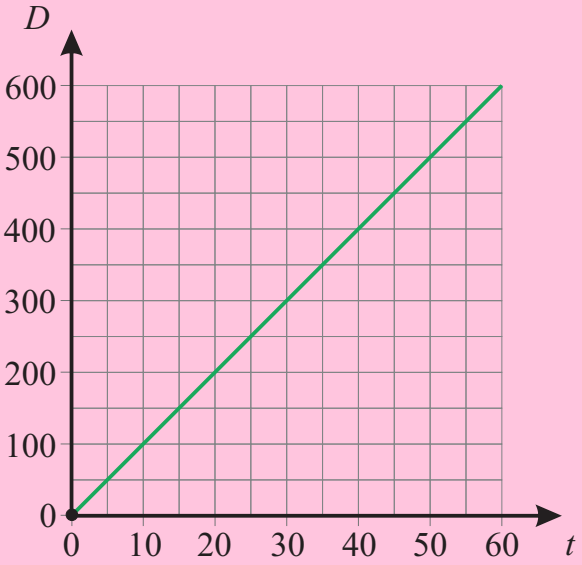
$$k = 4.5 \text{ or } \frac{9}{2}$$

$$Q = 4.5P \quad \text{or} \quad Q = \frac{9}{2}P$$

Example 4

Find the equation relating D and t from the graph below.

The graph is a straight line so D is directly proportional to t.

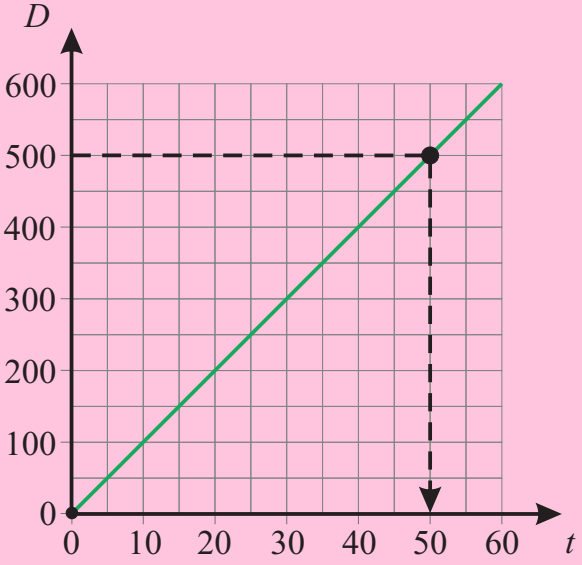


$D = kt$

k = the ratio $\frac{D}{t}$

Any point on the graph can be used to find k because D is directly proportional to t.

When $D = 500$, $t = 50$ (see below)



$k = \frac{500}{50}$

$k = 10$

$D = kt$

$D = 10t$

Example 5

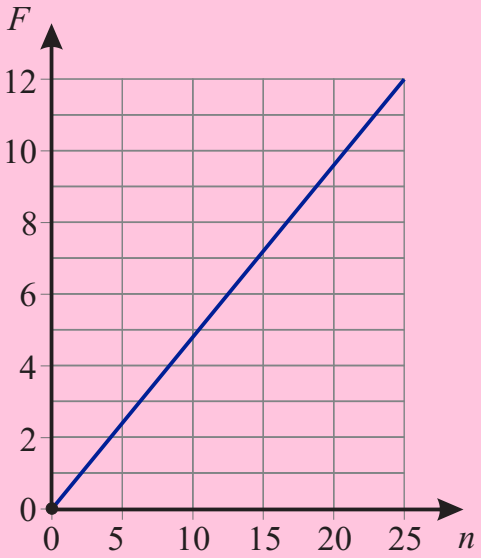
Find the equation relating F and n from the graph below.

The graph is a straight line so F is directly proportional to n.

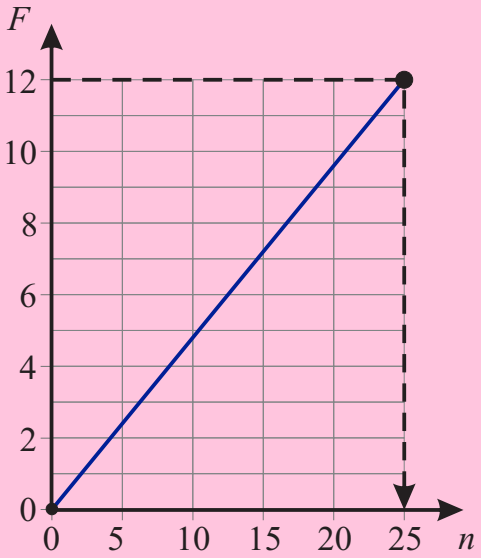
$F = kn$

k = the ratio $\frac{F}{n}$

Any point on the graph can be used to find k because F is directly proportional to n. A point needs to be found that lies on the line.



When $F = 12$, $n = 25$ (see below)



$k = \frac{12}{25}$

$k = 0.48$ or $\frac{12}{25}$

$F = kn$

$F = 0.48n$

or

$F = \frac{12}{25}n$

Example 6

Charles used a hose to put water into a fish tank. There were marks on the side of the tank every 20 litres. Charles timed how long it took for the water level to reach each 20 litre mark. The table below shows these times.

Time (seconds)	0	10	20	30	40	50
Volume (litres)	0	20	40	60	80	100

1. State if the volume of water in the tank is directly proportional to the time taken.
Answer the following questions if Volume is directly proportional to Time.
2. Find the relationship between Volume and Time.
3. What is the volume of water in the tank after 25 seconds?
4. How long would it take 110 litres of water to be put into the tank?
5. What is the volume of water in the tank after 38 seconds?
6. How long did it take 62 litres of water to be put in the tank?

Answers

Let V = volume of water and t = time taken

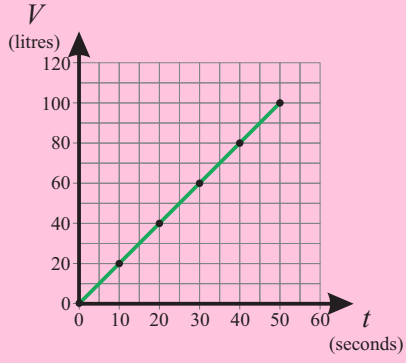
1. There are two ways to determine if V is directly proportional to t.

(a) Check the ratio $\frac{V}{t}$ for all the values except 0,0:

$\frac{20}{10} = \mathbf{2}$, $\frac{40}{20} = \mathbf{2}$, $\frac{60}{30} = \mathbf{2}$, $\frac{80}{40} = 2$, $\frac{100}{50} = \mathbf{2}$

All the ratios are the same so V is directly proportional to t.

(b) Draw the graph.
The straight line confirms that V is directly proportional to t.



2. V is directly proportional to t so the equation between V and t will be:

$$V = kt$$

From part 1 $k = 2$ (the ratio $\frac{V}{t}$) so:

$$\boldsymbol{V = 2t}$$

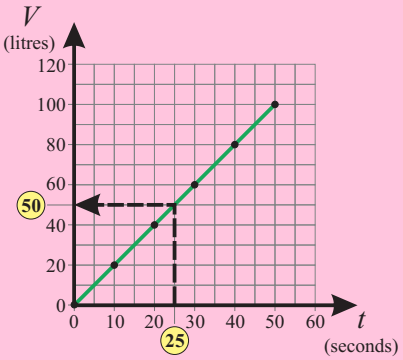
3. $t = 25$

$V = 2t$

$V = 2 \times 25$

$\boldsymbol{V = 50}$ **litres**

This could also have been found from the graph.



4. To find the time for a certain volume of water to be poured into the tank the equation needs to be transposed to make t the subject.

$$V = 2t$$

$$\frac{V}{2} = t$$

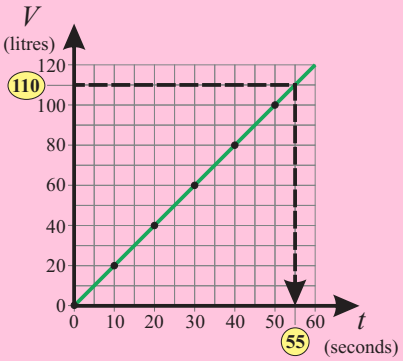
$$t = \frac{V}{2}$$

$V = 110$

$t = \frac{110}{2}$

$\boldsymbol{t}$ **= 55 seconds**

This could also have been found from the graph. Note the line needs to be extended to find this point.



5. To find the volume of water in the tank after 38 seconds the equation relating V and t will need to be used. The graph would need to be drawn in clear detail to achieve an accurate answer.

$$V = 2t$$

$V = 2 \times 38$
V = 76 litres

6. As with the answer to question 5 the equation needs to be used.

$$t = \frac{V}{2}$$

$t = \frac{V}{2}$
$V = 62$
$t = \frac{62}{2}$
t = 31 seconds

EXERCISE 5C

1. State if the quantities in the tables below are in direct proportion (**DP**) or not in direct proportion (**NDP**).

(a)

x	0	5	10	15	20	25
y	0	20	40	60	80	100

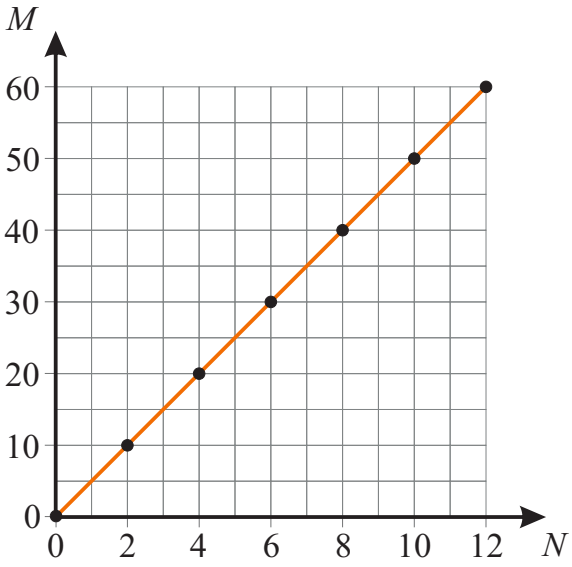
(b)

A	0	2	5	8	15	18
B	0	10	25	40	75	90

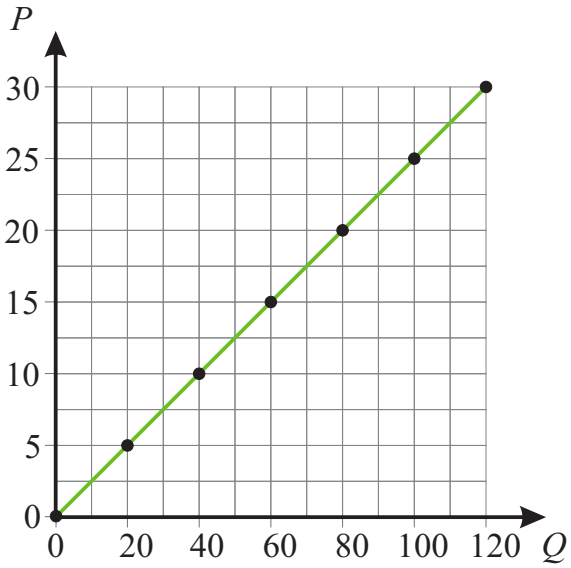
(c)

M	2	6	8	10	22	50
P	1	3	4	5	11	25

2. Find the equation relating the two quantities displayed on the graph below.



3. Find the equation relating the two quantities displayed on the graph below.



4. For the tables of data shown below:
(i) state if the two quantities are directly proportional.
(ii) if they are directly proportional find the equation relating the two quantities.

(a)

a	0	2	4	6	8	10
b	0	12	24	36	48	60

(b)

T	0	6	15	18	21	30
W	0	2	5	6	7	10

(c)

K	0	2	4	6	8	10
H	0	12	24	30	40	60

(d)

g	3	8	15	25	28	45
B	27	72	135	225	252	405

(e)

Q	0	8	15	25	30	52
R	0	4.8	9	15	18	31.2

(f)

V	3	8	12	18	24	38
c	4.5	12	18	30	40	45

(g)

I	0	4	12	20	32	44
H	0	10	30	50	80	110

(h)

j	3	10	18	30	52	70
Y	0.9	3	5.4	9	15.6	21

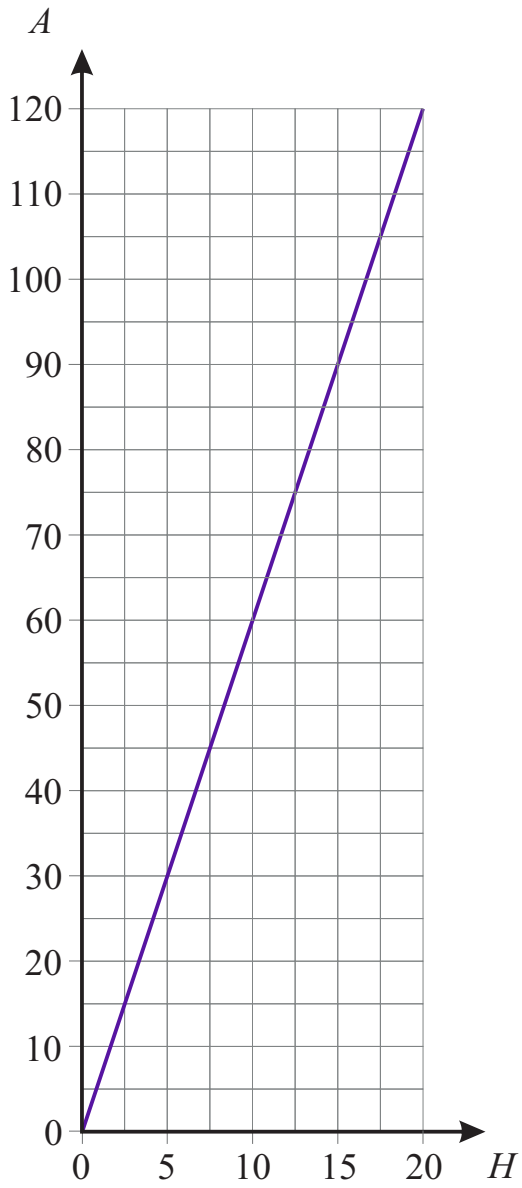
5. (a) Find the equation relating the two quantities displayed on the graph below.

(b) Find A for the following values of H:

(i) 5 (ii) 20 (iii) 8 (iv) 45 (v) 2.5 (vi) 15.2

(c) Find H for the following values of A:

(i) 60 (ii) 90 (iii) 24 (iv) 180 (v) 75.6 (vi) 215.4



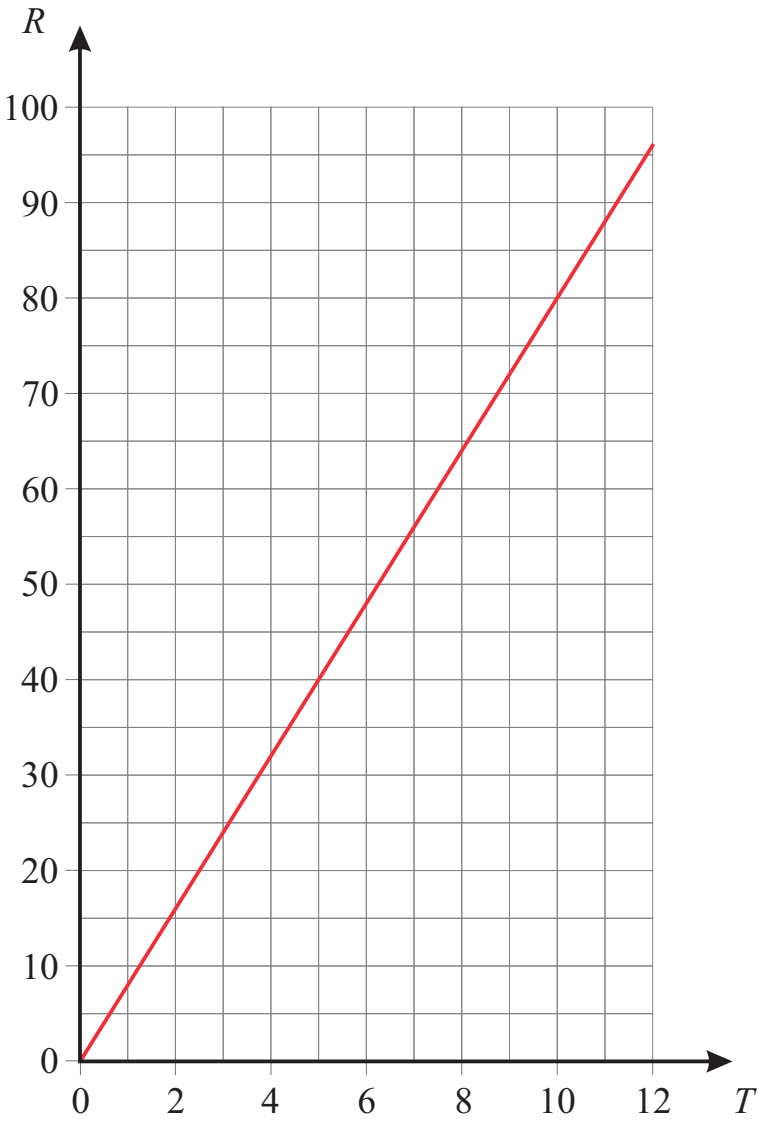
6. (a) Find the equation relating the two quantities displayed on the graph below.

(b) Find R for the following values of T:

(i) 5 (ii) 3 (iii) 9 (iv) 15 (v) 24.5 (vi) 52.6

(c) Find T for the following values of R:

(i) 80 (ii) 60 (iii) 8 (iv) 96 (v) 71.2 (vi) 122.4



7. (a) State if the two quantities displayed in the table below are directly proportional.
If they are directly proportional answer the following questions.
(b) Find the equation relating Y and P.
(c) Find P for the following values of Y.
(i) 3 (ii) 10 (iii) 35 (iv) 5.5 (v) 32.7

Y	0	2	6	9	16	24
P	0	4.8	14.4	21.6	38.4	57.6

8. Copy and complete the table of values for each of the following relationships.

(a) $M = 3N$

N	0	5		8.5		20.5
M			21		37.8	

(b) $Q = \frac{4}{5}K$

K	5		24		36.5	
Q		12		25.6		33.2

(c) $c = 4.5a$

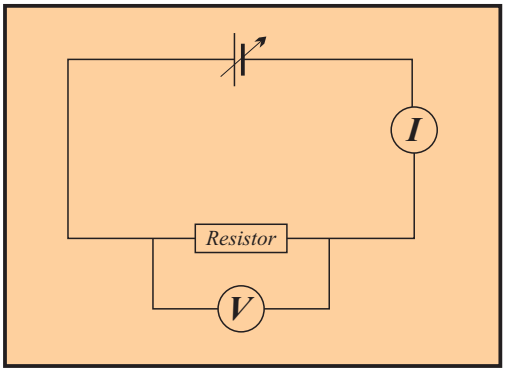
a	0.4		7.4		12.5	
c		27		39.6		68.85

(d) $T = 0.7b$

b		5.3		12		20.6
T	1.75		6.23		10.57	

9. Students in a year 9 science class were studying electric circuits. They set up a simple electric circuit and measured the voltage (V) across a resistor for different currents (I).
The measurements they recorded are shown in the table below.

Voltage (V) was measured in volts (V).
Current (I) is measured in amps (A).



I (A)	2	5	8.5	12	15.5	25
V (V)	24	60	102	144	186	300

(a) Is the voltage directly proportional to the current?
(b) Write an equation relating voltage and current.
(c) Find the voltage for the following currents:
(i) 8 amps (ii) 9.5 amps (iii) 17.2 amps
(d) Find the current for the following voltages:
(i) 36 volts (ii) 174 volts (iii) 296.4 volts

10. Harriet had a revolutions counter on one wheel of her bicycle. It measured the number of revolutions of the wheel as she rode.
Harriet rode around a 400 metre long athletics track and the counter indicated her wheel had turned 182 revolutions.
Harriet assumed the number of revolutions (N) was directly proportional to the distance travelled (D).
(a) Complete the following equation relating D and N. Write the constant of proportionality as a decimal correct to ***one*** decimal place.

$D = kN$ k is the constant of proportionality

(b) Harriet rode from her house to a nearby beach and the counter indicated 1595 revolutions. How far is the beach from Harriet's house?
(c) Harriet was going to compete in a 10 km bicycle race. How many revolutions would each wheel of her bicycle complete in this race?

11. A team of marine scientists were studying a coral reef. They used a specially equipped submarine to dive and study the marine life near the reef.

On one particular dive they were descending at a constant rate. After 2 minutes they had descended to a depth of 15 metres.

(a) Assuming they kept diving at the same rate, complete the following equation relating depth (D), in metres, to time (t), in minutes.

$D = kt$ k is the constant of proportionality

(b) At what depth would they be after the following times?
(i) 10 minutes (ii) 25 minutes (iii) 36 minutes

(c) How long would it take them to dive to the following depths?
(i) 45 metres (ii) 112.5 metres (iii) 195 metres

(d) The submarine can safely dive to a depth of 300 metres. How long would it take them to reach this depth?

(e) After taking several measurements and samples at a depth of 300 m the scientists started to ascend back to the surface. They ascended at a constant rate and after 5 minutes had reached a depth of 260 m. How long did it take them to reach the surface from their dive depth of 300 m?

Photo Courtesy Triton Submarines

12. Henry is a farmer who is considering planting a canola crop. He has a 200 hectare farm. The agriculture recommendations were that he would need 500 kg of canola seed to plant and he could expect a yield of 300 tonnes of canola seed from his 200 hectare farm.

(a) Assuming that the amount of seed to plant is directly proportional to land area, complete this equation relating the amount of seed to plant (P), in kg, to land area (A), in hectares.

$P = kA$ k is the constant of proportionality

(b) Assuming that the yield is directly proportional to land area, complete this equation relating yield (Y), in tonnes, to land area (A), in hectares.

$Y = cA$ c is the constant of proportionality

(c) Pam is also a farmer who is considering planting canola. She owns a 3000 hectare farm. Use the above equations to find the following:

(i) the amount of seed she will need to plant all of her farm with canola.

(ii) the yield she could expect from her crop.

(d) If the cost of planting canola seed is \$35/kg and the price expected on yield is \$400 per tonne find:

(i) the amount Henry will spend on seed.

(ii) the amount Pam will spend on seed.

(iii) the amount Henry will receive for his crop.

(iv) the amount Pam will receive for his crop.

Inverse Proportion

Previously in this chapter the relationship between two quantities that vary at the same rate has been studied. As one quantity increased, the other also increased at the same rate. As stated this relationship is called ***direct proportion*** and the relationship is represented mathematically by the following equation:

$y = kx$ where k is the constant of proportionality

Another type of relationship is when one quantity ***decreases*** at the same rate as the other quantity ***increases***.
For example, the speed of an object and the time taken to travel a certain distance. If the speed is ***doubled***, the time taken is ***halved***.
These types of relationships are called ***inverse proportionality***.
In the example of speed and time taken:

speed (s) is ***inversely proportional*** to the ***time taken*** (t)

As a mathematical equation this is written as:

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

or

$$s = \frac{k}{t}$$ where k is the constant of proportionality

Example

The time taken, t (in seconds), for a cyclist to ride around a track is recorded for different speeds, s (in m/s), and is shown in the table below.

t (s)	5	6	10	12	15
s (m/s)	12	10	6	5	4

1. State if t and s are inversely proportional.
2. Find the constant of proportionality.
3. Write the equation relating t and s.
4. Find the speed if the cyclist took 20 seconds to ride around the track.
5. How long would it take a cyclist riding at 2 m/s to ride around the track?
6. Draw the graph displaying this information.

Answers

1. If t and s are inversely proportional then:

$$s = \frac{k}{t}$$ where k is the constant of proportionality

This equation can be transposed:

$$st = k$$

This means that $s \times t$ should be a constant for all pairs of values.
To check this multiply s and t for all pairs of values:

$5 \times 12 = \mathbf{60}$
$6 \times 10 = \mathbf{60}$
$10 \times 6 = \mathbf{60}$
$12 \times 5 = \mathbf{60}$
$15 \times 4 = \mathbf{60}$

Because the product of s and t ($s \times t$) is the same for all pairs of values then s is inversely proportional to t. The value of the product is equal to k, the constant of proportionality.

2. $k = 60$

3. $\boxed{s = \frac{k}{t}}$

$$s = \frac{60}{t}$$

4. $t = 20$

Substitute $t = 20$ into the equation:

$$s = \frac{k}{t}$$

$$s = \frac{60}{20}$$

$$\mathbf{s = 3\ m/s}$$

5. $s = 2$ m/s

$$s = \frac{k}{t}$$

$$2 = \frac{60}{t}$$

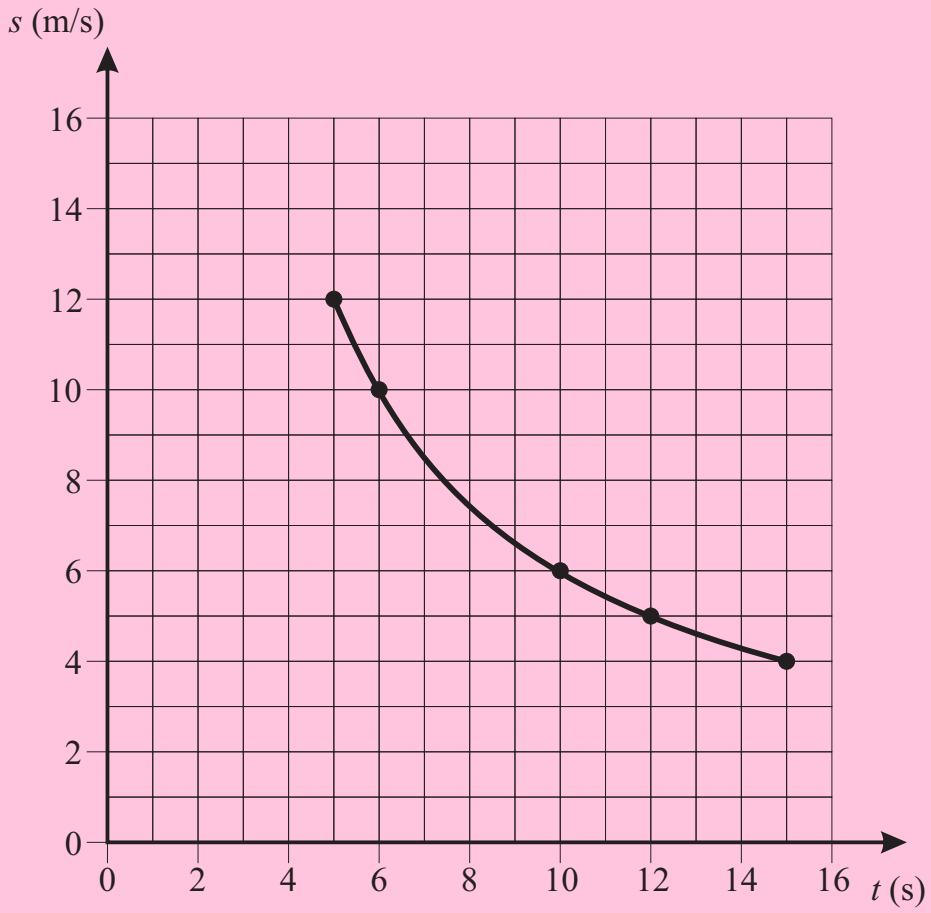
This equation needs to be transposed to solve for t.

$$2t = 60$$

$$t = \frac{60}{2}$$

$$\mathbf{t = 30\ s}$$

6.



The graphs of all inverse proportional relationships are this shape.
The name given to a curve with this shape is a ***hyperbola***.

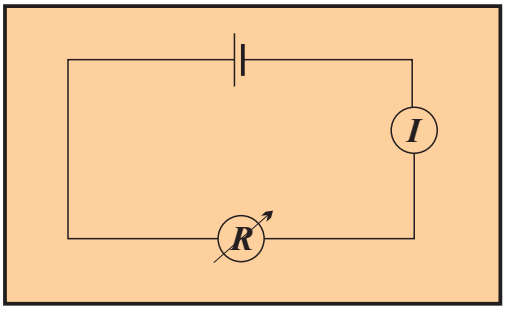
EXERCISE 5D

1. The time taken, t (in seconds), for a cyclist to ride around a track is recorded for different speeds, s (in m/s), and is shown in the table below.

t (s)	2	3	4	6	8
s (m/s)	24	16	12	8	6

(a) State if t and s are inversely proportional.
(b) Find the constant of proportionality.
(c) Write the equation relating t and s (s = ...).
(d) Find the speed if the cyclist took 16 seconds.
(e) How long would it take a cyclist riding at 1 m/s to ride around the track?
(f) Draw the graph displaying this information.

2. An experiment was conducted to find the relationship between resistance, R (measured in ohms), and current, I (measured in amps), in an electrical circuit. The size of the resistor was changed and the current measured for each resistor. A table showing the size of the resistor and the current measured is shown below.



R (ohms)	5	20	60	90	120
I (amps)	144	36	12	8	6

(a) State if R and I are inversely proportional.
(b) Find the constant of proportionality.
(c) Write the equation relating R and I (I = ...).
(d) Find the current when the resistance is:
(i) 2 ohms (ii) 40 ohms (iii) 360 ohms
(e) What resistance would result in the following currents?
(i) 1 amp (ii) 30 amps (iii) 180 amps
(f) Draw the graph displaying this information.

3. Clementine had a large tree in her yard that she was going to decorate with lights at Christmas. She was going to power the lights by batteries that were charged by solar panels.
She noted that the number of lights on the tree determined how long the lights remained on before the batteries went flat.
The table below shows the time the lights remain on, T (in minutes), for different numbers of lights, N.

N	2000	3000	4000	12 000
T (minutes)	240	160	120	40

(a) State if N and T are inversely proportional.
(b) Find the constant of proportionality.
(c) Write the equation relating N and T (T = ...).
(d) Find the time that the following number of lights would remain on:
(i) 6000 (ii) 5000 (iii) 20 000
(e) Clementine wanted the turn the lights on at 8:30 pm and have them turn off at 11.00 pm. How many lights should she put on the tree?

4. Science students wanted to investigate the relationship between pressure and volume in a gas. They connected a pressure gauge to a bicycle pump and recorded the pressure, P (in kilopascals - kPa), and volume, V (in cm^3), as they compressed the pump.
Their measurements are shown in the table below.

V (cm^3)	100	90	80	60
P (kPa)	72	80	90	120

(a) State if V and P are inversely proportional.
(b) Find the constant of proportionality.
(c) Write the equation relating V and P (P = ...).
(d) Find the pressure for the following volumes:
(i) 30 cm^3 (ii) 50 cm^3 (iii) 120 cm^3
(e) Find the volume that will create the following pressures:
(i) 100 kPa (ii) 150 kPa (iii) 180 kPa

EXERCISE 5E

State if the relationship between the following quantities would be a direct proportionality (**D**) or inverse proportionality (**I**).

1. The size of a house to be painted and the time taken for one painter to paint the house.

2. The number of painters painting a house and the time taken to paint the house.

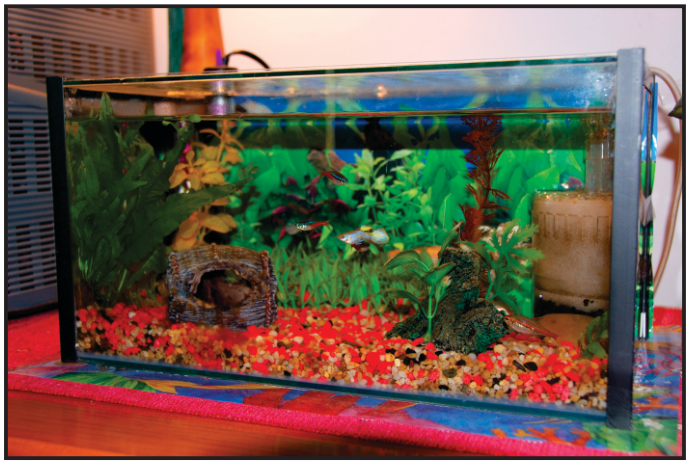
3. The size of a wheat farm and the time taken for a harvester to harvest the wheat.

4. The number of fruit pickers employed to pick all the fruit in an orchard and the time taken to pick the crop.

5. The time taken for a water tank to fill and the amount of water needed to fill the tank.

6. The time taken for a packet of bird seed to be eaten and the number of birds in the aviary.

7. The amount of food needed for the fish in an aquarium and the number of fish in the aquarium.



PROBLEM SOLVING

1. Michel and Angelo are painters. They have a job to paint three identical rooms in a house. Michel takes three hours to paint one of the rooms and Angelo takes six hours to paint another one of the rooms. They decide to work together to paint the third room. How long should it take them to paint the third room if they are working together?

2. Adelaide and Matilda decide to run around a park. They start at the same point and at the same time but run in opposite directions. Adelaide runs at 5 m/s. Matilda runs at 4 m/s. They meet 11 minutes later.
(a) What is the distance around the park?
(b) Who will return to their starting point first?
(c) How many seconds later will the other runner return to their starting point?

PUZZLES

1. Change **SLOW** into **FAST** in six steps by changing one letter at a time to form a new word. (Two letters of the middle word are included)

Example
CAT can be changed to **DOG** in three steps

CAT
COT
DOT
DOG

SLOW
L _ _T
FAST

2. Rearrange the letters of the following words and phrases to form words from this chapter.
(a) MITE (b) NEAT DISC (c) STARE (d) NO POOR TRIP
(e) TEAR (f) CREDIT (g) NEVER IS (h) LOONY AIRPORT PIT

CHAPTER REVIEW

1. The cost of rolled oats at a bulk store was \$4.00 for 5 kg.
(a) Find the cost of the following amounts of rolled oats:
(i) 2 kg (ii) 7 kg (iii) 8.5 kg
(b) How many kilograms of rolled oats could be bought for the following amounts of money?
(i) \$8 (ii) \$10 (iii) \$3

2. Margie was swimming in a pool that was 25 metres long. The average time it takes her to swim a lap is 40 seconds.
Give the answers to parts (a) and (b) below in minutes and seconds.
(a) How long will it take Margie to swim 20 laps?
(b) How long will it take Margie to swim 1 kilometre?
(c) How many metres will she swim in 30 minutes?

3. Kyle took 40 minutes to ride 20 km on his bicycle. At what speed, in km/h, was Kyle riding?

4. Lena jogged 600 metres in 3 minutes. How long would it take her to jog 5 km?

5. State if the quantities in the tables below are in direct proportion (**DP**) or not in direct proportion (**NDP**).

(a)

M	0	2	4	6	8	10
N	0	12	20	36	32	80

(b)

g	0	2	6	10	12	15
h	0	8	24	40	48	60

(c)

y	3	9	12	21	27	39
z	1	3	4	7	9	13

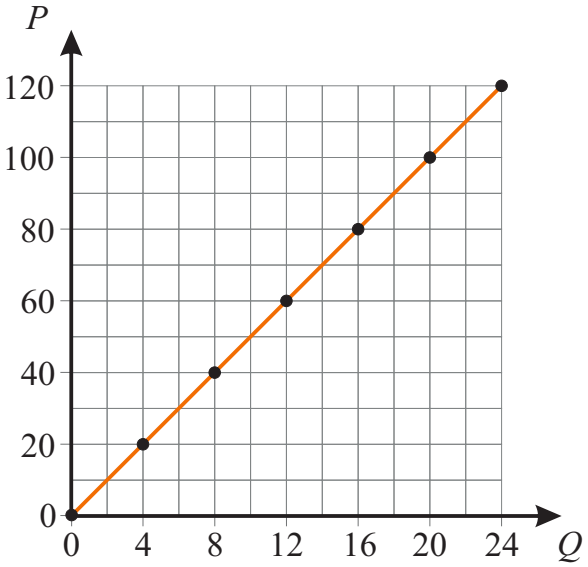
6. Write the equation relating the pairs of quantities from question 5 that are directly proportional.

7. (a) Find the equation relating the two quantities displayed on this graph.

(b) Find P for the following values of Q.
(i) 6 (ii) 19 (iii) 52

(c) Find Q for the following values of P:
(i) 70 (ii) 130 (iii) 168

(d) What is the constant of proportionality in this equation?



8. (a) Find the equation relating the quantities shown in the table of values below.

K	0	2	4	6	8	10
L	0	3	6	9	12	15

(b) Find L for the following values of K:
(i) 18 (ii) 25 (iii) 9.6 (iv) 37.8

(c) Find K for the following values of L:
(i) 24 (ii) 51 (iii) 28.5 (iv) 97.95

9. Copy and complete the table of values for each of the following relationships.

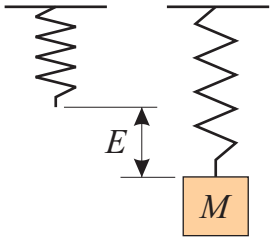
(a) $M = 4N$

N	0	5		9.5		20.5
M			24		50	

(b) $Q = 2.4K$

K	2		21		30.5	
Q		9.6		61.2		96.48

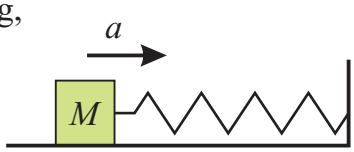
10. A vertical spring is extended by adding masses. The extension, E, in cm, for different masses, M, in kg, is recorded in the table below.



M (kg)	0.2	0.5	1.2	1.5	2.2
E (cm)	0.6	1.5	3.6	4.5	6.6

(a) Is the extension directly proportional to the mass added to the spring?
(b) Write an equation relating mass and extension.
(c) Find the extension for the following masses added to the spring:
(i) 0.4 kg (ii) 1.3 kg (iii) 2.7 kg
(d) What mass would result in the following extensions?
(i) 0.3 cm (ii) 4.2 cm (iii) 5.4 cm

11. A mass is attached to the end of a horizontal spring on a table. The spring is extended and the mass released. An experiment was conducted to find the relationship between the mass, M in kg, and its acceleration, a in m/s^2.
The results are shown in the table below.



M (kg)	0.2	0.4	1.0	1.5	2.0
a (m/s^2)	30	15	6	4	3

(a) State if M and a are directly or inversely proportional.
(b) Find the constant of proportionality.
(c) Write the equation relating M and a.
(d) Find the acceleration for the following masses:
(i) 0.5 kg (ii) 1.2 kg (iii) 2.4 kg
(e) What mass would cause an acceleration of 0.8 m/s^2?