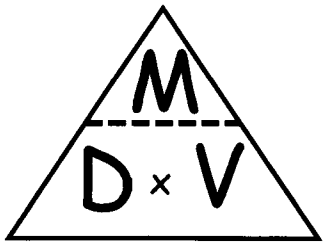
COMPOUND MEASURES

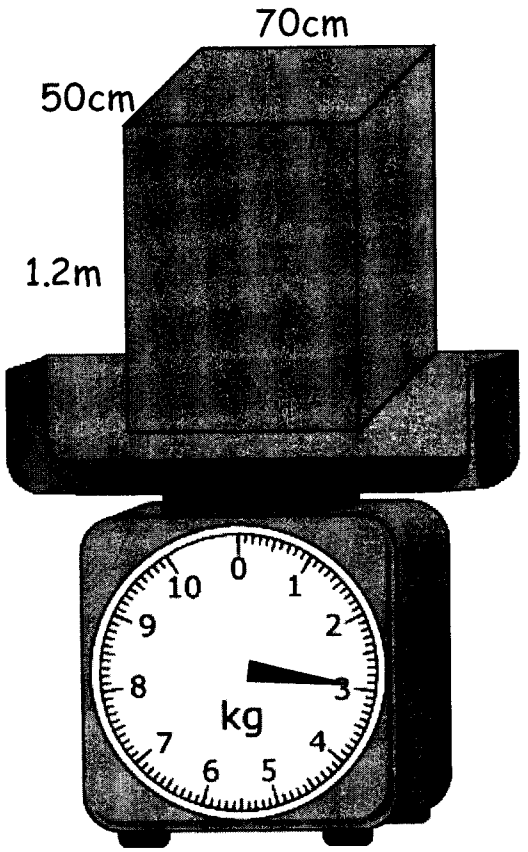
Density

Density = $\frac{\text{mass}}{\text{volume}}$



mass =

volume =



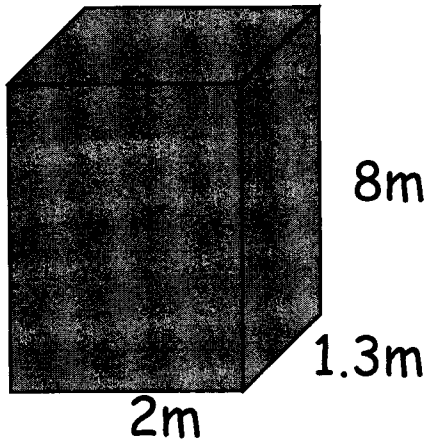
What is the density of the material the block is made from?

Volume of block in m^3

$= 1.2 \times 0.5 \times 0.7 = 0.42\ m^3$

Mass (from scales) = 3 kg

Density = $\frac{M}{V} = \frac{3}{0.42} = 7.14\ kg/m^3$



This block has a density of 5000kg/m^3. How much does it weigh?

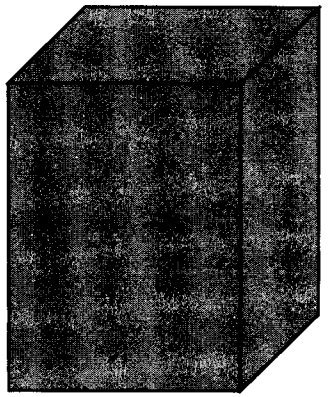
Volume of block $2 \times 1.3 \times 8$

$= 20.8\ m^3$

Mass = D x V

$= 5000 \times 20.8$

$= 104000\ kg$



This block is made from a material with density 4000 kg/m^3.

The weight of the block is 7500kg.

What is the volume of the block?

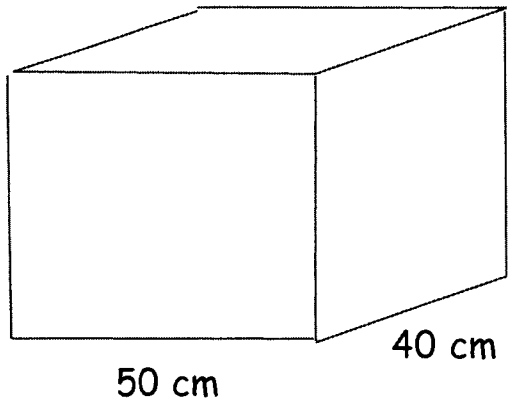
$V = \frac{M}{D}$

$V = \frac{7500}{4000} = 1.875\ m^3$

Calculate the missing quantity in each question.

Density = mass/volume
Mass = density x volume
Volume = mass/density

1

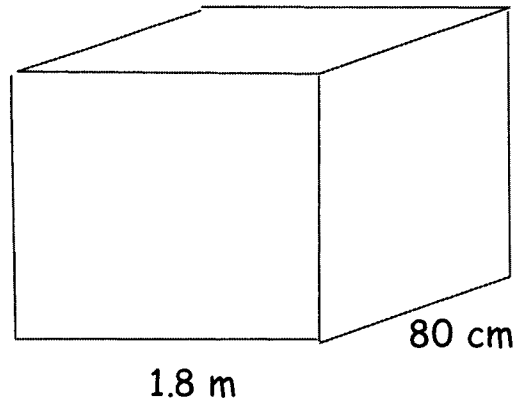


Calculate the volume of this block in m^3.
The block weighs 474 kg. What is the density of the material it is made out of?

Volume = $0.3 \times 0.5 \times 0.4 = 0.06 m^3$

$D = \frac{M}{V} = \frac{474}{0.06} = 7900 kg/m^3$

2



Calculate the volume of this block in m^3. $1.5 \times 1.8 \times 0.8 = 2.16 m^3$
The density of the material the block is made out of is 500 kg/m^3.
What is the weight of this block? $M = D \times V = 500 \times 2.16 = 1080$ kg

3 A cuboid of material has a mass of 30kg. The denisty of the material the block is made from is 150 kg/m^3.
What is the volume of the block? $V = \frac{M}{D} = \frac{30}{150} = 0.2 m^3$

4 Questions 1 to 3 contain 3 blocks, they are made from steel, wood and polystyrene. Match the material to the question number.

Steel Qu 1

Wood Qu 2

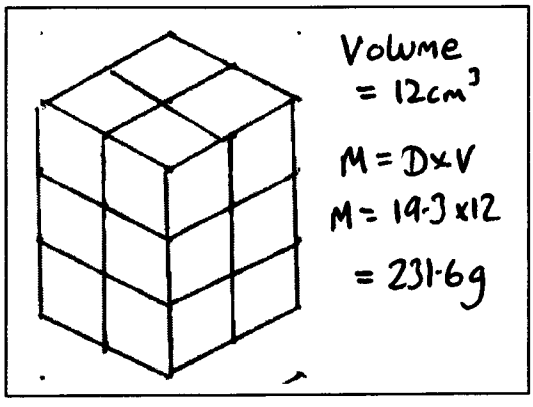
Polystyrene Qu 3

Density Each shape is a prism made from 1cm^3 cubes

The density of Iron = 7.8 g/cm^3 Aluminium = 2.7 g/cm^3 Gold 19.3 g/cm^3

1) What is the weight of each of these prisms?

a) A Cuboid made of Gold



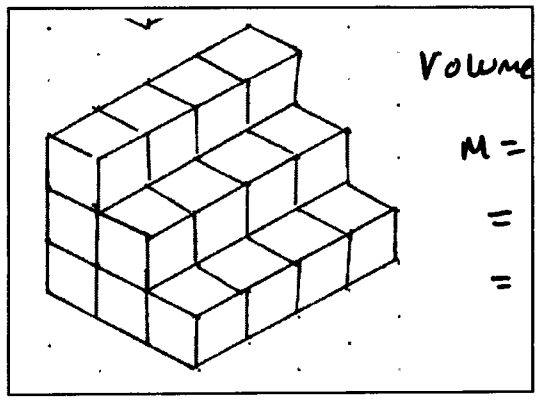
Volume = 12cm^3

M = D × V

M = 19.3 × 12

= 231.6g

b) A Prism made of Aluminium



Volume = 24cm^3

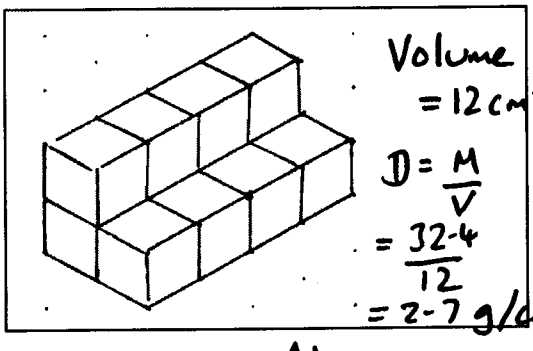
M = D × V

= 2.7 × 24

= 64.8g

2) Which material is each prism made of?

a) Mass = 32.4 g



Volume = 12cm^3

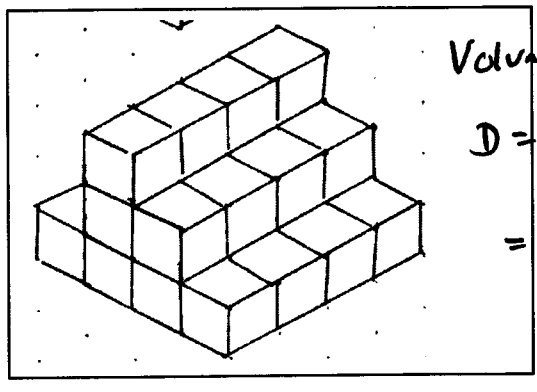
$D = \frac{M}{V}$

$= \frac{32.4}{12}$

= 2.7 g/cm^3

Aluminium

b) Mass = 218.4 g



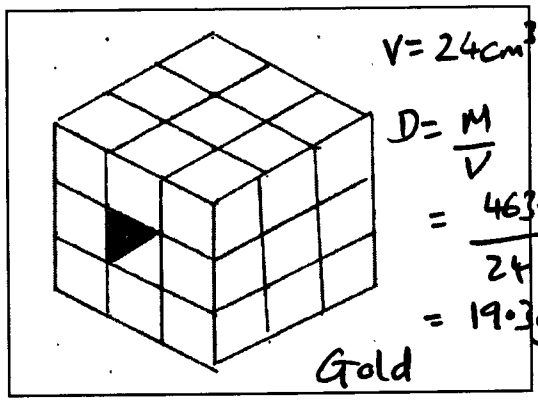
Volume 28cm^3

$D = \frac{M}{V} = \frac{218.4}{28}$

= 7.8 g/cm^3

Iron

c) Mass = 463.2 g



V = 24cm^3

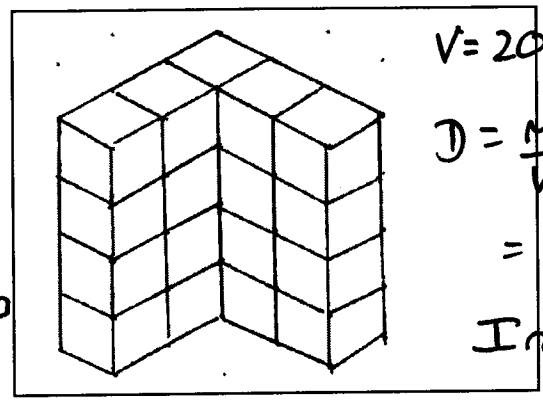
$D = \frac{M}{V}$

$= \frac{463.2}{24}$

= 19.3 g/cm^3

Gold

d) Mass = 156 g



V = 20cm^3

$D = \frac{M}{V} = \frac{156}{20}$

= 7.8 g/cm^3

Iron

3) Calculate the volume of each block. a) Block A is made of aluminium and weighs 135g.

$V = M/D = 135 \div 2.7 = 50cm^3$

b) Block B is made of iron and weighs 234g. c) Block C is made of gold and weighs 386g.

$V = \frac{M}{D} = \frac{234}{7.8} = 30cm^3$

$V = \frac{M}{D} = \frac{386}{19.3} = 20cm^3$

Time conversion calculations

1) 2.5 hours = 2 hours 30 minutes 0.5 x 60 = 30

2) 1.2 hours = 1 hours 12 minutes 0.2 x 60 = 12

3) 0.7 hours = 0 hours 42 minutes 0.7 x 60 = 42

4) 3.12 hours = 3 hours 7.2 minutes 0.12 x 60 = 7.2

5) 4.8 hours = 4 hours 48 minutes 0.8 x 60 = 48

6) 3 hours 24 minutes = 3.4 hours 24 ÷ 60 = 0.4

7) 4 hours 15 minutes = 4.25 hours 15 ÷ 60 = 0.25

8) 1 hours 48 minutes = 1.8 hours 48 ÷ 60 = 0.8

9) 1 hours 45 minutes = 1.75 hours 45 ÷ 60 = 0.75

10) 2 hours 54 minutes = 2.9 hours 54 ÷ 60 = 0.9

A car starts a journey at 3.12 pm. The journey finishes at 6.30 pm.

11) How long did the journey take in hours and minutes? 3h 18 mm

12) How long did the journey take as a decimal? 3.3 hrs 18 ÷ 60 = 0.3

A car starts a journey at 4.22 pm. The journey finishes at 6.07 pm.

13) How long did the journey take in hours and minutes? 1h 45 m

14) How long did the journey take as a decimal? 1.75 hrs 45 ÷ 60 = 0.75

A car starts a journey at 1.56 pm. The journey finishes at 3.20 pm.

15) How long did the journey take in hours and minutes? 1h 24mm

16) How long did the journey take as a decimal? 1.4 hrs 24 ÷ 60 = 0.4.

A car starts a journey at 1.56 pm and took 4 hours 15 minutes.

17) At what time did the journey finish? 6.11 pm

18) How long did the journey take as a decimal? 4.25 hrs 15 ÷ 60 = 0.25

A car starts a journey at 3.47 pm. The journey took 3.35 hours. 0.35 x 60 = 21.

19) How long did the journey take in hours and minutes? 3h 21 min

20) At what time did the journey finish? 7.08 pm

Speed

1) A car sets off at 8.45 am and arrives at 10.09 am. It travels a distance of 84 miles.

a) How long does the journey take, in hours and minutes? 1h 24min

b) How will you enter this time in hours on your calculator? 1·4

c) What is the average speed of the car for the journey? $S = \frac{D}{T} = \frac{84}{1.4} = 60$ mph

2) A car is travelling at 65 mph. It travels 143 miles.

a) How long does the journey take, in hours and minutes? $T = \frac{D}{S} = \frac{143}{65} = 2.2 = 2h\ 12min$

$0.2 \times 60 = 12$

b) The car set off at 10.50 am. What time did arrive?

10·50 am + 2h 12 min = 1·02 pm

3) A car is travelling at 40 mph. It set off at 7.55 am and arrives at 9.04 am.

a) How long does the journey take, in hours and minutes? 1h 9 min

b) How will you enter this time in hours on your calculator? 1·15 $9 \div 60 = 0.15$

c) What is the length of the journey? $D = S \times T = 40 \times 1.15 = 46$ miles

4) A train sets off at 8.45 am and arrives at 11.25 am. It travels a distance of 320 miles.

a) How long does the journey take, in hours and minutes? 2h 40 m $40 \div 60 = 0.\dot{6}$

b) How will you enter this time in hours on your calculator? $2.\dot{6}$ hours

c) What is the average speed of the train for the journey? $S = \frac{D}{T} = \frac{320}{2.\dot{6}} = 120$ mph.

5) A car is travelling at 40 mph. It travels 74 miles.

a) How long does the journey take, in hours and minutes? $T = \frac{D}{S} = 74 \div 40 = 1.85 = 1h\ 51min$

$0.85 \times 60 = 51$

b) The car set arrived at 22:15. What time did it leave? Give your answer in am/pm time

22·15 − 1h 51mn = 8·24pm or 20:24

6) A cyclist is travelling at 20 mph. They set off at 7.55 am and arrive at 5.40 pm.

a) How long does the journey take, in hours and minutes? 9h 45 mn

b) How will you enter this time in hours on your calculator? 9·75 $45 \div 60 = 0.75$

c) What is the length of the journey? $D = S \times T$

$= 20 \times 9.75 = 195$ miles

$$\text{Time} = \frac{\text{Distance}}{\text{Speed}}.$$

Car travelling at 40 mph

	time taken	am/pm	24h
Newcastle	X	11 am	11:00
Leeds	80÷40=2	1pm	13:00
Sheffield	40÷40=1	2pm	14:00
Luton	100÷40=2.5	4.30pm	16:30
London	30÷40=0.75	5.15pm	17:15

Car travelling at 60 mph

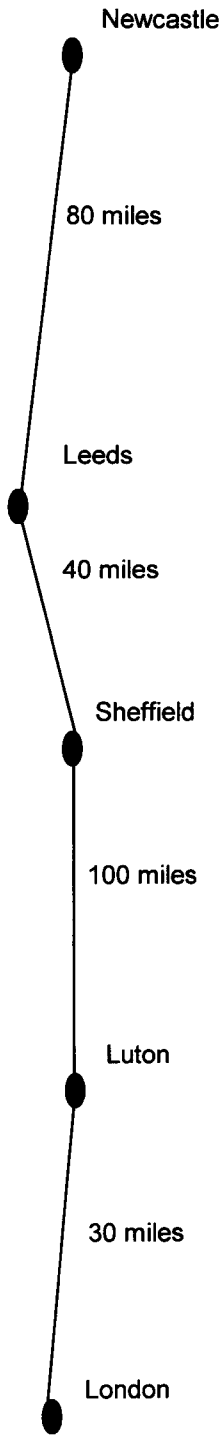
	time taken	am/pm	24h
Newcastle	X	11 am	11:00
Leeds	80÷60=1.3	12.20pm	12:20
Sheffield	40÷60=0.6	1pm	13:00
Luton	100÷60=1.6	2.40pm	14:40
London	30÷60=0.5	3.10pm	15:10

Car travelling at 80 mph

	time taken	am/pm	24h
Newcastle	X	11 am	11:00
Leeds	80÷80=1	12pm	12:00
Sheffield	40÷80=0.5	12.30pm	12:30
Luton	100÷80=1.25	1.45pm	13:45
London	30÷80=	2.08pm	14.08

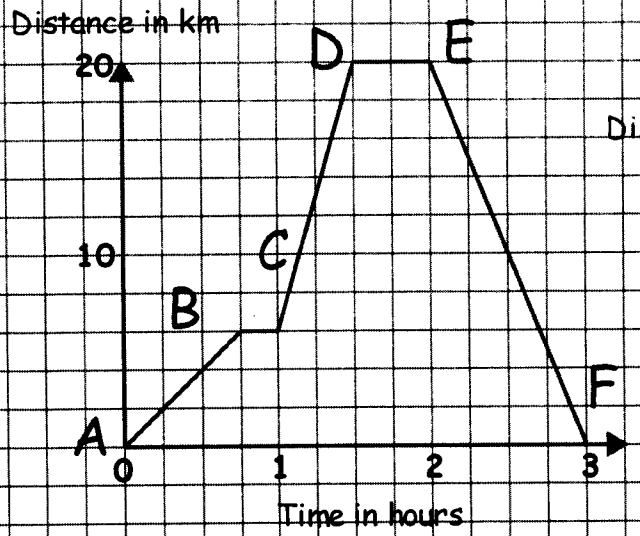
0.375 = 23 mins

Time = distance ÷ speed



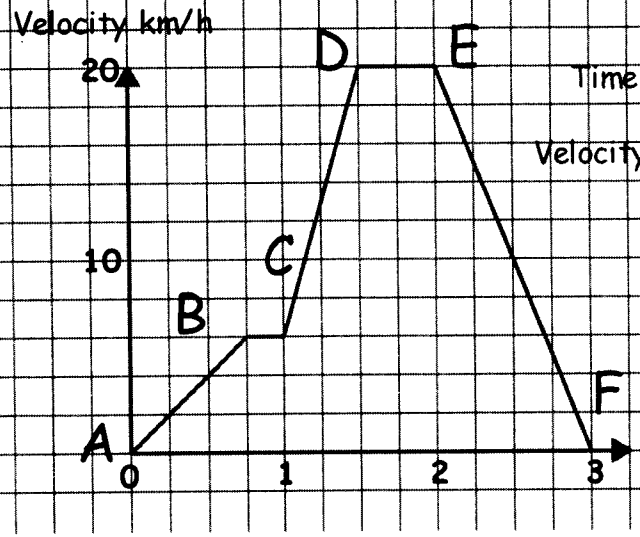
The car travelling at 80 mph is the first car to arrives at London.
How long is it before the other two cars arrive.

The 60 mph car. 1h 2m
The 40 mph car. 3h 7m



Time	0	0.25	0.5	0.75	1	1.25	1.5	1.75	2	2.25	2.5	2.75	3
Distance	0	2	4	6	6	12	20	20	20	15	10	5	0

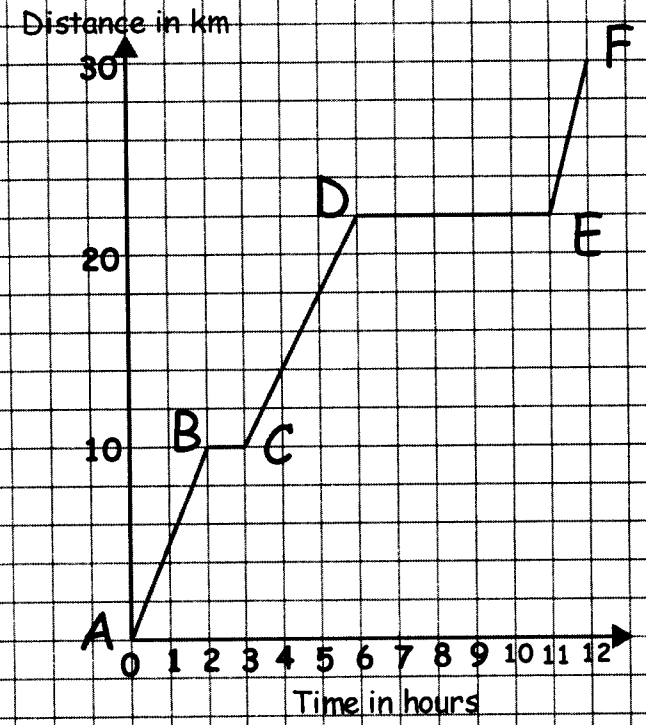
Section	Distance	Time	Velocity	Description
A to B	6	45 mins	$6 \div 0.75 = 8$ km/h	
B to C	0	15 mins	0	
C to D	14	30 mins	$14 \div 0.5 = 28$ km/h.	
D to E	0	30 mins	0	
E to F	20	1	$20 \div 1 = 20$ km/h	(speed = 20 km/h, velocity = -20 km/h)



Time	0	0.25	0.5	0.75	1	1.25	1.5	1.75	2	2.25	2.5	2.75	3
Velocity	0	24	6	6	6	12	20	20	20	15	10	5	0

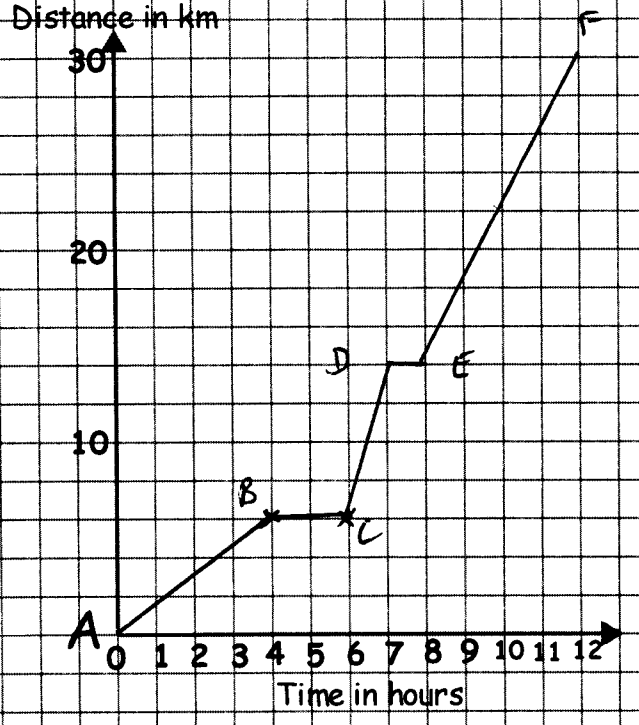
Section	Acceleration	Description
A to B	$6 \div 0.75 = 8$ km/h^2	
B to C	0	
C to D	$14 \div 0.5 = 28$ km/h^2	
D to E	0	
E to F	$20 \div 1 = 20$ km/h^2	(technically -20 km/h^2)

1) Fill in the table from the graph



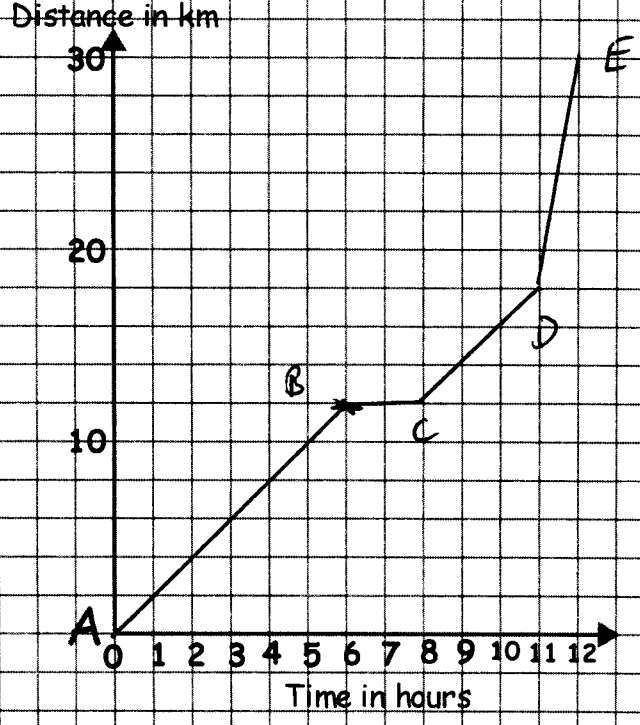
Section	Distance	Time	Speed
A to B	10	2	5
B to C	0	1	0
C to D	12	3	4
D to E	0	5	0
E to F	8	1	8

2) Fill in the graph from the table
Complete the table



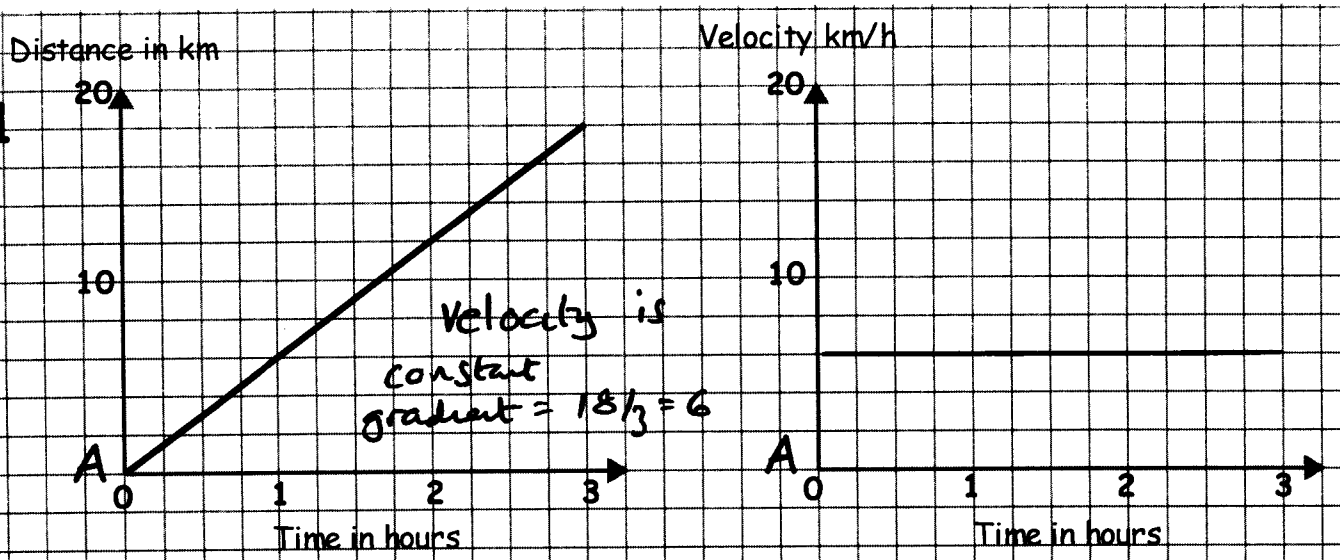
Section	Distance	Time	Speed
A to B	6 km	4 hours	1·5
B to C	0 km	2 hours	0
C to D	8 km	1 hour	8
D to E	0 km	1 hour	0
E to F	16 km	4 hours	4

3) Fill in the graph from the table
Complete the table



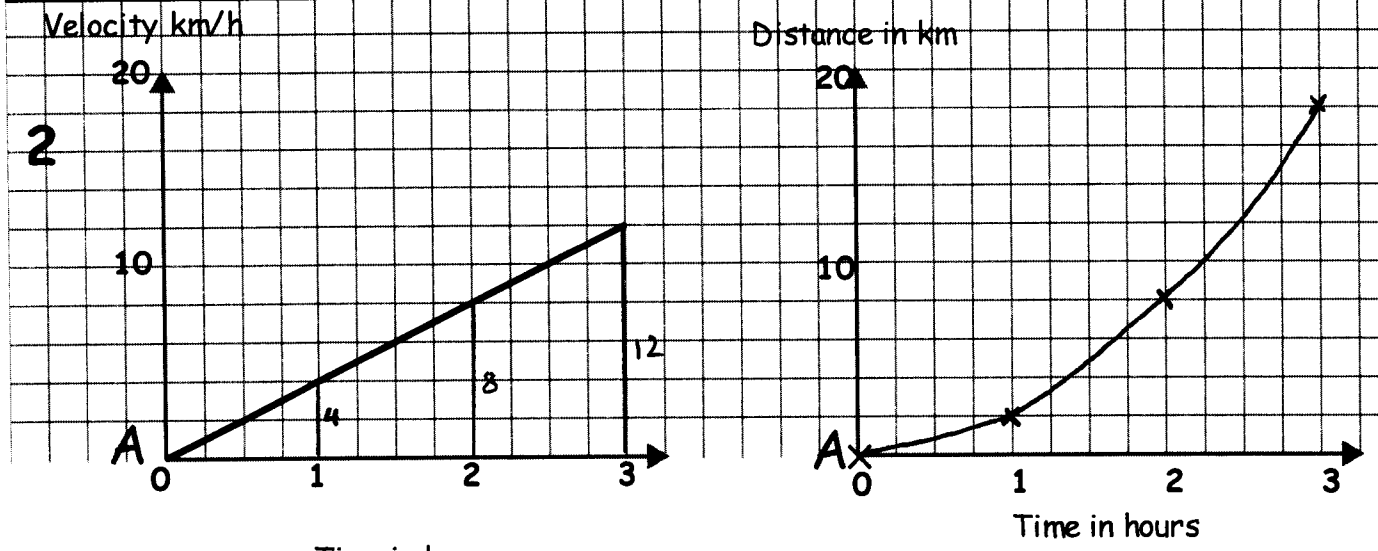
Section	Distance	Time	Speed
A to B	12 km	6 hours	2
B to C	0 km	2 hours	0
C to D	6 km	3 hours	2
D to E	12 km	1 hour	12

1



Complete the velocity time graph by using the distance time graph.

2

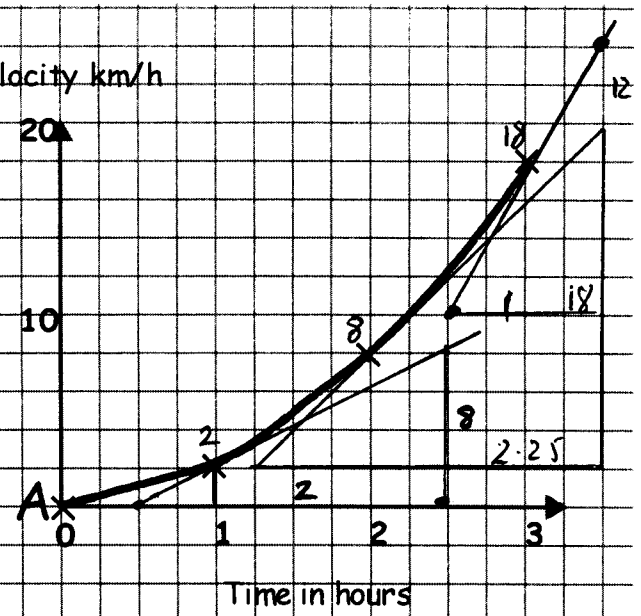


Complete the distance time graph by using the velocity time graph.

distance = area under graph

Area of triangles $\frac{1\times4}{2}=2$ $\frac{8\times2}{2}=8$ $\frac{12\times3}{2}=18$

3



Complete the two tables by using the velocity time graph

Time (hours)	0	1	2	3
Acceleration (km/h²) gradients of tangents	0	$\frac{8}{2}=4$	$\frac{18}{2\cdot25}=8$	$\frac{12}{1}=12$

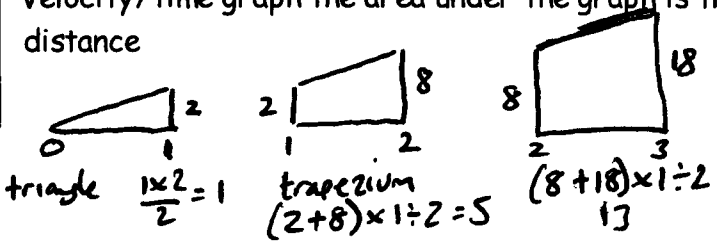
Time (hours)	0	1	2	3
Distance (km) area under graph see below	0	$\frac{1\times2}{2}$ = 1	1+5 = 6	1+5+13 = 19

Remember

Distance/time graph the gradient is the velocity

Velocity/time graph the gradient is the acceleration

Velocity/time graph the area under the graph is the distance



1 km = 1000 m 1 hour = 60 minutes = 3600 seconds

Converting from m/s to km/h

30 m/s means 30 metres in 1 second.

In 1 minute this would be 1800 m. 30 x 60

In 1 hour this would be 108000 m. 1800 x 60

In 1 hour this would be 108 km.

So 30 m/s is 108 km/h.

Converting from km/h to m/s

72 km/h means 72 km in 1 hour.

In 1 hour this would be 72000 m. 72 x 1000

In 1 minute this would be 1200 m. 72000 ÷ 60

In 1 second this would be 20 m. 1200 ÷ 60

So 72 km/h is 20 m/s.

Converting from mph to m/s

1 mile is 1.61 km 1 km = 1000 m

30 mph means 30 miles in 1 hour.

30 miles is 48·3 km, is 48300 m 30 x 1·61 = 48·3 km

In 1 hour this would be 48300 m.

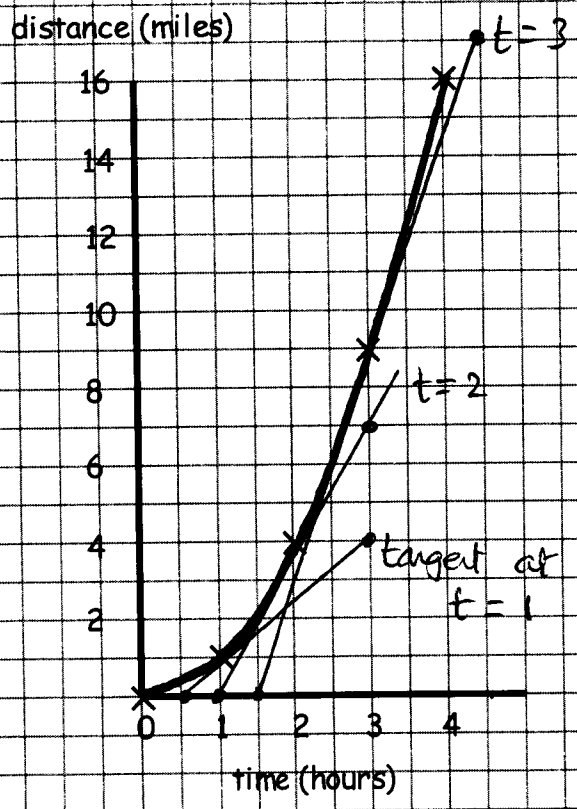
In 1 minute this would be 805 m. 48300 ÷ 60

In 1 second this would be 13·4 m. 805 ÷ 60

So 30 mph is 13·4 m/s.

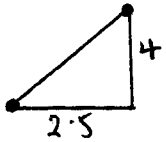
NOTE: As tangents are drawn by hand, answers may differ slightly.

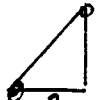
Speed

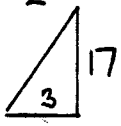


Speed is the gradient of the graph.

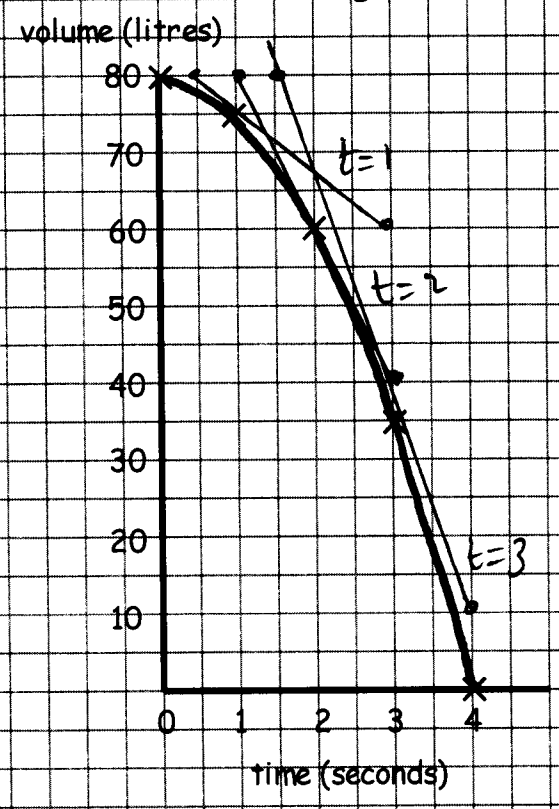
By drawing tangents find the speed at these times. (remember to use the scale)

t = 1  $\frac{4}{2.5} = 1.6$ mph

t = 2  $\frac{7}{2} = 3.5$ mph

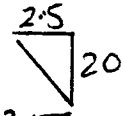
t = 3  $\frac{17}{3} = 5.7$ mph

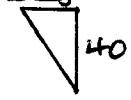
Draining a tank of water

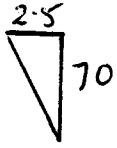


Rate of flow is the gradient of the graph.

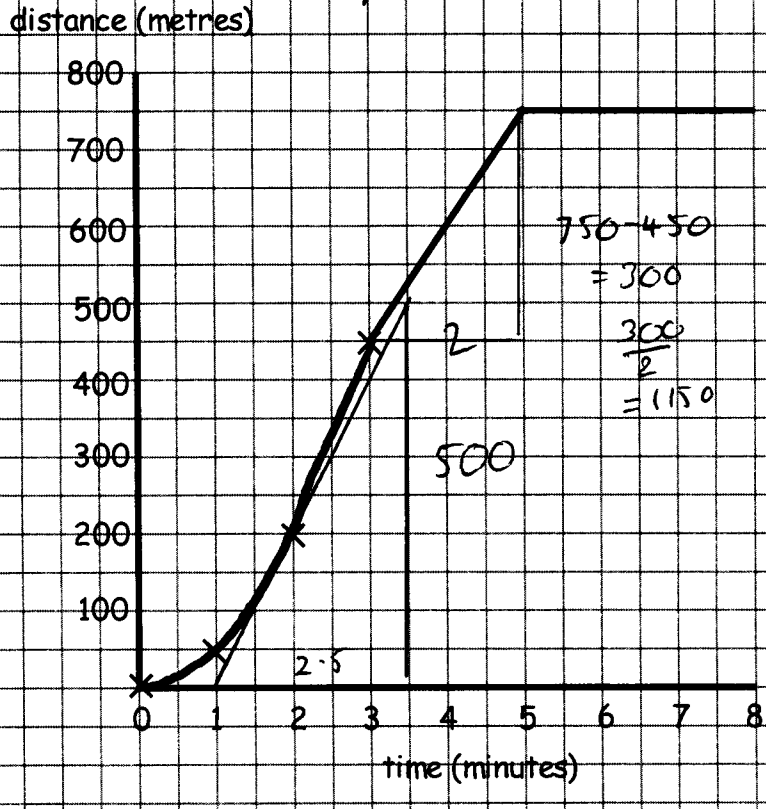
By drawing tangents find the speed at these times. (remember to use the scale)

t = 1  $-\frac{20}{2.5} = -8$ Litres/second

t = 2  $\frac{-40}{2.5} = -\frac{20}{2.5}$ L/s

t = 3  $\frac{-70}{2.5} = -28$ L/s

Cyclist



Speed is the gradient of the graph.

The graph is split into three sections in terms of the speed of the cyclist.

Minutes 0 to 3 the speed is increasing/decreasing/constant/zero

Minutes 3 to 5 the speed is increasing/decreasing/constant/zero

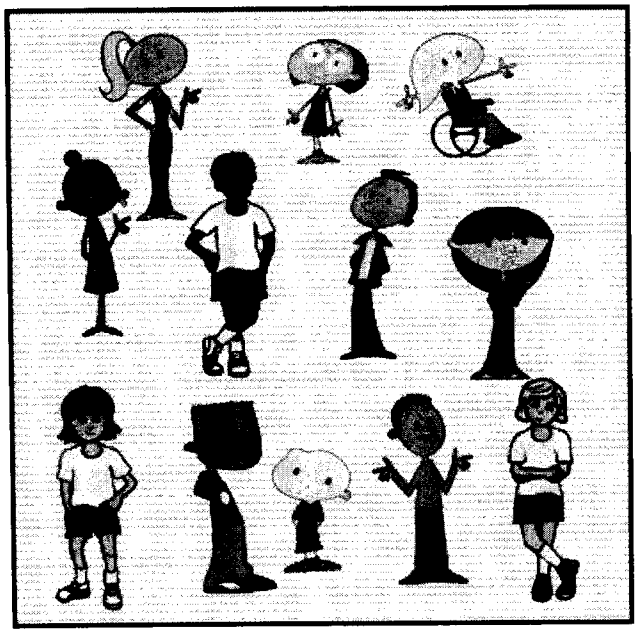
Minutes 5 to 8 the speed is increasing/decreasing/constant/zero

Find the speed at t = 2 and t = 4

t = 2 $\frac{500}{2.5} = 200$ m/min t = 4 150 m/min

Population Density = Population ÷ Area

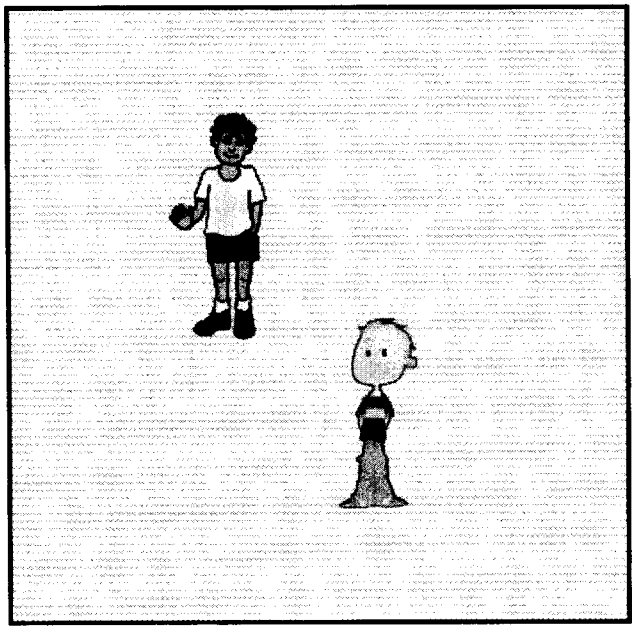
Town A



5 m

5 m

Town B



5 m

Find the population density of each town.
What do the answers show?

Town A

12 people

Area = $5 \times 5 = 25\ m^2$

Population density = $\frac{12}{25}$ =

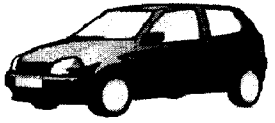
$= 0.48$ people per m^2

Town B = $\frac{2}{25} = 0.08$ people per m^2

Town A more densley populated.

London 200 miles

They all set off at 11.30 am.
What time do they arrive?
What is the difference between the fastest and the slowest?
Round times to the nearest minute.



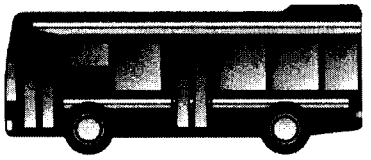
travels at 70 mph

$T = \frac{D}{S} = \frac{200}{70} = 2.857\ldots$

$= 2$ hrs 51 min.

Arrives 11.30 am + 2h 51 m.

$= 2.21$ pm

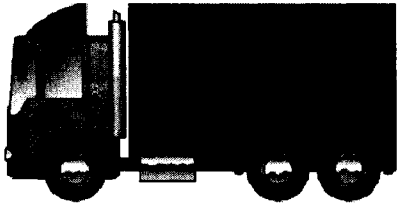


60 mph

$T = \frac{200}{60} = 3.\dot{3}$

$= 3$h 20 min

2.50 pm



50 mph

$T = \frac{200}{50} = 4$ hours

3.30 pm.

difference between fastest & slowest = 1h 9 min.