A Level Physics transition work booklet

Name:___________________

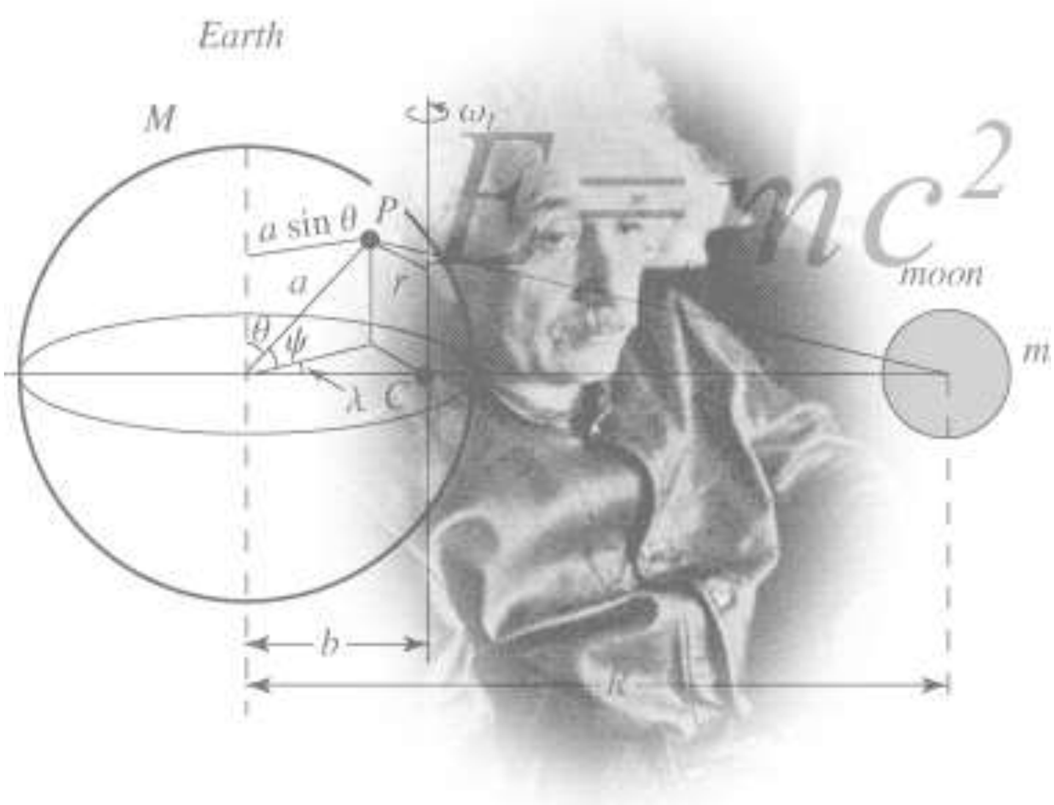


Figure 1 http://scienceworld.wolfram.com/physics/images/main-physics.gif

This pack contains a programme of activities and resources to prepare you to start an A level in Physics in September. It is aimed to be used after you complete your GCSE, throughout the remainder of the Summer term and over the Summer Holidays to ensure you are ready to start your course in September.

This booklet should be handed in to your Physics teacher when you start the A level course in September.

Symbols and Prefixes

Prefix	Symbol	Power of ten
Nano	n	x 10^{-9}
Micro	µ	x 10^{-6}
Milli	m	x 10^{-3}
Centi	c	x 10^{-2}
Kilo	k	x 10^{3}
Mega	M	x 10^{6}
Giga	G	x 10^{9}

At A level you need to remember all symbols, units and prefixes. Below is a list of quantities youmay have already come across and will be using during your A level course

Quantity	Symbol	Unit
Velocity	v	ms^{-1}
Acceleration	a	ms^{-2}
Time	t	S
Force	F	N
Resistance	R	Ω
Potential difference	V	V
Current	I	A
Energy	E or W	J
Pressure	P	Pa
Momentum	p	$kgms^{-1}$
Power	P	W
Density	ρ	kgm^{-3}
Charge	Q	C

Solve the following:

1. How many metres in 2.4 km?
2. How many joules in 8.1 MJ?
3. Convert 326 GW into W.
4. Convert 54600 mm into m.
5. How many grams in 240 kg?
6. Convert 0.18 nm into m.
7. Convert 632 nm into m. Express in standard form.
8. Convert 1002 mV into V. Express in standard form.
9. How many eV in 0.511 MeV? Express in standard form.
10. How many m in 11 km? Express in standard form.

Standard Form

At A level quantity will be written in standard form, and it is expected that your answers will be too.

This means answers should be written as ….x 10^y. E.g. for an answer of 1200kg we would write 1.2 x 10^3kg. For more information visit: www.bbc.co.uk/education/guides/zc2hsbk/revision

1. Write 2530 in standard form.
2. Write 280 in standard form.
3. Write 0.77 in standard form.
4. Write 0.0091 in standard form.
5. Write 1 872 000 in standard form.
6. Write 12.2 in standard form.
7. Write 2.4 x 10^{2} as a normal number.
8. Write 3.505 x 10^{1} as a normal number.
9. Write 8.31 x 10^{6} as a normal number.
10. Write 6.002 x 10^{2} as a normal number.
11. Write 1.5 x 10^{-4} as a normal number.
12. Write 4.3 x 10^{3} as a normal number.

Rearranging formulae

This is something you will have done at GCSE and it is crucial you master it for success at A level. For a recap of GCSE watch the following links:

www.khanacademy.org/math/algebra/one-variable-linear-equations/old-school-equations/v/solving-for-a-variable

www.youtube.com/watch?v=_WWgc3ABSj4

Rearrange the following:

1. E=m x g x h to find h

2. E = ½ m v^2 to find m

3. E = ½ m v^2 to find v

4. v = u + at to find u

5. v = u + at to find a

6. $v^2 = u^2 + 2as$ to find s

7. $v^2 = u^2 + 2as$ to find u

Rearranging formulae – More practice

Rearrange each equation into the subject shown in the middle column.

Equation		Rearrange Equation
$V = IR$	R	
$I = \frac{Q}{t}$	t	
$\rho = \frac{RA}{l}$	A	
$\varepsilon = V + Ir$	r	
$s = \frac{(u+v)}{2}t$	u	

Equation		Rearrange Equation
$hf = \phi + E_K$	f	
$E_P = mgh$	g	
$E = \frac{1}{2} Fe$	F	
$v^2 = u^2 + 2as$	u	
$T = 2\pi\sqrt{\frac{m}{k}}$	m	

Significant figures

At A level you will be expected to use an appropriate number of significant figures in your answers. The number of significant figures you should use is the same as the number of significant figures in the data you are given. You can never be more precise than the data you are given so if that is given to 3 significant your answer should be too. E.g. Distance = 8.24m, time = 1.23s therefore speed = 6.75m/s

The website below summarises the rules and how to round correctly.

http://www.purplemath.com/modules/rounding2.htm

Give the following to 3 significant figures:

1. 3.4527
2. 40.691
3. 0.838991
4. 1.0247
5. 59.972

Calculate the following to a suitable number of significant figures:

6. 63.2/78.1
7. 39+78+120
8. (3.4+3.7+3.2)/3
9. 0.0256 x 0.129
10. 592.3/0.1772

Recording Data

Whilst carrying out a practical activity you need to write all your raw results into a table. Don't wait until the end, discard anomalies and then write it up in neat.

Tables should have column heading and units in this format quantity/unit e.g. length /mm

All results in a column should have the same precision and if you have repeated the experiment you should calculate a mean to the same precision as the data.

Below are link to practical handbooks so you can familiarise yourself with expectations.

http://filestore.aqa.org.uk/resources/physics/AQA-7407-7408-PHBK.PDF

http://www.ocr.org.uk/Images/295483-practical-skills-handbook.pdf

http://www.ocr.org.uk/Images/295483-practical-skills-handbook.pdf

Below is a table of results from an experiment where a ball was rolled down a ramp of different lengths. A ruler and stop clock were used.

1) Identify the errors the student has made.

	Time			
Length/cm	**Trial 1**	**Trial 2**	**Trial 3**	**Mean**
10	1.45	1.48	1.46	1.463
22	2.78	2.72	2.74	2.747
30	4.05	4.01	4.03	4.03
41	5.46	5.47	5.46	5.463
51	7.02	6.96	6.98	6.98
65	8.24	9.68	8.24	8.72
70	9.01	9.02	9.0	9.01

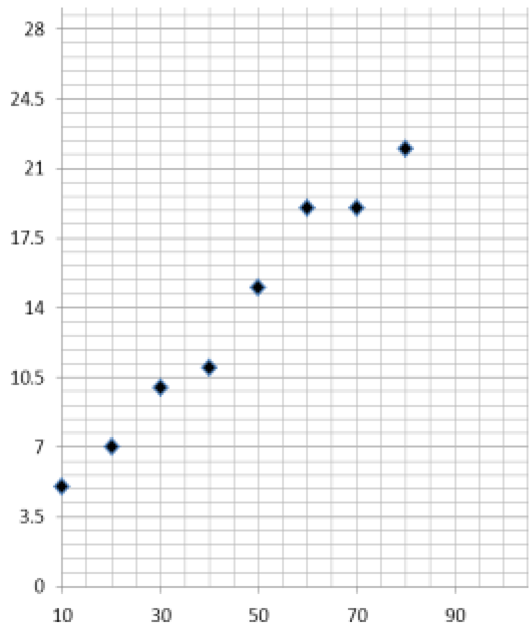
Graphs

After a practical activity the next step is to draw a graph that will be useful to you. Drawing a graph is a skill you should be familiar with already but you need to be extremely vigilant at A level. Before you draw your graph to need to identify a suitable scale to draw taking the following into consideration:

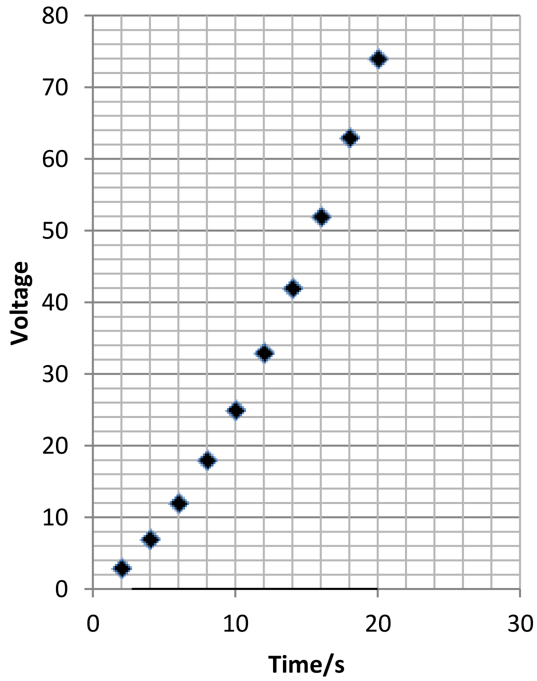
- the maximum and minimum values of each variable
- whether 0.0 should be included as a data point; graphs don't need to show the origin, a false origin can be used if your data doesn't start near zero.
- the plots should cover at least half of the grid supplied for the graph.
- the axes should use a sensible scale e.g. multiples of 1,2, 5 etc)

Identify how the following graphs could be improved

Graph 1



Graph 2



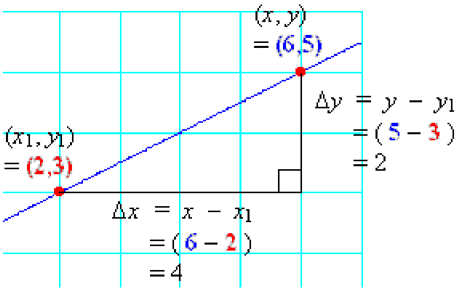
Gradients – straight line graphs

Gradients are a useful tool that show how fast or slow quantities change – eg speed tells us how fast distance is changing, or how quickly energy is being lost over time.

To calculate the gradient, pick any two points on the line as far away as possible and draw a large triangle between them.
The gradient is given by:

$$gradient = \frac{difference\ in\ y\ values}{difference\ in\ x\ values}$$

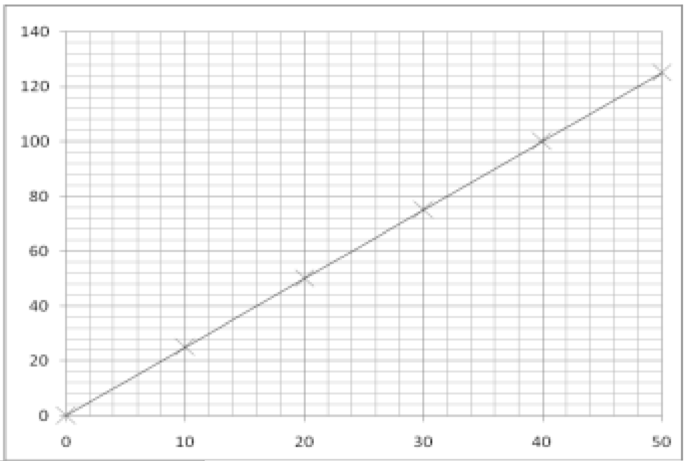
But make sure that you subtract the values in the same order! Remember – if the line slopes up, the gradient should be positive; if the line slopes down, then the gradient should be negative.

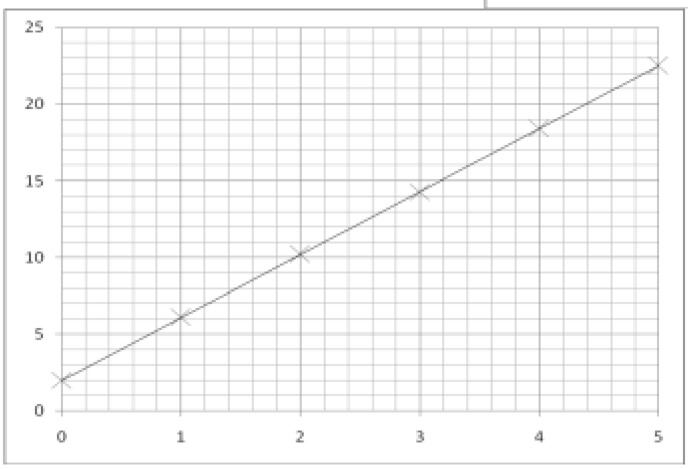


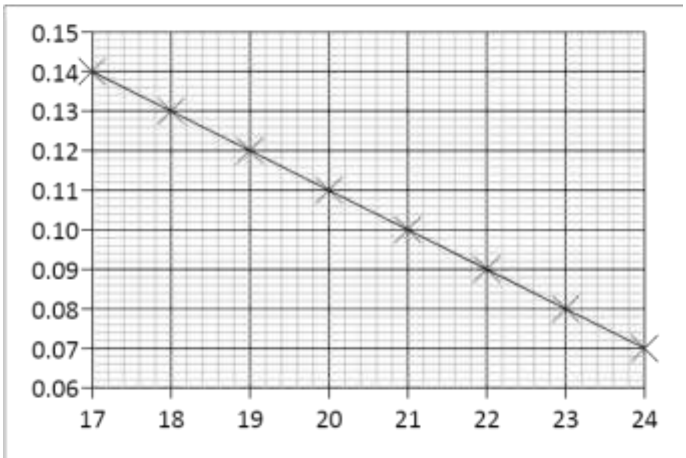
Gradient $= \frac{2}{4}$

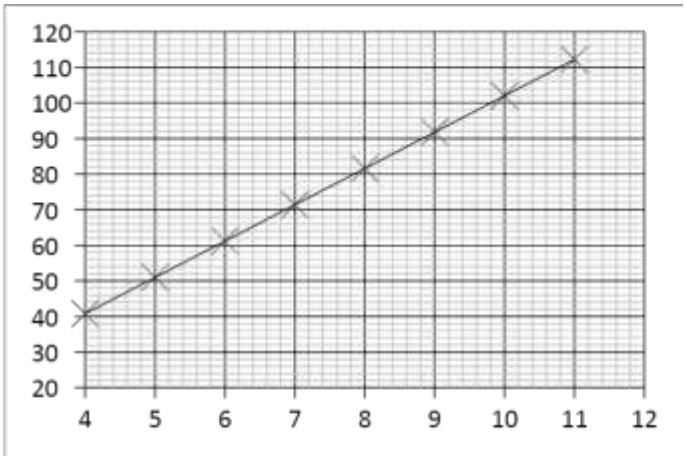
= 0.5

Calculate the gradients of the graphs below






0.15
0.14
0.13
0.12
0.11
0.10
0.09
0.08
0.07
0.06
17
18
19
20
21
22
23
24


120
110
100
90
80
70
60
50
40
30
20
4
5
6
7
8
9
10
11
12

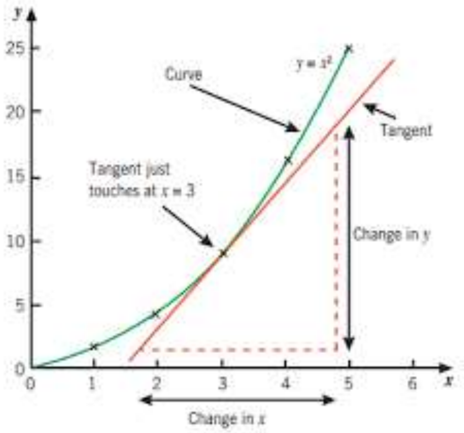
Gradients – curved line graphs

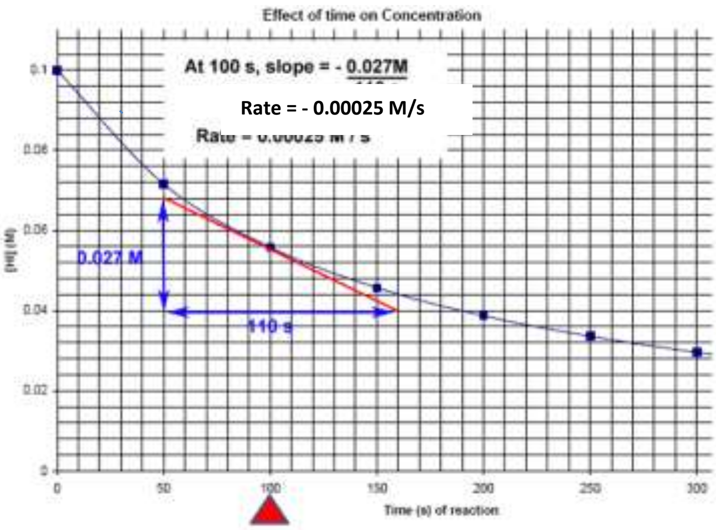
Most graphs in real life are not straight lines, but curves; however it is still useful to know how the quantity changes over time, hence we still need to calculate gradients.

If we want to know the gradient at a particular point, firstly we need to draw a *tangent* to the curve at that point. A tangent is a straight line that follows the gradient at the required point. Once we have drawn the straight line tangent, its gradient can be calculated in exactly the same way as the previous page showed.

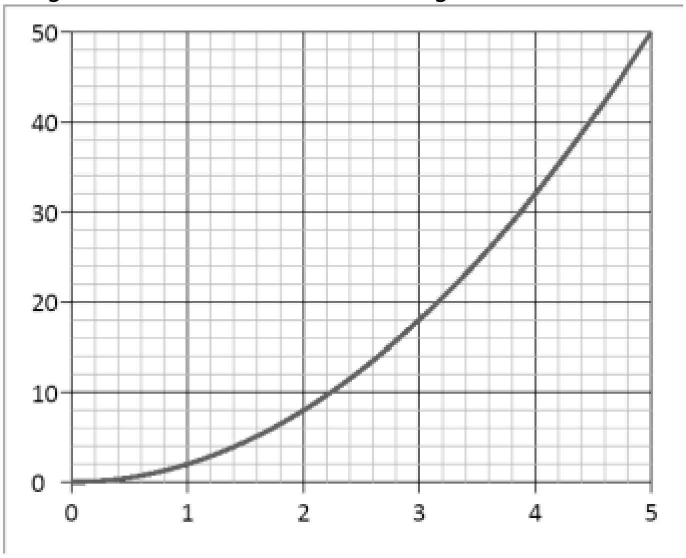
Tip – make sure your tangents and gradient triangles are as big as possible to be as accurate as you can!

Examples of drawing tangents and calculating the gradient of a tangent:

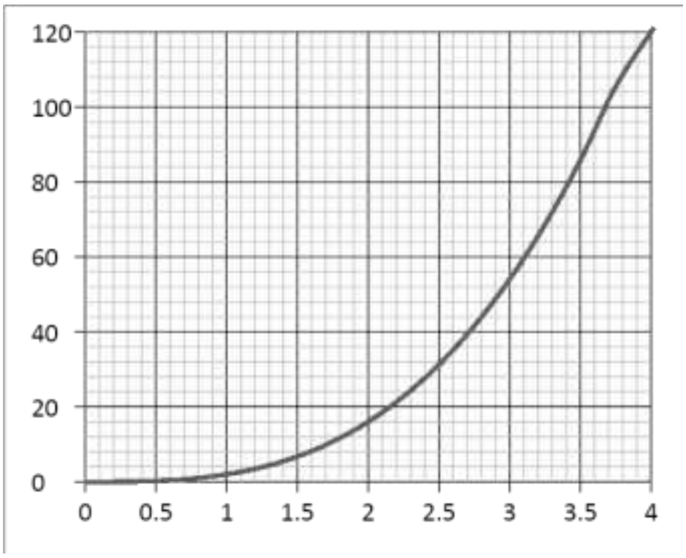




Draw a tangent to the line and calculate its gradient at x=2.0 and x=4.0:



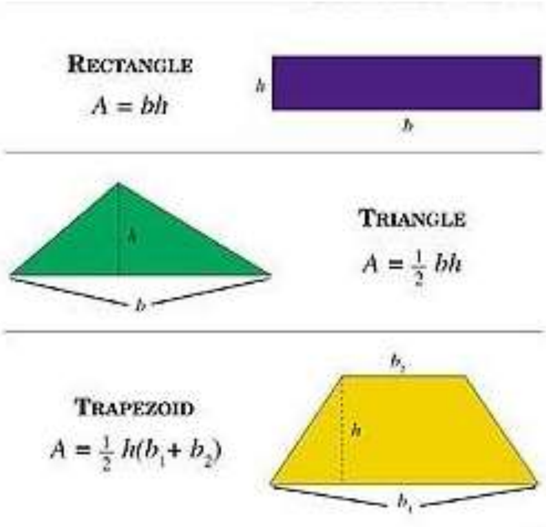
Draw a tangent to the line and calculate its gradient at x=1.5 and x=3.5:



Calculating Areas – Straight line Graphs

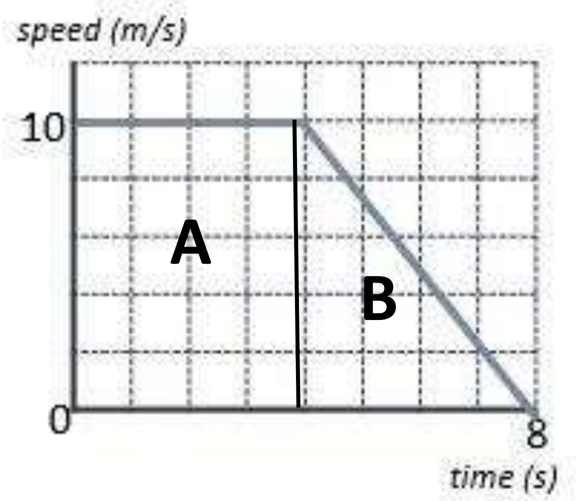
Often other quantities can be found by multiplying the two quantities represented on a graph together (for example, multiplying velocity and time gives distance travelled). The exact quantity can be found by calculating the area under the graph.

If the graph is made of straight lines, the total area can be found by splitting the graph into segments of rectangles and triangles (or into a trapezium) and adding those areas together.



Important – the heights that you use should always be the perpendicular height from the base.

Calculate the distance travelled by determining the area under the graph:



Area A = 10 x 4 = 40 m

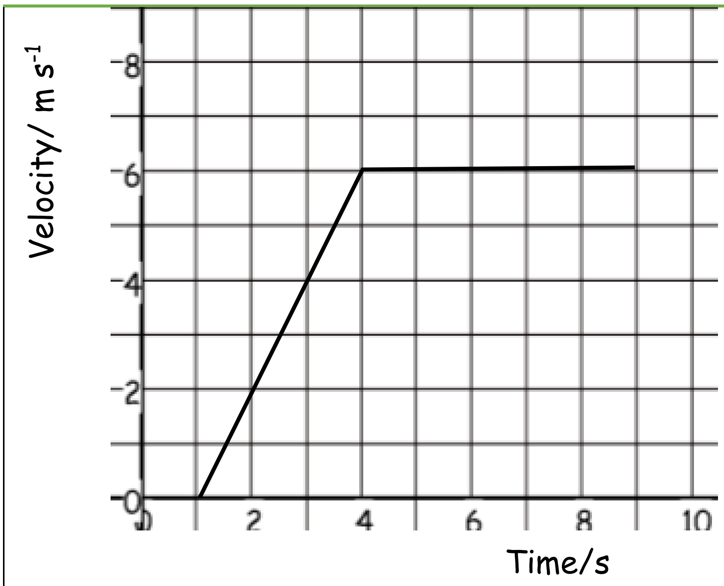
Area B = ½ x 4 x 10 = 20 m

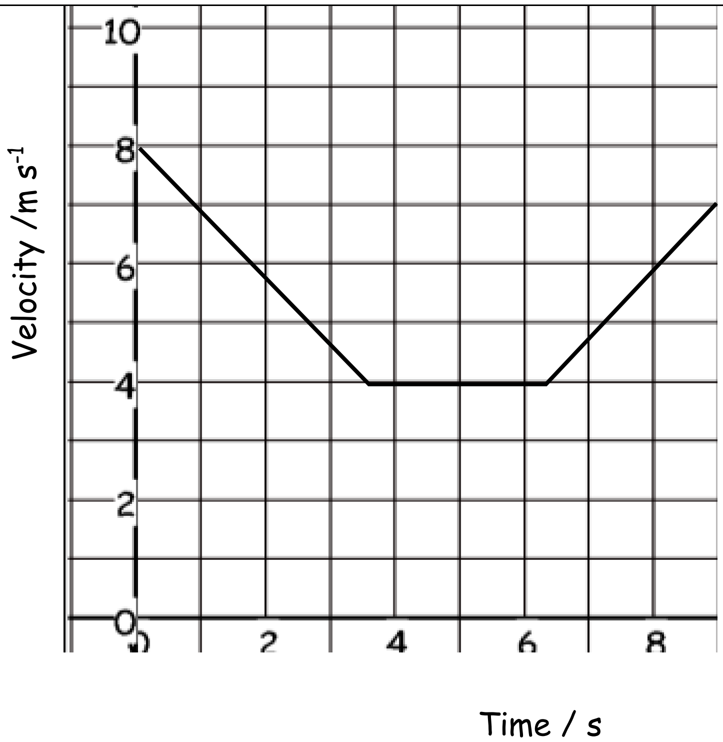
Total Area = A + B = 40 + 20 = **60 m**

Or

Area of trapezium = ½ (4 + 8) x 10 = **60 m**

Calculate the area of the below graphs and the correct unit for that area.



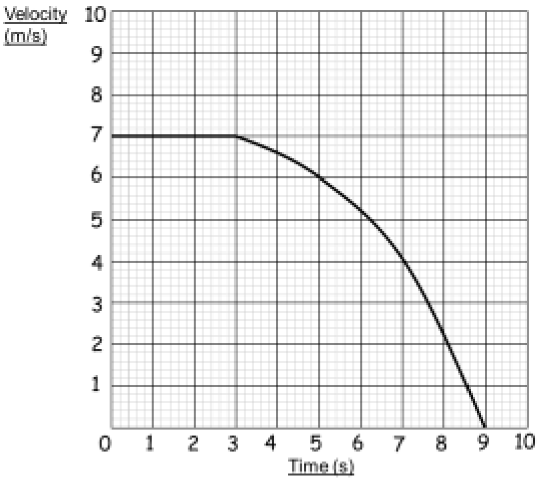


Calculating Areas – Curved line Graphs

When graphs have curved lines we use a simple process of counting squares and estimating.

1) Calculate the area of 1 small (but the not smallest!) square on the graph
2) Count the number of whole squares under the line
3) Estimate the whole number of squares that have been segmented by the line.
4) Multiply the total number of squares by the area of one square to estimate the area.

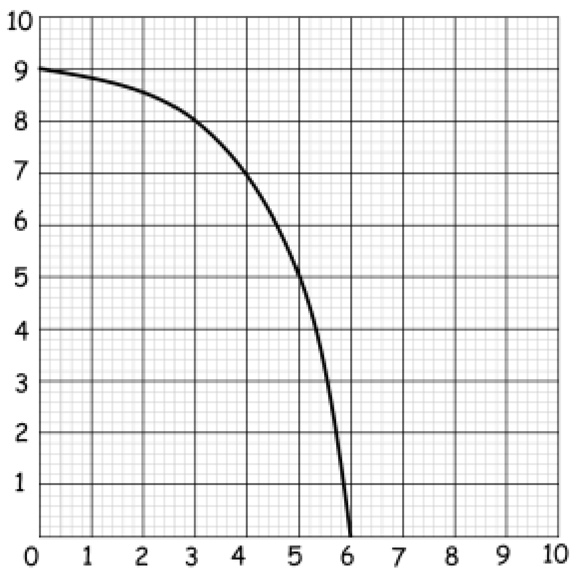
Eg. Work out the distance travelled by calculating the area under the graph.



1) 1 square = 1 m s^{-1} x 1 s = 1 m
2) Whole Squares = 44
3) Segmented squares = 4
4) 48 squares x 1 m = **<u>48 m</u>**

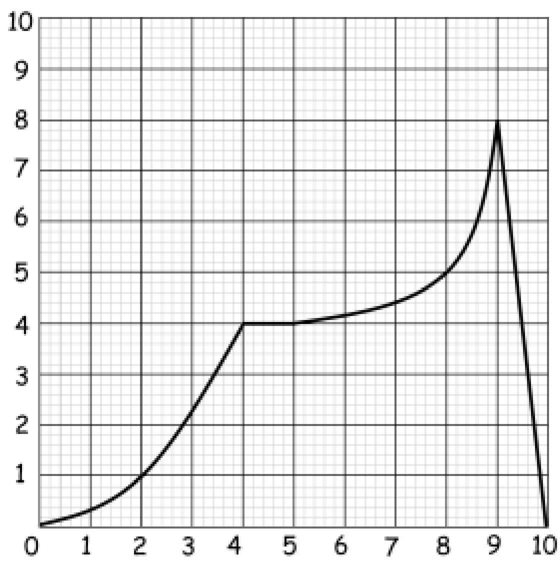
Calculate the area under the following graphs.

velocity/m s^{-1}



time /s

velocity/ km s^{-1}



time /min

Converting length, area and volume

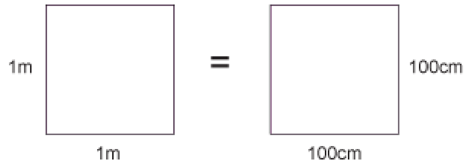
Whenever substituting quantities into an equation, you must always do this in SI units – such as time in seconds, mass in kilograms, distance in metres…
If the question doesn't give you the quantity in the correct units, you should always convert the units **first**, rather than at the end. Sometimes the question may give you an area in mm^2 or a volume in cm^3, and you will need to convert these into m^2 and m^3 respectively before using an equation.
To do this, you first need to know your length conversions:
1m = 100 cm = 1000 mm (1 cm = 10 mm)

m → cm	x 100	cm → m	÷ 100
m → mm	x 1000	m → mm	÷ 1000

Always think –
"Should my number be getting larger or smaller?" This will make it easier to decide whether to multiply or divide.

Converting Areas

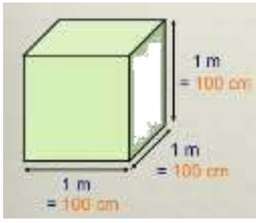
A 1m x 1m square is equivalent to a 100 cm x 100 cm square.
Therefore, $1\ m^2 = 10\ 000\ cm^2$
Similarly, this is equivalent to a 1000 mm x 1000 mm square;
So, $1\ m^2 = 1\ 000\ 000\ mm^2$



m^2 → cm^2	x 10 000	cm^2 → m^2	÷ 10 000
m^2 → mm^2	x 1 000 000	m^2 → mm^2	÷ 1 000 000

Converting Volumes

A 1m x 1m x 1m cube is equivalent to a 100 cm x 100 cm x 100 cm cube.
Therefore, $1\ m^3 = 1\ 000\ 000\ cm^3$
Similarly, this is equivalent to a 1000 mm x 1000 mm x 1000 mm cube;
So, $1\ m^3 = 10^9\ mm^3$



m^3 → cm^3	x 1 000 000	cm^3 → m^3	÷ 1 000 000
m^3 → mm^3	x 10^9	m^3 → mm^3	÷ 10^9

$6\ m^2$	=		cm^2
$0.002\ m^2$	=		mm^2
$24\ 000\ cm^2$	=		m^2
$46\ 000\ 000\ mm^3$	=		m^3
$0.56\ m^3$	=		cm^3

$750\ mm^2$	=		m^2
$5 \times 10^{-4}\ cm^3$	=		m^3
$8.3 \times 10^{-6}\ m^3$	=		mm^3
$3.5 \times 10^2\ m^2$	=		cm^2
$152000\ mm^2$	=		m^2

Now use the technique shown on the previous page to work out the following conversions:

31×10^8 m^2	=	km^2
59 cm^2	=	mm^2
24 dm^3	=	cm^3
4 500 mm^2	=	cm^2
5×10^{-4} km^3	=	m^3

(*Hint: There are 10 cm in 1 dm)*

A 2.0 m long solid copper cylinder has a cross-sectional area of 3.0×10^2 mm^2. What is its volume in cm^3?

Volume = _____ cm^3

For the following, think about whether you should be writing a smaller or a larger number down to help decide whether you multiply or divide.

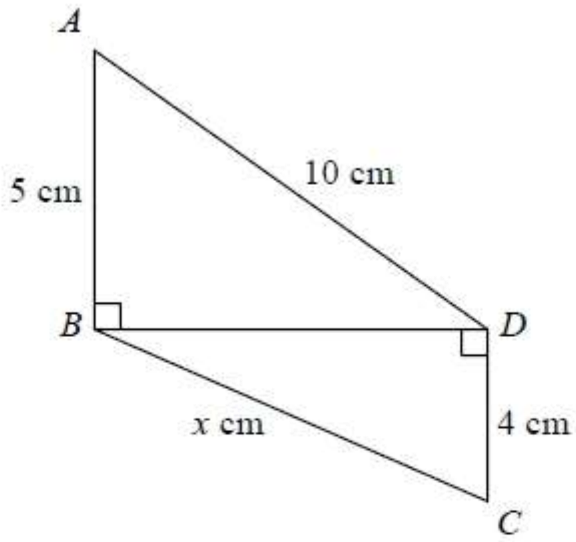
Eg. *To convert 5 m ms^{-1} into m s^{-1} – you will travel more metres in 1 second than in 1 millisecond, therefore you should multiply by 1000 to get 5000 m s^{-1}.*

5 N cm^{-2}	=	N m^{-2}
1150 kg m^{-3}	=	g cm^{-3}
3.0 m s^{-1}	=	km h^{-1}
65 kN cm^{-2}	=	N mm^{-2}
7.86 g cm^{-3}	=	kg m^{-3}

Pythagoras and Trigonometry

Q1.

Triangles *ABD* and *BCD* are right-angled triangles.



Work out the value of *x*. Give your answer correct to 2 decimal places.

....

(Total for question = 4 marks)

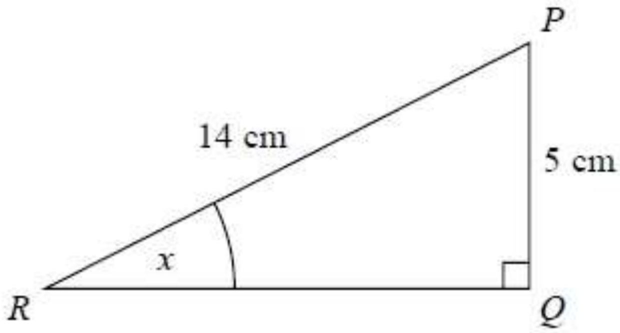
Q2.

Triangle *ABC* has perimeter 20 cm. *AB* = 7 cm. *BC* = 4 cm.
By calculation, deduce whether triangle *ABC* is a right–angled triangle.

(Total for question = 4 marks)

Q3.

PQR is a right-angled triangle.



Work out the size of the angle marked *x*.
Give your answer correct to 1 decimal place.

....°

(Total for question = 2 marks)

Q4.

Triangle *ABC* has a right angle at *C*.

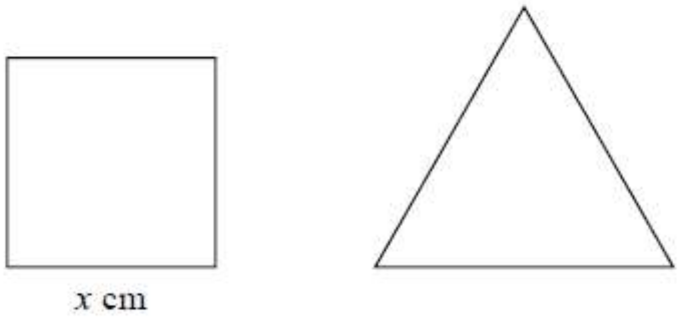
Angle *BAC* = 48°.
AB = 9.3 cm.

Calculate the length of *BC*.

(Total for question = 3 marks)

Q5.

Here are a square and an equilateral triangle.

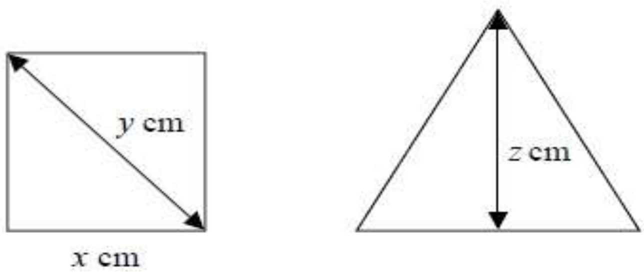


The length of a side of the square is x cm. The length of a side of the equilateral triangle is 2 cm more than the length of a side of the square. The perimeter of the square is equal to the perimeter of the equilateral triangle.

(a) Work out the perimeter of the square.

(3)

Here are the same square and the same equilateral triangle.



The length of the diagonal of this square is y cm. The height of this equilateral triangle is z cm.

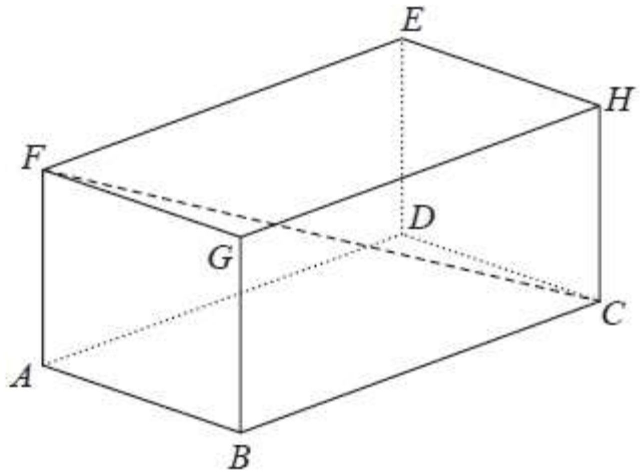
(b) Which has the greater value, y or z?

(4)

(Total for question = 7 marks)

Q6.

The diagram shows a cuboid *ABCDEFGH*.



AB = 7 cm, *AF* = 5 cm and *FC* = 15 cm.

Calculate the volume of the cuboid.
Give your answer correct to 3 significant figures.

.... cm^3

(Total for question is 4 marks)

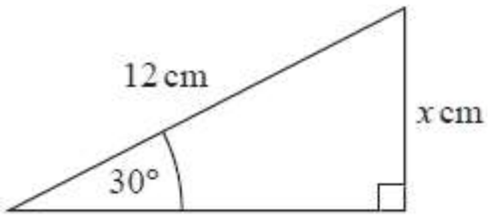
Q7.

(a) Write down the exact value of cos30°

....

(1)

(b)



Given that sin30° = 0.5,
work out the value of *x*.

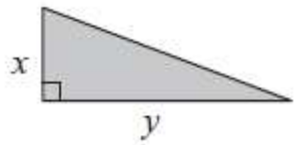
....

(2)

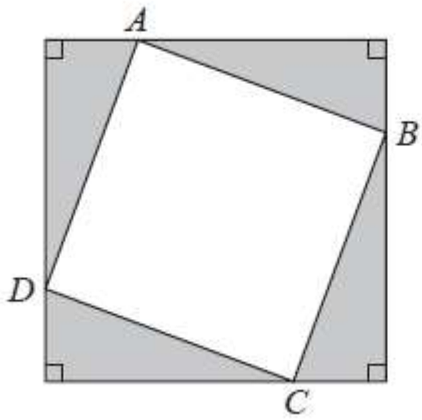
(Total for question is 3 marks)

Q8.

Here is a right–angled triangle.



Four of these triangles are joined to enclose the square *ABCD* as shown below.



Show that the area of the square *ABCD* is $x^2 + y^2$

(Total for question = 3 marks)