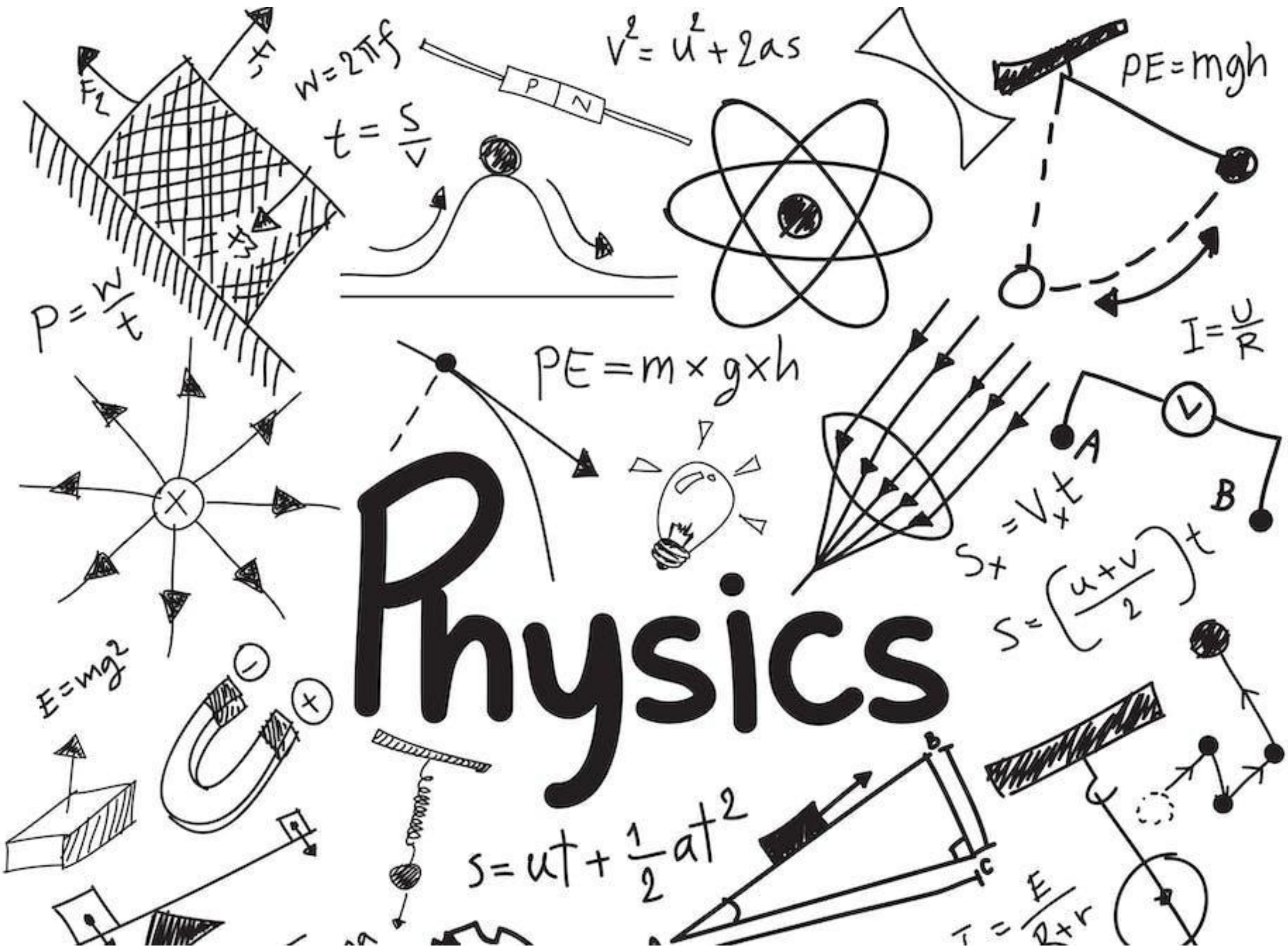


Physics Transition Task

Sponne School

A Music & Science Academy

Name: ______________________________

Transition Booklet from GCSE Physics to A level Physics

Introduction

This booklet will assist you in getting better prepared to study A level Physics at Sponne School. You must work through the booklet to identify the topics/areas for improvement. Write a brief comment on your progress in the comments box as you complete each topic. This help will inform you with what you must revise prior to beginning the Physics course. Bring your copy of the completed booklet to your first Physics lesson. A mark scheme will be given once your teacher has seen your completed booklet. You will then self assess your work. Good luck!

Physics	# Contents
Skills	

Physics	# 1. Prefixes and units
Skills	

In Physics we have to deal with quantities from the very large to the very small. A prefix is something that goes in front of a unit and acts as a multiplier. This sheet will give you practice at converting figures between prefixes.

Symbol	Name	What it means		How to convert	
P	peta	10^{15}	1000000000000000		↓ x1000
T	tera	10^{12}	1000000000000	↑ ÷ 1000	↓ x1000
G	giga	10^{9}	1000000000	↑ ÷ 1000	↓ x1000
M	mega	10^{6}	1000000	↑ ÷ 1000	↓ x1000
k	kilo	10^{3}	1000	↑ ÷ 1000	↓ x1000
			1	↑ ÷ 1000	↓ x1000
m	milli	10^{-3}	0.001	↑ ÷ 1000	↓ x1000
µ	micro	10^{-6}	0.000001	↑ ÷ 1000	↓ x1000
n	nano	10^{-9}	0.000000001	↑ ÷ 1000	↓ x1000
p	pico	10^{-12}	0.000000000001	↑ ÷ 1000	↓ x1000
f	femto	10^{-15}	0.000000000000001	↑ ÷ 1000	

Convert the figures into the units required.

6 km	=	6×10^{3}	m
54 MN	=		N
0.086 µV	=		V
753 GPa	=		Pa
23.87 mm/s	=		m/s

Convert these figures to suitable prefixed units.

640	GV	=	640×10^{9}	V
		=	0.5×10^{-6}	A
		=	93.09×10^{9}	m
	kN	=	32×10^{5}	N
	nm	=	0.024×10^{-7}	m

Convert the figures into the prefixes required.

s	ms	µs	ns	ps
0.00045	0.45	450	450 000 or 450 x10^3	450 x 10^6
0.000000789				
0.000 000 000 64				

mm	m	km	µm	Mm
1287360				
295				

The equation for wave speed is:

$$wave\ speed = frequency\ \times wavelength$$

$$(m/s) \qquad (Hz) \qquad (m)$$

Whenever this equation is used, the quantities must be in the units stated above. At GCSE we accepted m/s but at AS/A Level we use the index notation. m/s becomes m s^{-1} and m/s^2 becomes m s^{-2}.

Calculate the following quantities using the above equation, giving answers in the required units.

1) Calculate the speed in m s^{-1} of a wave with a frequency of 75 THz and a wavelength 4.0 µm.

$$v = f\lambda = 75 \times 10^{12} \times 4.0 \times 10^{-6} = 3.0 \times 10^{8}\ \text{m s}^{-1}\ (300\ \text{Mm s}^{-1})$$

2) Calculate the speed of a wave in m s^{-1} which has a wavelength of 5.6 mm and frequency of 0.25 MHz.

3) Calculate the wavelength in metres of a wave travelling at 0.33 km s^{-1} with a frequency of 3.0 GHz.

4) Calculate the frequency in Hz of a wave travelling at 300 x 10^3 km s^{-1} with a wavelength of 0.050 mm.

5) Calculate the frequency in GHz of a wave travelling at 300 Mm s^{-1} that has a wavelength of 6.0 cm.

Physics	# 2. Significant Figures
Skills	

1. **All non-zero numbers ARE significant.** The number 33.2 has THREE significant figures because all of the digits present are non-zero.

2. **Zeros between two non-zero digits ARE significant.** 2051 has FOUR significant figures. The zero is between 2 and 5

3. **Leading zeros are NOT significant.** They're nothing more than "place holders." The number 0.54 has only TWO significant figures. 0.0032 also has TWO significant figures. All of the zeros are leading.

4. **Trailing zeros when a decimal is shown ARE significant.** There are FOUR significant figures in 92.00 and there are FOUR significant figures in 230.0.

5. **Trailing zeros in a whole number with no decimal shown are NOT significant.** Writing just "540" indicates that the zero is NOT significant, and there are only TWO significant figures in this value.

(THIS CAN CAUSE PROBLEMS!!! WE SHOULD USE POINT 8 FOR CLARITY, BUT OFTEN DON'T - 2/3 significant figures is accepted in IAL final answers - eg 500/260 = 1.9 to 2 sf. Better 5.0×10^2 / 2.6×10^2 = 1.9)

8. **For a number in scientific notation: N x 10^x, all digits comprising N ARE significant by the first 5 rules; "10" and "x" are NOT significant.** 5.02×10^4 has THREE significant figures.

For each value state how many significant figures it is stated to.

Value	Sig Figs	Value	Sig Figs	Value	Sig Figs	Value	Sig Figs
2		1066		1800.45		0.070	
2.0		82.42		2.483×10^4		69324.8	
500		750000		0.0006		0.0063	
0.136		310		5906.4291		9.81×10^4	
0.0300		3.10×10^4		200000		40000.00	
54.1		3.1×10^2		12.711		0.0004×10^4	

<u>When adding or subtracting numbers</u>

Round the final answer to the **least precise** number of decimal places in the original values.

Eg. 0.88 + 10.2 – 5.776 (= 5.304) = **<u>5.3</u>** (to 1d.p. , since 10.2 only contains 1 decimal place)

(Khan Academy- Addition/ subtraction with sig fig excellent video- make sure you watch .)

Add the values below then write the answer to the appropriate number of significant figures

Value 1	Value 2	Value 3	Total Value	Total to correct sig figs
51.4	1.67	3.23		

7146	–32.54	12.8		
20.8	18.72	0.851		
1.4693	10.18	–1.062		
9.07	0.56	3.14		
739762	26017	2.058		
8.15	0.002	106		
152	0.8	0.55		

<u>When multiplying or dividing numbers</u>

Round the final answer to the **least** number of significant figures found in the initial values.

E.g. 4.02 x 3.1 |0.114 = (109.315…) = **<u>110</u>** (to 2s.f. as 3.1 only has 2 significant figures.

Multiply the values below then write the answer to the appropriate number of significant figures

Value 1	Value 2	Total Value	Total to correct sig figs
0.91	1.23		
8.764	7.63		
2.6	31.7		
937	40.01		
0.722	634.23		

Divide value 1 by value 2 then write the answer to the appropriate number of significant figures

Value 1	Value 2	Total Value	Total to correct sig figs
5.3	748		
3781	6.50		
91 x 10^2	180		
5.56	22 x 10^{-3}		
3.142	8.314		

<u>When calculating a mean</u>

1) Remove any **obvious** anomalies (circle these in the table)

2) Calculate the mean with the remaining values, and record this to the **least** number of decimal places in the included values

E.g. Average 8.0, 10.00 and 145.60:

1) Remove 145.60

2) The average of 8.0 and 10.00 is **9.0** (to 1 d.p.)

Calculate the mean of the values below then write the answer to the appropriate number of significant figures

Value 1	**Value 2**	**Value 3**	**Mean Value**	**Mean to correct sig figs**
1	1	2		
435	299	437		
5.00	6.0	29.50		
5.038	4.925	4.900		
720.00	728.0	725		
0.00040	0.00039	0.000380		
31	30.314	29.7		

Physics Skills

3. 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)

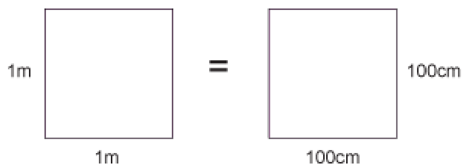
m → cm	x 100	cm → m	÷ 100
m → mm	x 1000	m → mm	÷ 1000

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, $1\ m^2 = 10\ 000\ cm^2$

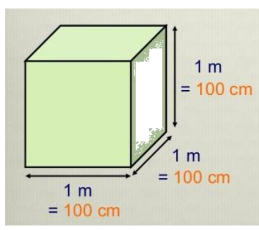
Similarly, this is equivalent to a 1000 mm x 1000 mm square;

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:

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

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

A 2.0 m long solid copper cylinder has a cross-sectional area of $3.0 \times 10^2\ mm^2$. 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}

Physics	# 4. Rearranging Equations
Skills	

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	

Physics	5. Constructing tables
Skills	

The **left hand column** is for your **independent variable**.

The **right hand column** is for your **dependent variable**. You may split this up into further columns if repeats are carried out, and make sure you include an average column. Each sub column must come under the main heading (including the average column).

Place results in the table in order of independent variable, usually starting with the smallest value first.

Ensure each column contains a heading with units in brackets. No units should be placed in the table.

All measured values in one column should be to the same decimal place – don't forget to add zeros if necessary!

Any averages should be given to the same number of decimal places as the measured values. Remember to remove any anomalies by circling the results and do not include them in calculating your average.

Any calculated values should be given to a suitable number of significant figures/ precision.

At AS/A Level we don't use brackets to separate the quantity heading from the units but use a / .

Example: **mass (kg)** should be written as **mass / kg.**

speed of car (m/s) should be written as **speed of car / m s^{-1}**

Independent Variable Heading	Dependent Variable Heading /unit

/unit	1	2	3	Average

A student forgot his exercise book when doing a practical on electrical resistance for a resistor. Below are his readings in the practical. He measured the current in the circuit three times for five different voltages. He has made many errors.

V : 0.11A, 0.1A, 0.12A
2.0V : 0.21A, 0.18A, 0.24

5V : 0.5, 5.1, 0.48   4.0V : 0.35A, 0.40A, 0.45

3.0V: 0.33A, 0.6
0.30

Construct a suitable table for his results.

6. Drawing Lines of Best Fit

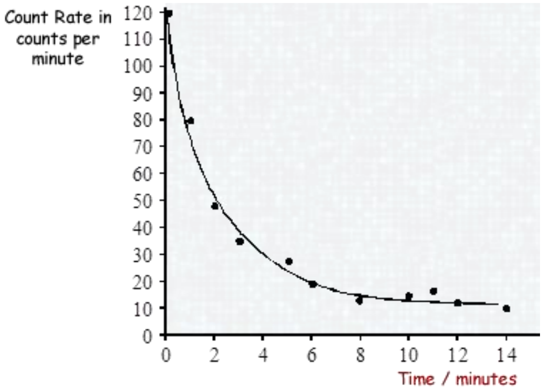
Physics Skills

When drawing lines of best fit, draw a *smooth* straight or curved line that passes through the majority of the points. If you can, try to have an even number of points above and below the line if it can't go through all points.

When describing the trend, use the phrase….

"As 'X' increases, 'Y' *increases/decreases* in a *linear/non-linear* fashion."

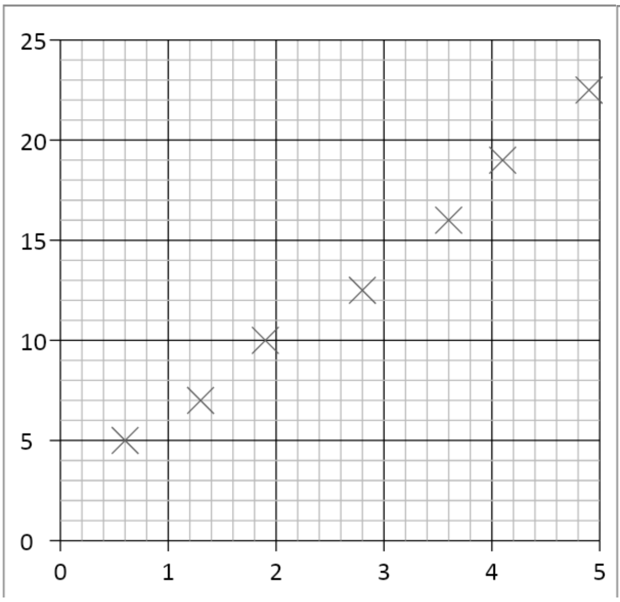
Substitute the quantities into X and Y, and choose either of the two options to describe the graph.

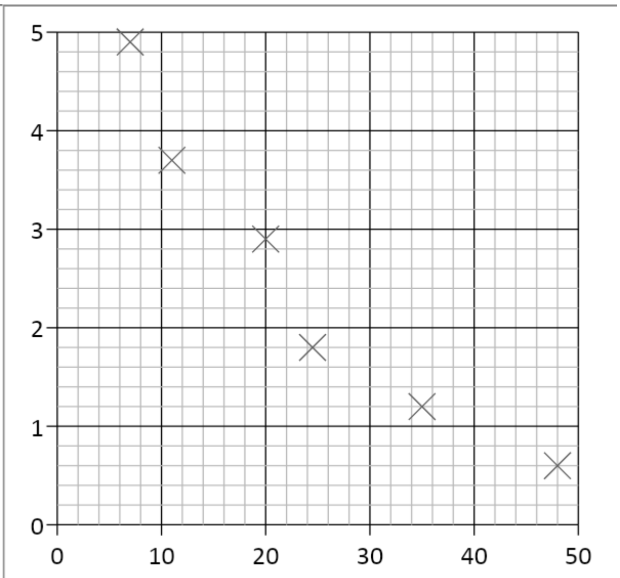


Eg.

As time increases, the count rate decreases in a non-linear fashion.

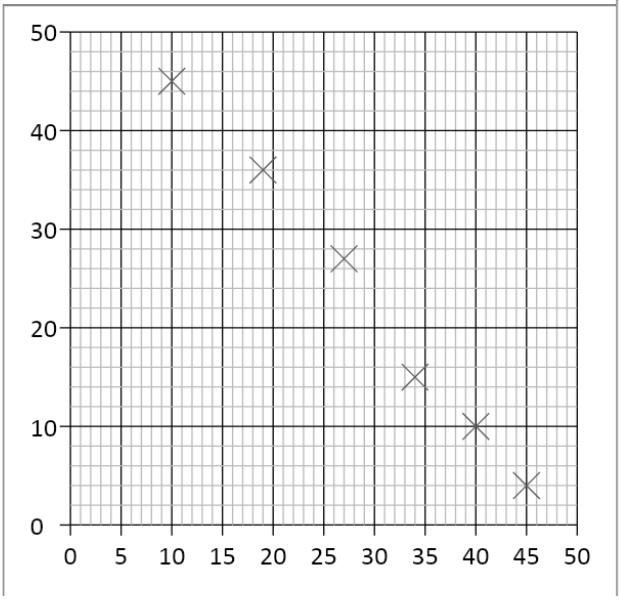
Draw a line of best fit for each of the graphs and describe the trend shown by each (call the quantities X and Y).

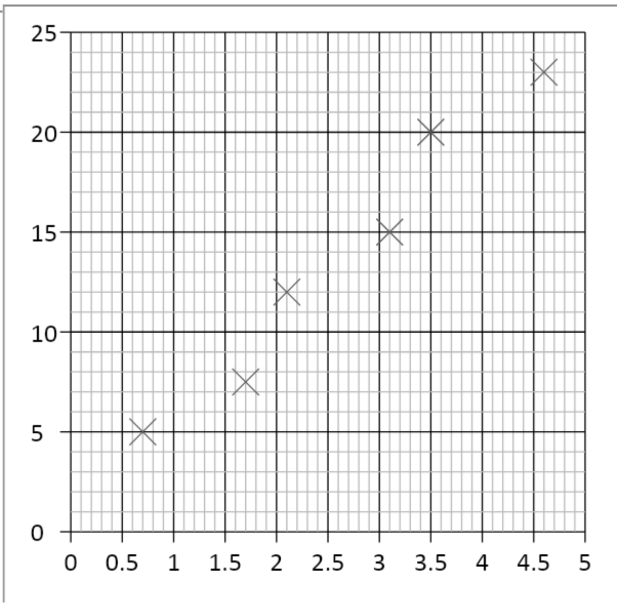




1.

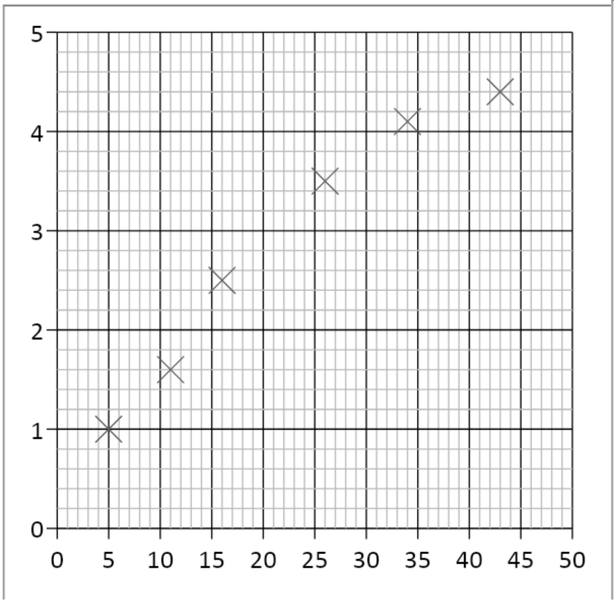
2.

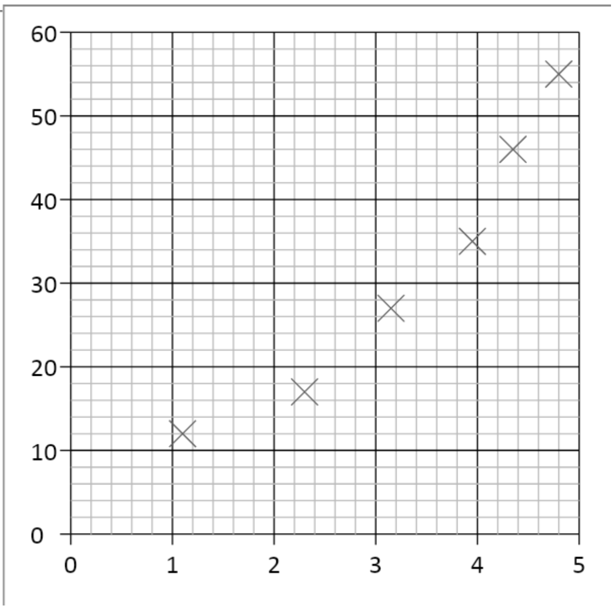




3.

4.





5.

6.

Physics	

Skills

7. Calculating Gradients – Straight Lines

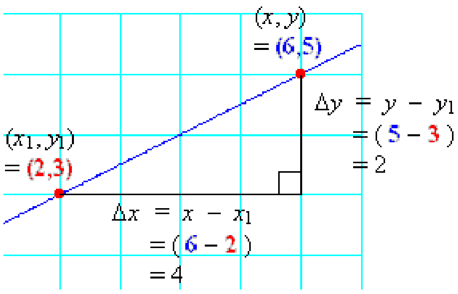
Gradients are a useful tool that show how fast or slow quantities change – eg speed tells us how fast distance is changing, or how quickly energy is being lost over time.

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:

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

But make sure the 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.

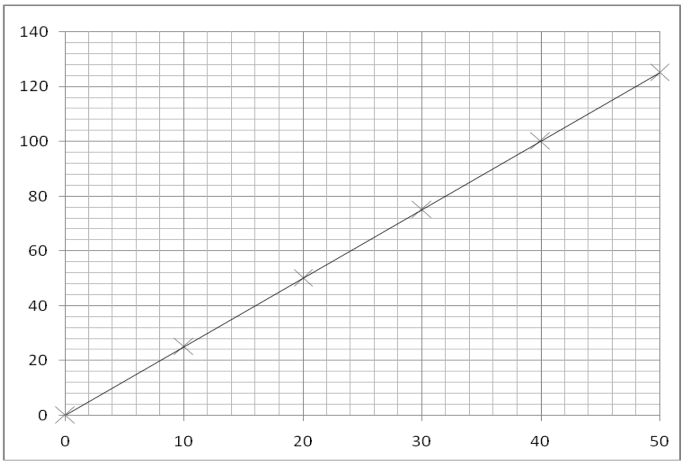


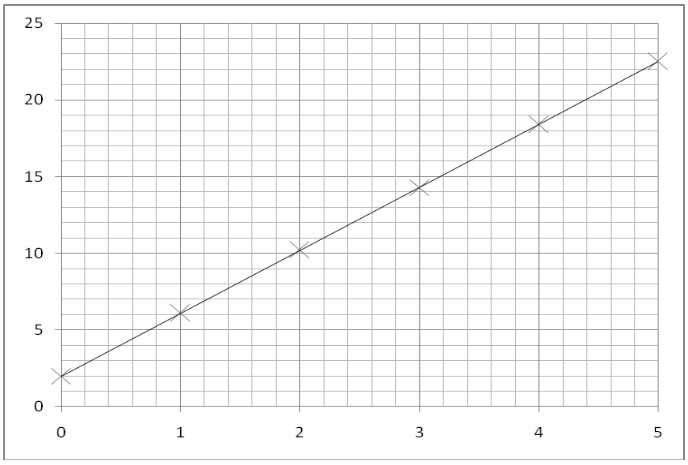
$$Gradient = \frac{□□□□□□□□□□□\ □□\ □}{□□□□□□□□□□□\ □□\ □}$$

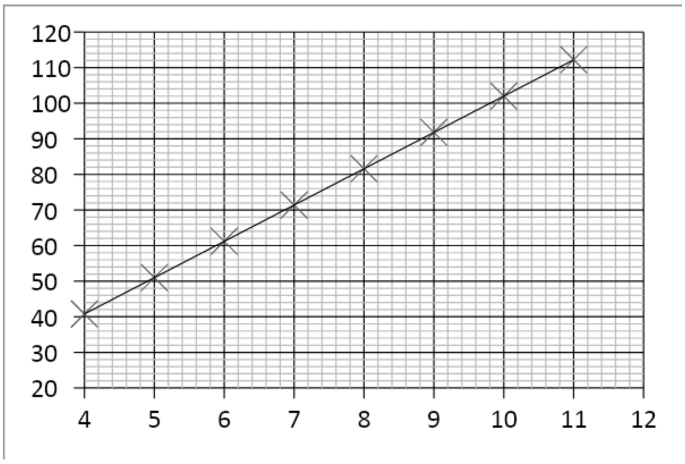
$$= \frac{2}{4}$$

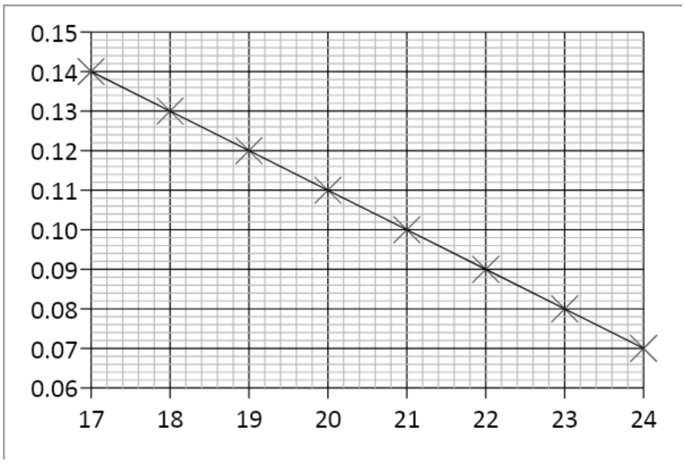
$$\underline{= \mathbf{0.5}}$$

Calculate the gradients of the graphs below




0
5
10
15
20
25
0
1
2
3
4
5


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


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

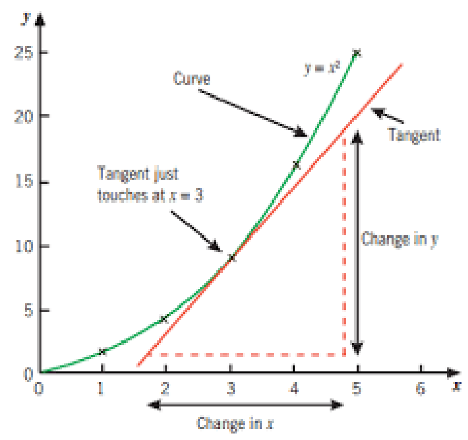
Physics	8. Calculating Gradients – Curved Lines
Skills	

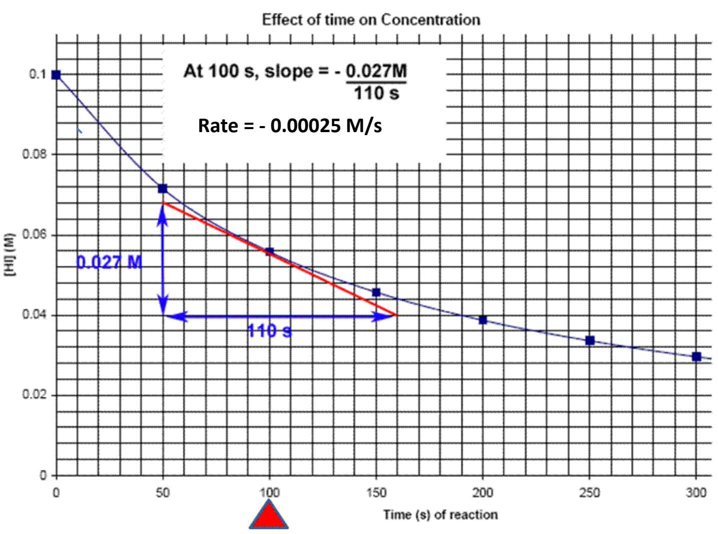
Most graphs in real life are not straight lines, but curves; however it is still useful to know how the quantity changes over time, hence we still need to calculate gradients.

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.

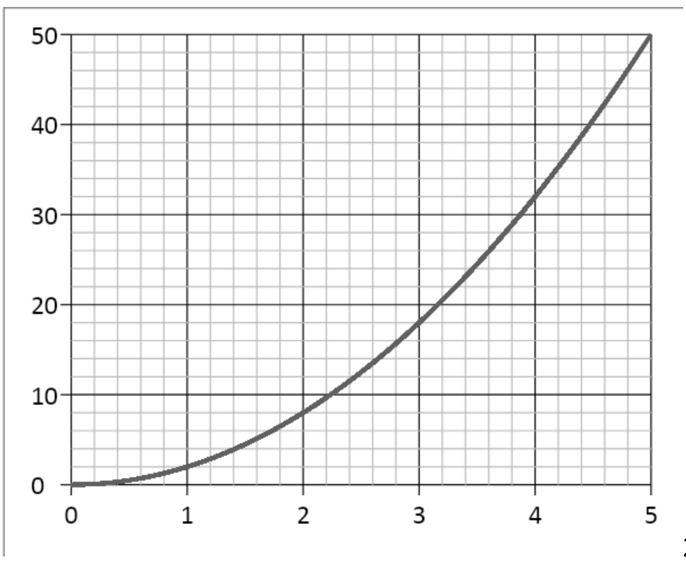
Tip – make sure your tangents and gradient triangles are as big as possible to be as accurate as you can!

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

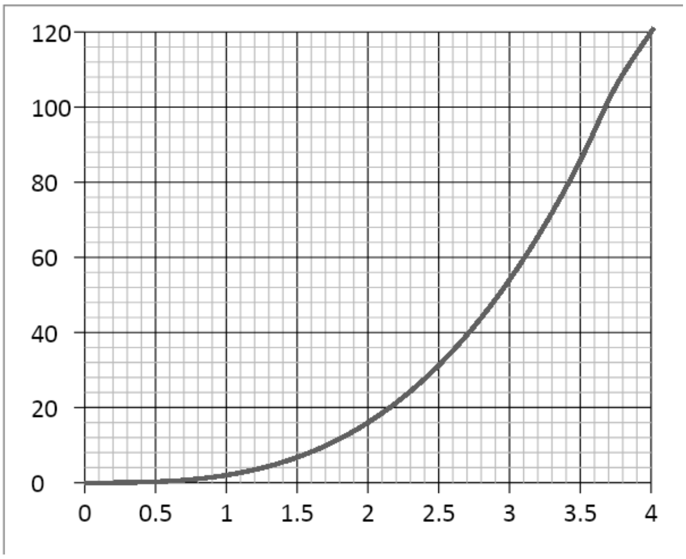




Draw a tangent to the line and calculate its gradient at the following x-axis values:



2.0 and 4.0



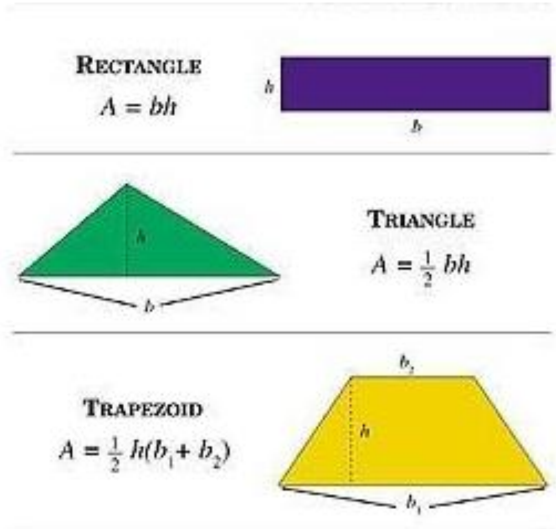
1.5 and 3.5

(Note - gradients in Physics often have units, this is something we will consider as we progress in the course)

Physics	9. Calculating Areas – Straight line Graphs
Skills	

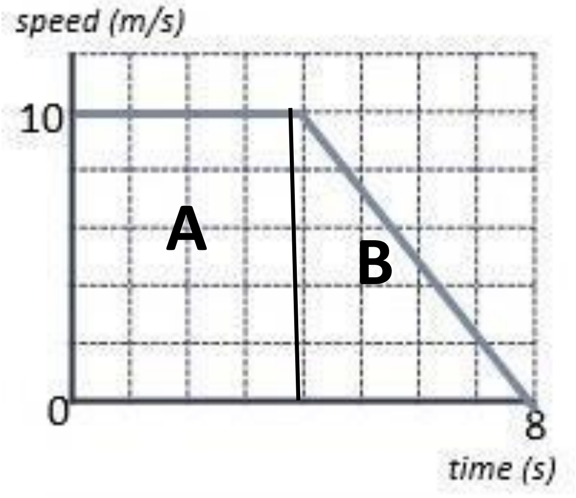
Often other quantities can be found by multiplying the two quantities represented on a graph together (for example, multiplying velocity and time gives distance travelled). The exact quantity can be found by calculating the area under the graph.

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

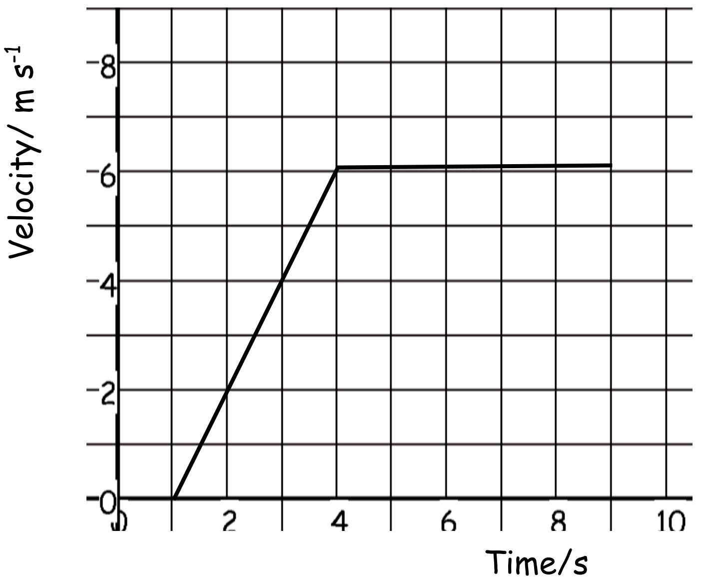
Area B = ½ x 4 x 10 = 20 m

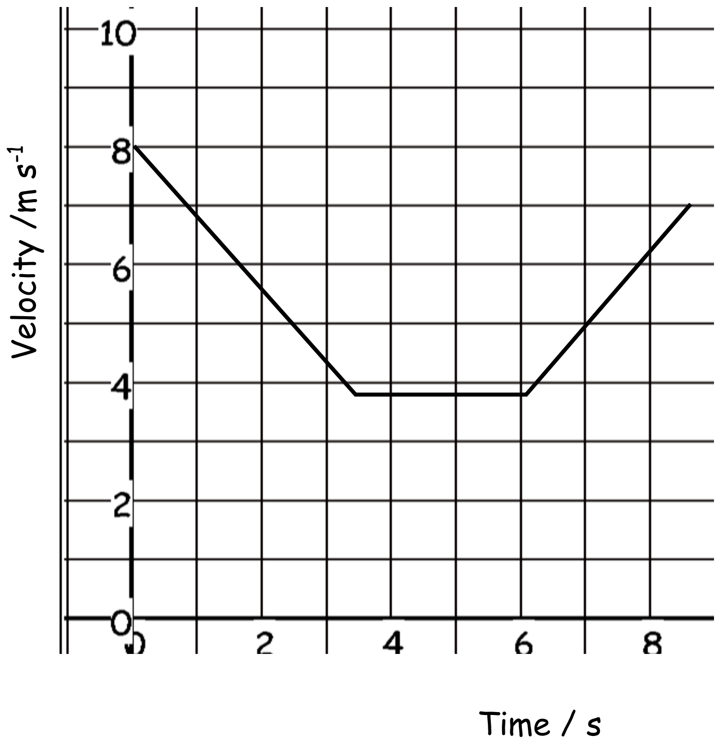
Total Area = A + B = 40 + 20 = **60 m**

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.





Reading List

Reading any of these books will increase your Physics curiosity. Anything by John Gribbin or Richard Feynman will leave you gasping for more Physics.

Astrophysics and cosmology

A Brief History of Time - *Stephen Hawking*

Universe in a Nutshell - *Stephen Hawking*

The Elegant Universe - *Brian Greene*

Three Roads to Quantum Gravity - *Lee Smolin*

Blackholes and Timewarps: Einstein's Outrageous Legacy - *Kip Thorne*

The First Three Minutes - *Steven Weinberg*

Just Six Numbers - *Martin Rees*

In Search of the Big Bang - *John Gribbin*

Hyperspace - *Michio Kaku*

The Road to Reality: A Complete Guide to the Laws of the Universe - *Roger Penrose*

The Fabric Of Reality - *David Deutsch*

The Fifth Essence - *Lawrence Krauss*

Quantum Physics

In Search of Schrodinger's Cat - *John Gribbin*

Schrodinger's Kittens - *John Gribbin*

QED - The Strange Theory of Light and Matter - *Richard Feynman*

The new quantum universe - *Hey and Walters*

Quantum Theory Cannot Hurt You - *Marcus Chown*

Quantum - *Manjit Kumar*

How to teach Quantum Physics to your dog - *Chad Orzel*

Relativity

Special Relativity - *A. P. French.*

Relativity - *Albert Einstein*

Does God Play Dice? - *Ian Stewart*

Chaos - *James Gleick*

General Physics

Feynman Lectures In Physics (Vol I-III) - *Richard Feynman*

Six Easy Pieces/Six Not So Easy Pieces - *Richard Feynman*

The Meaning of it All - *Richard Feynman*

A Short History of Nearly Everything - *Bill Bryson*

Hidden Unity in Nature's Laws - *John C. Taylor*

Historical & Casual Reads

Great Physicists - *William H. Cropper*

Surely You're Joking Mr Feynman? - *Richard Feynman*

The Pleasure of Finding Things Out - *Richard Feynman*

Course Text: You will be provided with the following book, but having your own copy will allow you to make notes in the book.

A Level Physics A for OCR Student Book By by Graham Bone (Author), Nigel Saunders (Author), Gurinder Chadha (Series Editor)

Revision Guides: These will be a great resource For Revision

OCR A Level Physics A Revision Guide by Gurinder Chadha

New A-Level Physics: OCR A Year 2 Complete Revision & Practice with Online Edition by CGP

Some useful websites

- http://www.iop.org/resources/videos/education/
- . http://www.youtube.com/user/minutephysics
- . http://research.microsoft.com/apps/tools/tuva/
- . https://www.zooniverse.org/
- http://phet.colorado.edu/