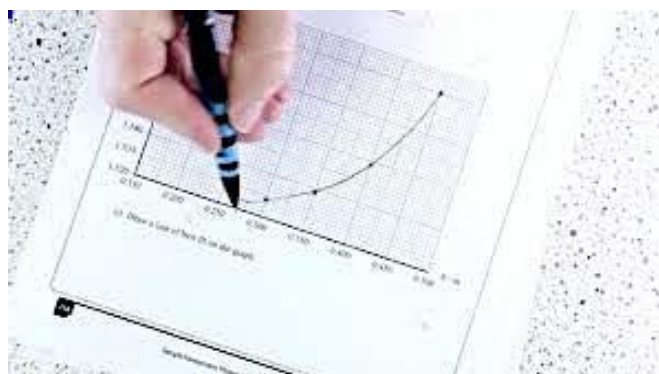# A-Level Physics at Myton School

Summer Transition Work

Introduction

This booklet will assist you in getting better prepared to study A-Level Physics at Myton School. You must work through the booklet and self-assess using the answers at the end 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 (or answers) to your first lesson.

In addition, you will be given a test on GCSE knowledge in your second week back at school.

AS Physics			
Skills	Contents		

Topic	Title	Completed (date)	Comments. Do you need more practice? Are you confident with this area? What areas of weakness have you identified?
1	Prefixes and units		
2	Significant Figures		
3	Converting Length, Area and Volume		
4	Rearranging Equations		
5	Constructing Tables		
6	Drawing Lines of Best Fit		
7	Calculating Gradients – Straight Lines		
8	Calculating Gradients – Curved Lines		
9	Calculating Areas – Straight Line Graphs		
10	Calculating Areas – Curved Line Graphs		
11	Identifying Errors		
12	Describing Experiments		
13	Solutions.		

1. Prefixes and units

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 x10³	450×10^{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}.

By convention we should also leave one space between values and units. 10m should be 10 m.

We also leave a space between different units but no space between a prefix and units.

This is to remove ambiguity when reading values.

Example   ms^{-1} means 1/millisecond because the ms means millisecond, 10^{-3} s

  but   m s^{-1} means metre per second the SI unit for speed.

    or mms^{-1} could mean   mm s^{-1} compared with   m ms^{-1}

                     millimeters per second   compared with   meters per millisecond - quite a difference!!!

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.

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

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.

2. Significant Figures

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 10ˣ, 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	

When adding or subtracting numbers

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) = **5.3** (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		

When multiplying or dividing numbers

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…) = **110** (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		
91×10^2	180		
5.56	22×10^{-3}		
3.142	8.314		

When calculating a mean

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		

AS 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
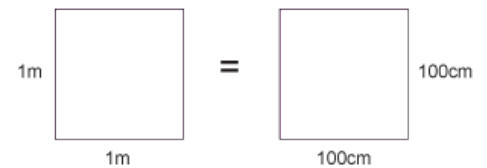
Converting Volumes

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 m²	=	cm²	750 mm² = m²
0.002 m²	=	mm²	5 x 10⁻⁴ cm³ = m³

Left table:
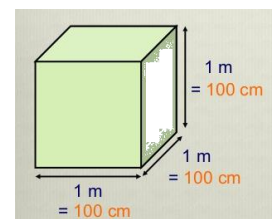
6 m²	=	cm²
0.002 m²	=	mm²
24 000 cm²	=	m²
46 000 000 mm³	=	m³
0.56 m³	=	cm³

Right table:

750 mm²	=	m²
5 x 10⁻⁴ cm³	=	m³
8.3 x 10⁻⁶ m³	=	mm³
3.5 x 10² m²	=	cm²
152000 mm²	=	m²

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

31 x 10⁸ m²	=	km²
59 cm²	=	mm²
24 dm³	=	cm³
4 500 mm²	=	cm²
5 x 10⁻⁴ km³	=	m³

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

A 2.0 m long solid copper cylinder has a cross-sectional area of 3.0 x10² mm². What is its volume in cm³?

Volume = _____ cm³

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

4. Rearranging Equations

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

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

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

5. Constructing tables

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 /unit	Dependent Variable Heading /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.

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….

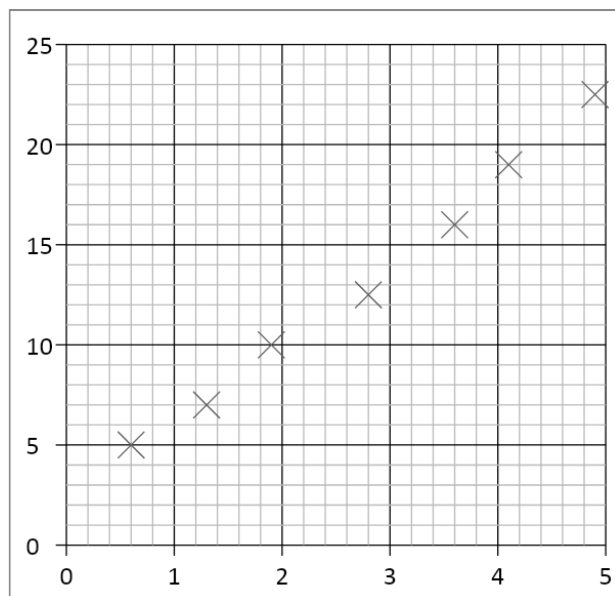"As 'X' increases, 'Y' *increases/decreases* in a *linear/non-linear* fashion."

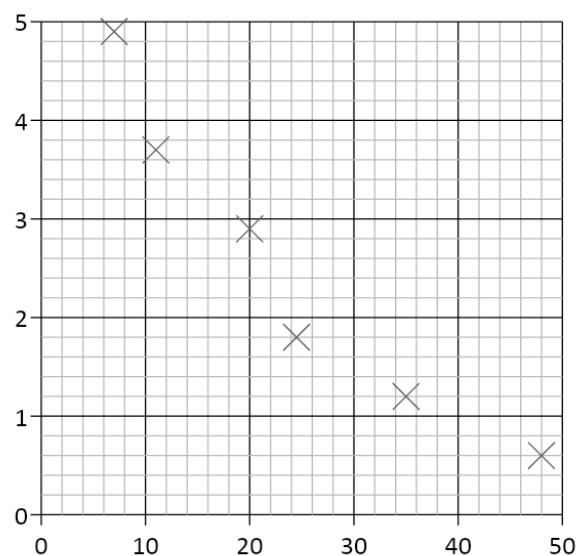Substitute the quantities into X and Y, and choose either of the two options to describe the graph.
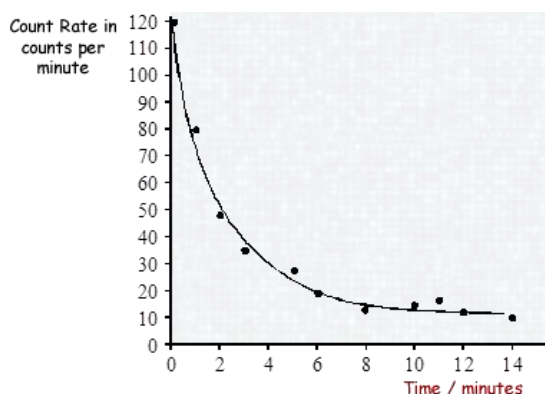
Eg.

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.
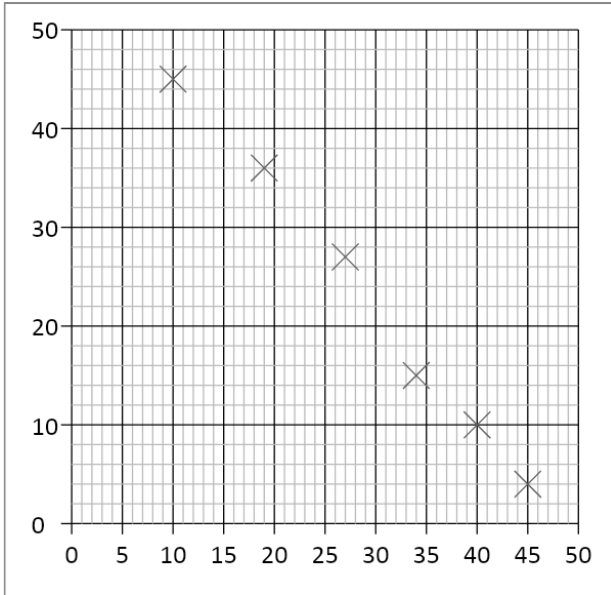
3.
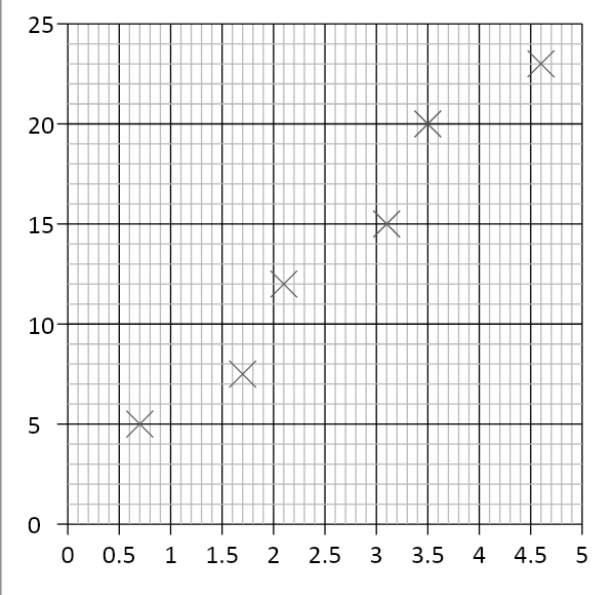
4.
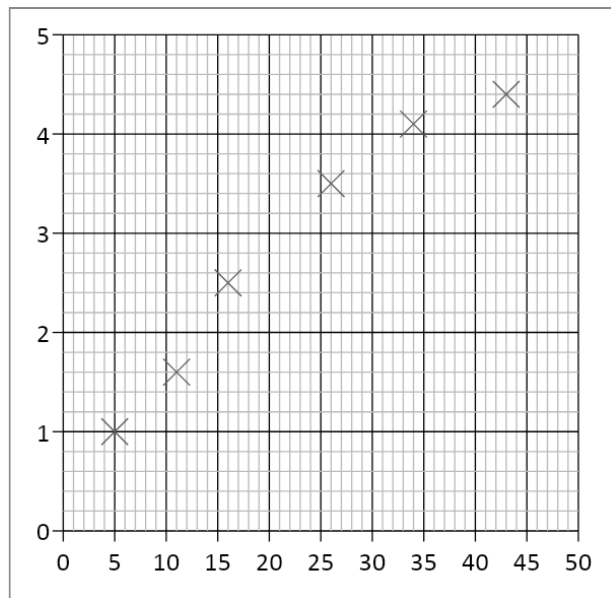
5.
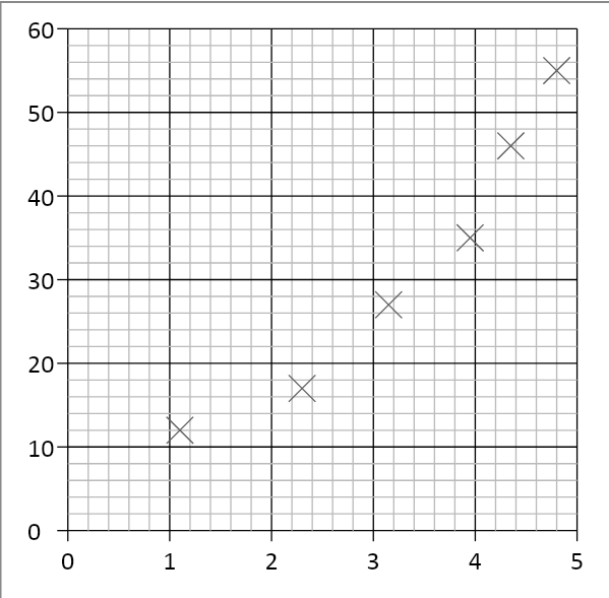
6.

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.
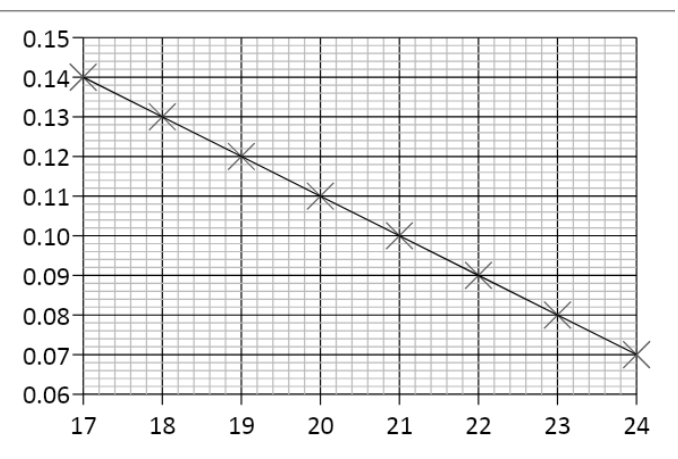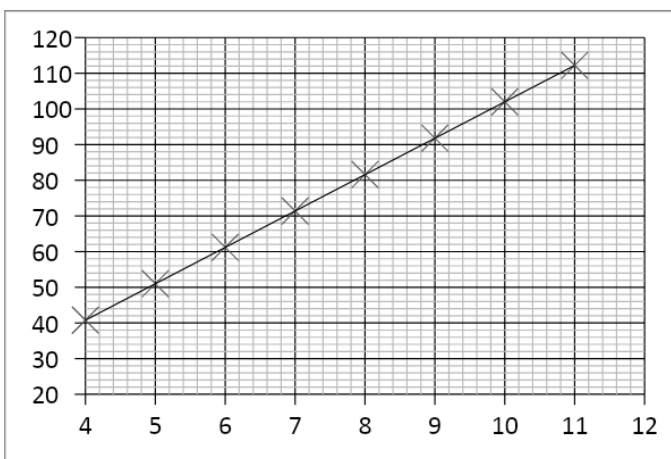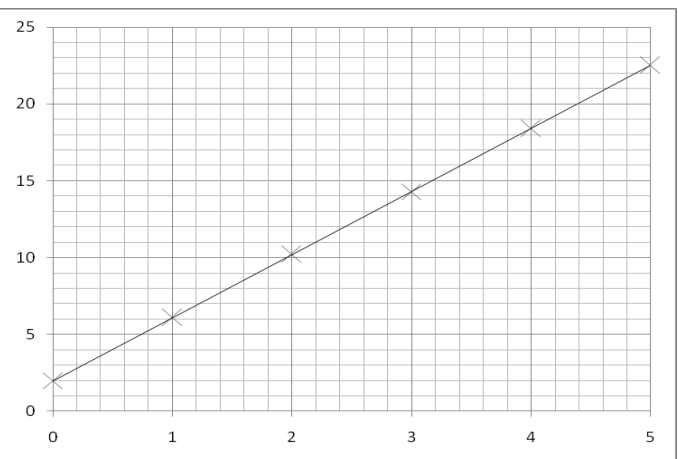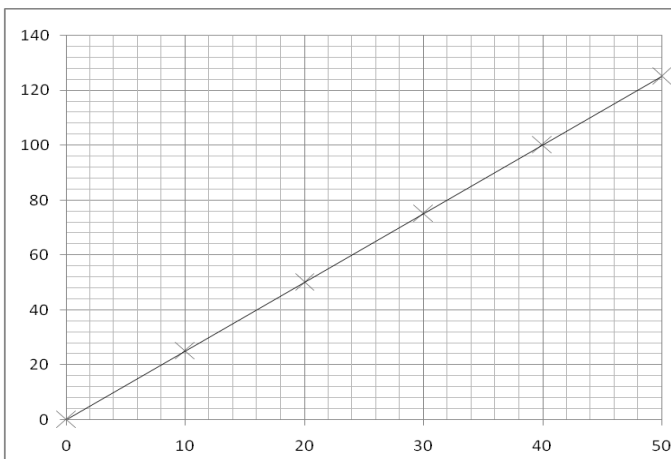The gradient is given by:

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

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.
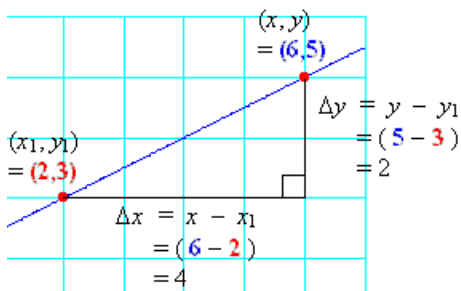
$Gradient = \dfrac{difference\ in\ y}{difference\ in\ x}$

$= \dfrac{2}{4}$

= 0.5

*Calculate the gradients of the graphs below*

8. Calculating Gradients – Curved Lines

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!
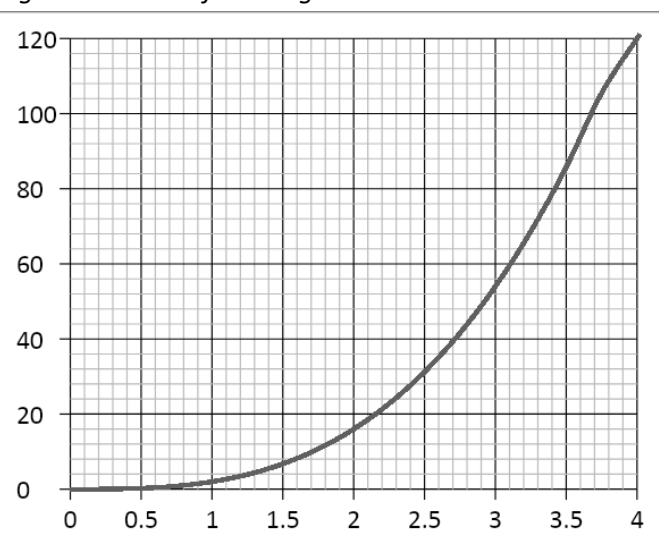
Examples of drawing tangents and calculating the gradient of a tangent:
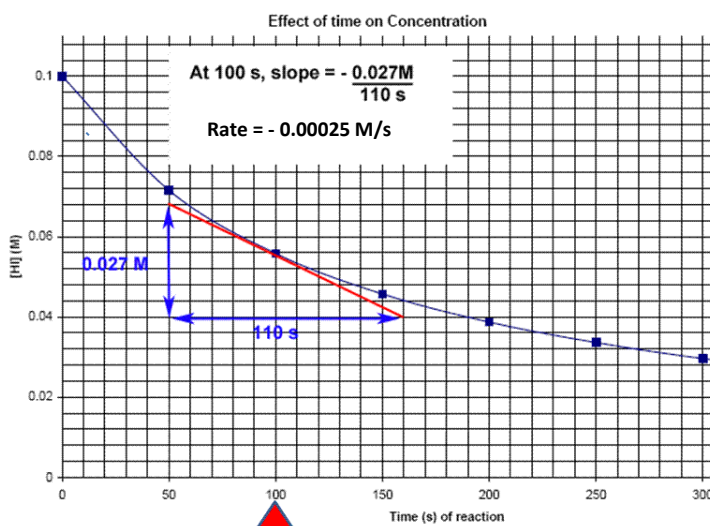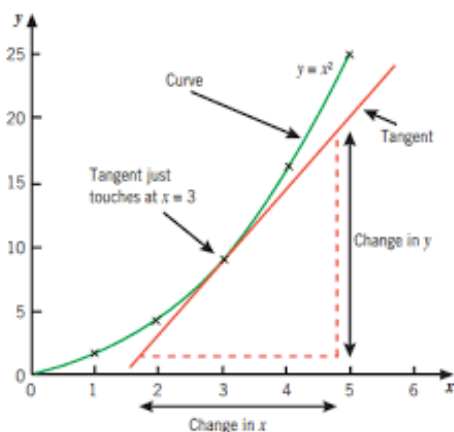
Draw a tangent to the line and calculate its gradient at the following x-axis values:
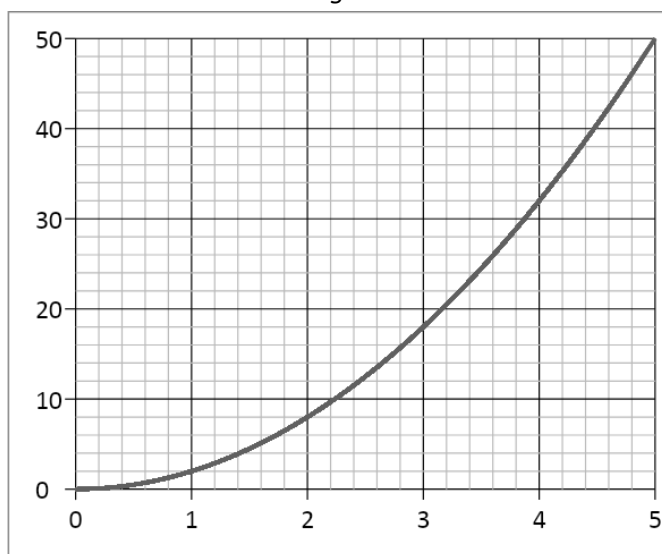
<div style="display:flex">
<div>2.0 and 4.0</div>
<div>1.5 and 3.5</div>
</div>

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

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.

RECTANGLE
$A = bh$

TRIANGLE
$A = \frac{1}{2} bh$

TRAPEZOID
$A = \frac{1}{2} h(b_1 + b_2)$
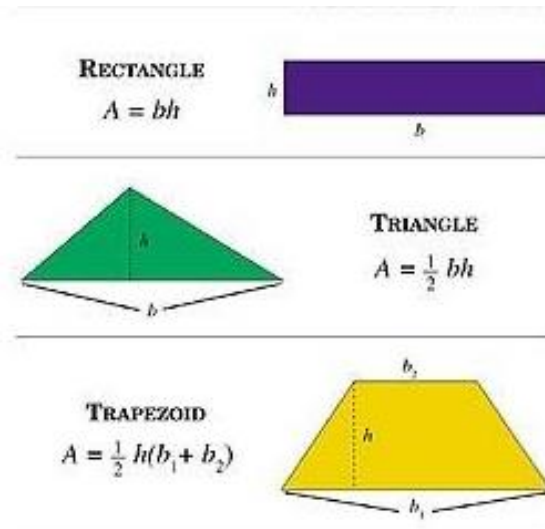
Important – the heights that you use should always be the perpendicular height from the base.

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

Area A = 10 x 4 = 40 m
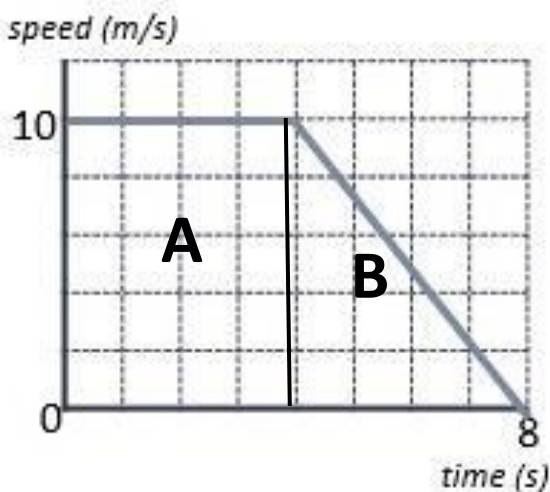
Area B = ½ x 4 x 10 = 20 m
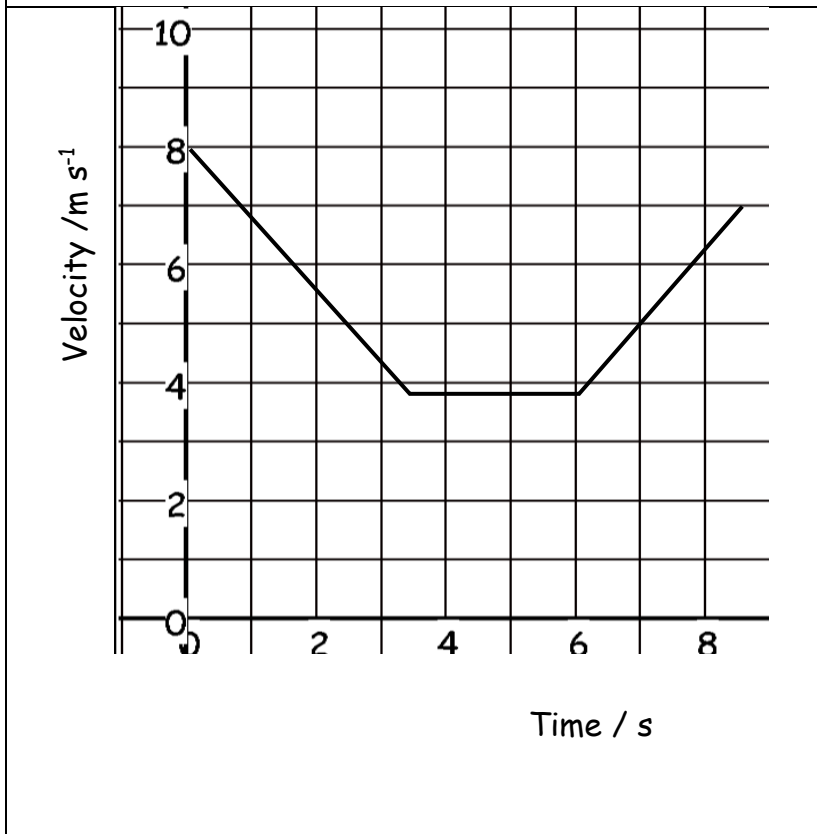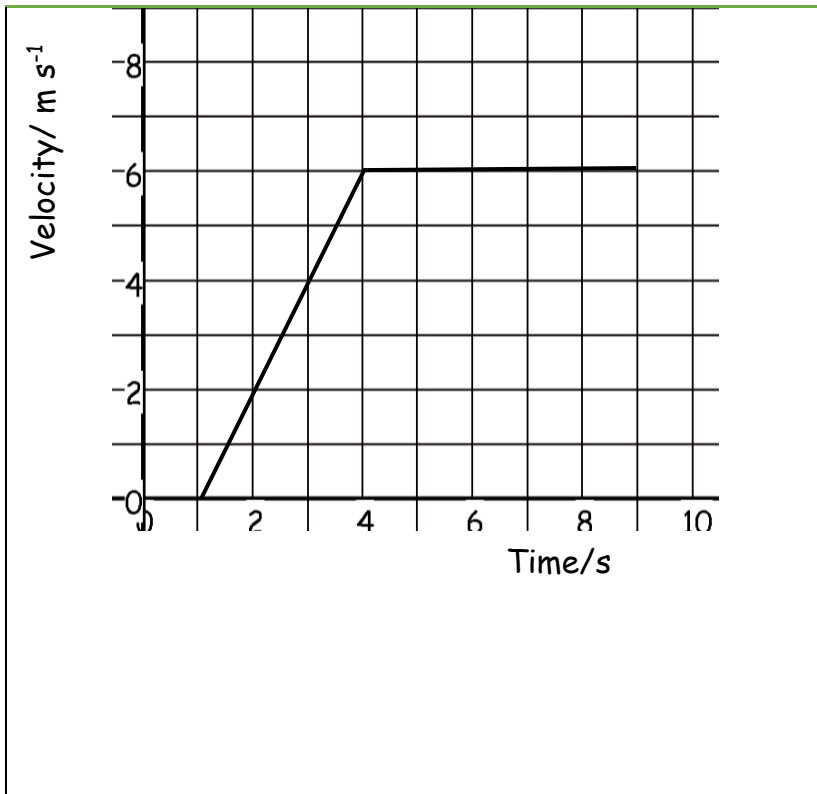
Total Area = A + B = 40 + 20 = **60 m**

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.

10. 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.
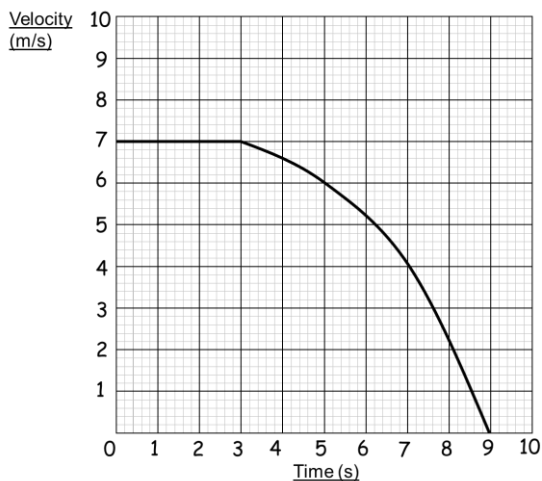
1) 1 square = 1 m s^{-1} x 1 s = 1 m
2) Whole Squares = 44
3) Segmented squares = 4
4) 48 squares x 1 m = **48 m**

Calculate the area under the following graphs.

velocity/m s^{-1}

time /s

velocity/ km s^{-1}

time /min
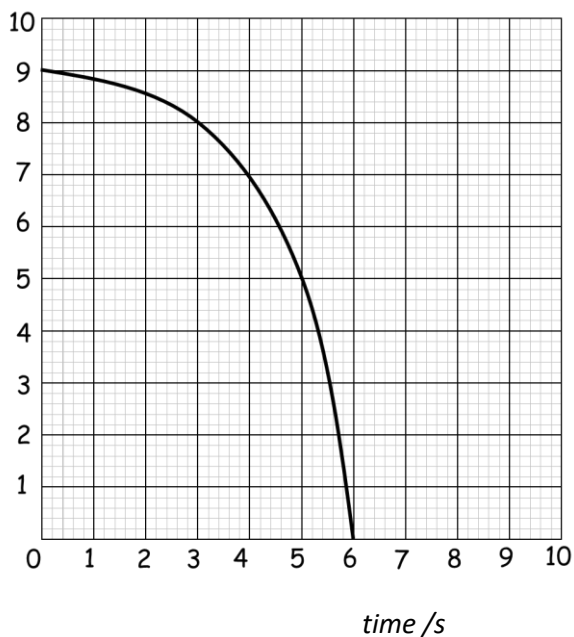
11. Identifying Errors

There are two main types of error in Science:
1) Random error
2) Systematic error

Random errors can be caused by changes in the environment that causes readings to alter slightly, measurements to be in between divisions on a scale or observations being perceived differe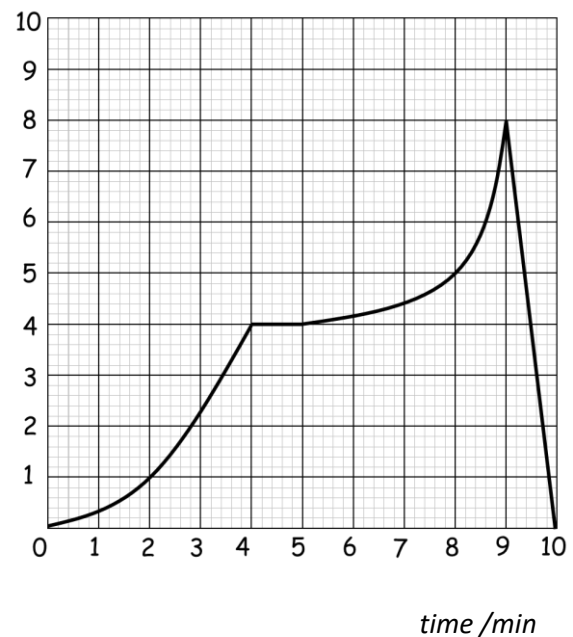ntly by other observers. These errors can vary in size and can give readings both smaller and larger than the true value.

The best way to reduce random error is to use as large values as possible (eg. Large distances) and repeat and average readings, as well as taking precaution when carrying out the experiment.

Systematic errors have occurred when all readings are shifted by the same amount away from the true value.
The two main types of systematic error are:

i)   *Zero error* – this is where the instrument does not read zero initially and therefore will always produce a shifted result (eg. A mass balance that reads 0.01g before an object is placed on it). Always check instruments are zeroed before using.

ii)   *Parallax error* – this is where a measurement is not observed from eye level so the measurement is always read at an angle producing an incorrect reading. Always read from eye level to avoid parallax.
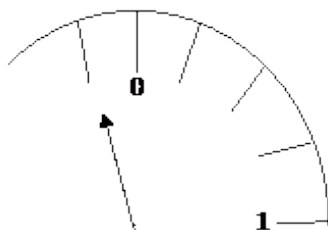
Zero Error
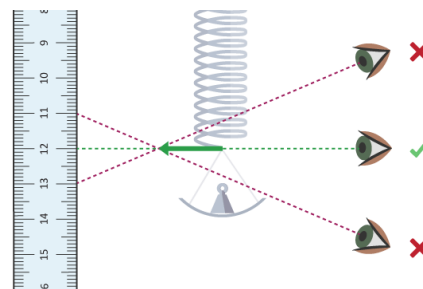
Parallax Error

Repeat and averaging experiments will not reduce systematic errors as correct experimental procedure is not being followed.

There are occasions where readings are just measured incorrectly or an odd result is far away from other readings – these results are called **anomalies**. Anomalies should be removed and repeated before used in any averaging.

For each of the measurements listed below identify the most likely source of error what type of error this is and one method of reducing it.

Measurement	Source of error	Type of error
A range of values are obtained for the length of a copper wire		
The reading for the current through a wire is 0.74 A higher for one group in the class		
A range of values are obtained for the rebound height of a ball dropped from the same start point onto the same surface.		
A few groups obtain different graphs of resistance vs light intensity for an LDR. A light bulb placed at different distances from the LDR was used to vary the light intensity.		
The time period (time of one oscillation) of a pendulum showing a range of values		

Variables *– Which variables will you keep the same and which will you change?*
Instruments *– What measuring instruments will you use and how will you take the measurements?*
Range *– Give specific values for the range and intervals you will use. Make sure your range is large with small intervals.*
Analyse *– State any equations you will use and what graph you will plot including the axes.*
Accuracy *– State ways you are being accurate with your measuring instruments.*
Reliability *– State "Repeat and average" to improve reliability*

Using the steps above, describe how to carry out the following experiments below:

e.g.
Water is placed in a plastic tray, one end it raised, dropped and the speed of the water wave is measured. A student suggests that the speed of the wave depends on the height of the water in the tray. How could you prove this?

Change the depth of water by filling the tray to different heights. The height of the water will be measured by placing a ruler into the tray. Depths from 1.0 to 5.0 cm, at 1.0 cm intervals should be used.
The tray should be lifted to the same height each time and dropped without pushing it down. The height the tray is lifted to should also be measured with a ruler that is vertical using a set square.
When the tray hits the table, the time should be measured for the wave to pass end to end 4 times, then divided by 4 to make the reading more accurate to reduce reaction time. The time should be measured using a stopwatch.
The length of the tray should be measured using a ruler, overhead and measured at eye level for accuracy.
The equation speed = distance / time should be used to calculate the speed of the wave.
Repeat each height and average to improve reliability.
Plot a graph of speed (y axis) vs depth of water (x axis) to see if there is a relationship between the two variables.

Question. A student suggests that if an egg was dropped from different heights the area of splatter would increase as the height increases but only until a certain point. How could you investigate this?

13. Solutions

Topic 1

54×10^6	0.086×10^{-6}	753×10^9	23.87×10^{-3}
0.5 µm	93.09 Gm	3 200 kN	2.4 nm

s	ms	µs	ns	ps
0.00045	0.45	450	450 000 or 450×10^3	450×10^6
0.000000789	0.000789	0.789	789	789×10^3
0.000 000 000 64	0.000 000 64	0.000 64	0.64	640

mm	m	km	µm	Mm
1287360	1 287.360	1.28 7360	1 287 360 000	0. 001 287 360
295	0.295	0.000 295	295 000	0 .000 000 295

2. $v = f\lambda = 0.25 \times 10^6 \times 5.6 \times 10^{-6} = 1400$ m s^{-1}

3. $\lambda = v/f = 330 / 3.0 \times 10^9 = 1.1 \times 10^{-7}$ m

4. $f = v/\lambda = 300 \times 10^6 / 0.050 \times 10^{-3} = 6.0 \times 10^{12}$ Hz $= 6.0$ THz

5. $f = v/\lambda = 300 \times 10^6 / 6.0 \times 10^{-2} = 5.0 \times 10^9$ Hz $= 5.0$ GHz

Topic 2

Value	Sig Figs	Value	Sig Figs	Value	Sig Figs	Value	Sig Figs
2	1	1066	4	1800.45	7	0.070	2
2.0	2	82.42	4	2.483×10^4	4	69324.8	6
500	1	750000	2	0.0006	1	0.0063	2
0.136	3	310	2	5906.4291	8	9.81×10^4	3
0.0300	3	3.10×10^4	3	200000	1	40000.00	7
54.1	3	3.1×10^2	2	12.711	5	0.0004×10^4	1

Value 1	Value 2	Value 3	Total Value	Total to correct sig figs
51.4	1.67	3.23	56.3	56.3
7146	−32.54	12.8	7126.26	7126
20.8	18.72	0.851	40.371	40.4
1.4693	10.18	−1.062	10.5873	10.59
9.07	0.56	3.14	12.77	12.77
739762	26017	2.058	765781.058	765781
8.15	0.002	106	114.152	114
152	0.8	0.55	153.35	153

Value 1	Value 2	Total Value	Total to correct sig figs
0.91	1.23	1.1193	1.1
8.764	7.63	66.86932	66.9
2.6	31.7	82.42	82
937	40.01	37489.37	37 500
0.722	634.23	457.91406	458

Value 1	Value 2	Total Value	Total to correct sig figs
5.3	748	7.085561×10^{-3}	7.1×10^{-3}
3781	6.50	581.6923077	582
91×10^2	180	50.55555555556	51
5.56	22×10^{-3}	252.727272727	250
3.142	8.314	0.37791677	0.3779

Value 1	Value 2	Value 3	Mean Value	Mean to correct sig figs
1	1	2	1.3333	1
435	299	437	436	436
5.00	6.0	29.50	5.50	5.5
5.038	4.925	4.900	4.9543333333	4.954
720.00	728.0	725	724.3333333333	724
0.00040	0.00039	0.000380	0.000380	0.00038
31	30.314	29.7	30.338	30

6 m^2	=	60 000 cm^2
0.002 m^2	=	2000 mm^2
24 000 cm^2	=	2.4 m^2
46 000 000 mm^3	=	0.046 m^3
0.56 m^3	=	560 000 cm^3

750 mm^2	=	0.00075 m^2
5 x 10^{-4} cm^3	=	5.0 x10^{-10} m^3
8.3 x 10^{-6} m^3	=	8300 mm^3
3.5 x 10^2 m^2	=	3.5 x 10^6 cm^2
152000 mm^2	=	0.152 m^2

31 x 10^8 m^2	=	3100 km^2
59 cm^2	=	5900 mm^2
24 dm^3	=	24000 cm^3
4 500 mm^2	=	45 cm^2
5 x 10^{-4} km^3	=	500 000 m^3

A 2.0 m long solid copper cylinder has a cross-sectional area of 3.0 x10^2 mm^2. What is its volume in cm^3?

h= 2.0 m = 2.0 x 10^2 cm   csa = 3.0 cm^2

V = cross-section area x height = 2.0 x 10^2 x 3.0= 600

Volume = _____600 cm^3

5 N cm^{-2}	=	50 000 N m^{-2}
1150 kg m^{-3}	=	(1150 x1000 / 100x100x100) = 1.15 g cm^{-3}
3.0 m s^{-1}	=	(3.0 /1000) x (60x60) = 10.8 km h^{-1}
65 kN cm^{-2}	=	650 N mm^{-2}
7.86 g cm^{-3}	=	7860 kg m^{-3}

Topic 4

$R = V/I$ $t = Q/I$ $A = \rho L/A$ $r = (\varepsilon-V)/I$

$u = 2s/t - v$ $f = (\Phi + E_k)/h$ $g = E_{P,}/ mh$ $F = 2E/e$

$u = \sqrt{(v^2-2as)}$ $m = T^2 k/ 4\pi^2$

Topic 5.

Pd across resistor/V	Current through the resistor/A			
	I_1	I_2	I_3	$I_{average}$
1.0	0.11	0.10	0.12	0.11
2.0	0.21	0.18	0.24	0.21
3.0	0.33	0.60	0.30	0.32
4.0	0.35	0.40	0.45	0.40
5.0	0.50	5.10	0.48	0.49

Topic 6

1. Straight line positive gradient , constant
2. Curve, negative gradient, steep then getting shallower
3. Straight line, negative gradient, constant
4. Straight line positive gradient, constant
5. Curve , positive gradient, decreasing
6. Curve, positive gradient, increasing.

Topic 7

Show construction lines on your graphs.

1. m = 124-0/50-0 = 2.5   2. m = 22.5 -2.0/5.0-0 = 4.1

3. m= 112 - 42/11-4 = 10   4. m = 0.07-0.14/24-17 = -0.01

Topic 8.

Construction lInes need to be drawn on graphs for the full method.

1. Gradient at point 2.0   m= 22-0/4-0 = 5.5   gradient at point 4.0   m= 46-0/5.0-1.8 = 14.4
2. Gradient at point 1.5   m= 424-0/4-1 = 14.7   gradient at point 3.5   m= 116-0/4-2 = 58

<u>Topic 9-</u> always show a full method with your solutions.

Top graph   area = 39 m   Bottom graph area = 33 +/- 1 m (to 2 sig fig)

<u>Topic 10.</u>   All values approximate, your estimate should be within quoted error.
Left hand graph- 41 squares   each square 1 m s^{-1} x 1 s = 1 m   area = 41 m +/- 1 m

Right hand graph 31 squares   each square 1 km s^{-1} x 60 s = 60 km   area = 1860 km +/- 60 km

<u>Topic 11.</u>

Measurement	Source of error	Type of error
A range of values are obtained for the length of a copper wire	RULER measuring length of wire	RANDOM
Reduce this error by ensuring the wire is laid out straight, place the rules directly next to the wire, take repeat readings, remove anomalous readings and calculate an average length for the wire		
The reading for the current through a wire is 0.74 A higher for one group in the class	Ammeter	SYSTEMATIC
Zero error in the ammeter. Check reading before any current flows in the circuit. Subtract zero error reading from each value or calibrate/adjust ammeter to read zero.		
A range of values are obtained for the rebound height of a ball dropped from the same start point onto the same surface.	Ruler / person measuring rebound height	RANDOM SYSTEMATIC
RANDOM because person recording the height looks at the rule from different positions and or doesn't use same part of ball to record max height. SYSTEMATIC because rule might have a zero error. Solution- put graph paper scale on a screen behind the ball. Drop the ball close to the screen and record the fall in slo-mo using a camera (smart phone). Analyse the play back to get accurate values.		
A few groups obtain different graphs of resistance vs light intensity for an LDR. A light bulb placed at different distances from the LDR was used to vary the light intensity.	Additional light sources in the room	SYSTEMATIC
Some groups may be near a window which will allow extra light onto the measuring equipment beyond that from the light bulb used in the initial experiment. Reduce error by using proper black out curtains and switch off additional light sources while taking readings or cover the apparatus with blackout material.		
The time period (time of one oscillation) of a pendulum showing a range of values	Timing the oscillation	Random

Topic 12.

Some pointers.

Produce an equipment list; think of key/essential equipment .

IV height egg dropped from, m

DV diameter of splatter, m (area, m^2 , calculated from this value, we don't calculate the area directly)

CV size of egg, type of surface the egg is dropped onto.

Range of IV 0.50 to 4.00 m in 0.50 m increments.

Give a suitable table with heading /units

Graph plotted of height egg dropped (m) on x-axis v area of splatter (m^2)

Add more detail to your method and hand in with the rest of the notes.

Your method should be detailed enough to be followed and the experiment carried out.