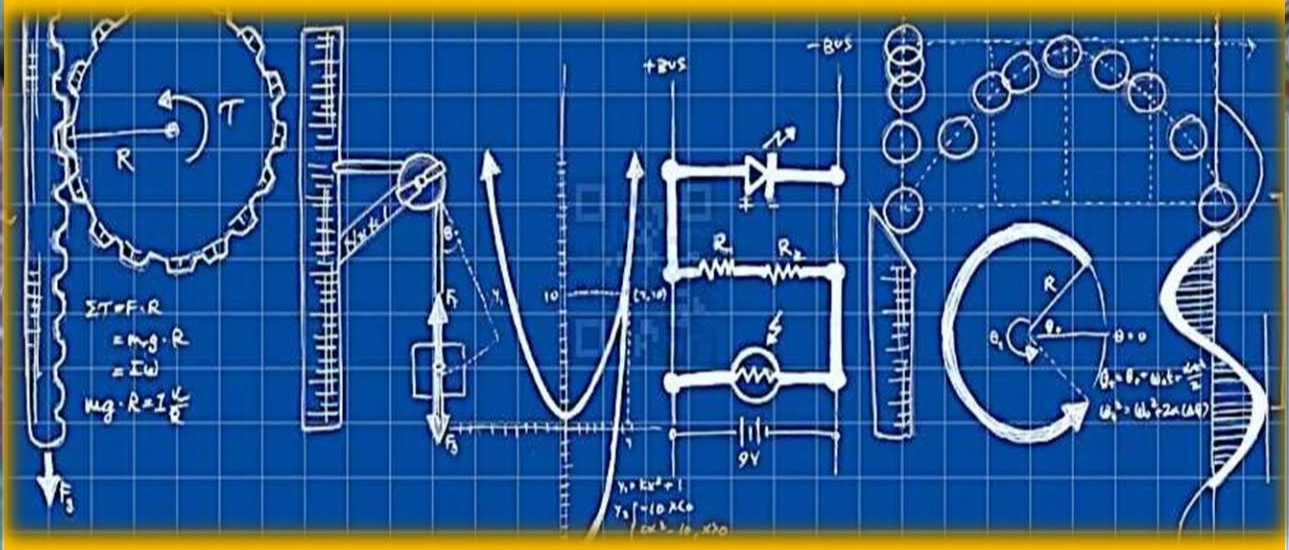
WPS VI

'Ipsum quod faciendum est diutius'

A Level Physics Transition Booklet



This booklet will assist you in getting better prepared to study A Level Physics at Wootton Park School. You must work through the booklet and self-assess 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 A Level Physics course. Bring your copy of the completed booklet to your first A Level Physics lesson.

Please note the compulsory summer work which starts on page 3

About the course: The specification we teach is produced by AQA. The unit code is 7408 (A -evel) and a full copy of this specification and other useful information is available at:

https://www.aqa.org.uk/subjects/science/as-and-a-level/physics-7407-7408

The course consists of nine sections:

1. **Measurements and their errors**
2. **Particles and radiation**
3. **Waves**
4. **Mechanics and materials**
5. **Electricity**
6. **Further mechanics and thermal physics**
7. **Fields and their consequences**
8. **Nuclear physics**
9. **One optional topic**

As well as this, there are a further 12 required activities that will be undertaken by each candidate with the purpose of supporting and consolidating scientific concepts, developing investigative skills, and building and mastering practical skills.

Assessments:

Paper 1	Paper 2	Paper 3
What's assessed • Measurements and their errors • Particles and radiation • Waves • Mechanics and materials • Electricity • Periodic motion	**What's assessed** • Thermal physics • Fields and their consequences • Nuclear physics	**What's assessed** • Practical skills and data analysis • One optional topic
Assessed • Written exam: 2 hours • 85 marks • 34% of A-Level	**Assessed** • Written exam: 2 hours • 85 marks • 32% of A-Level	**Assessed** • Written exam: 2 hours • 80 marks • 32% of A-Level
Questions 60 marks of short and long answer questions and 25 multiple choice questions on content.	**Questions** 60 marks of short and long answer questions and 25 multiple choice questions on content.	**Questions** 45 marks of short and long answer questions on practical experiments and data analysis. 35 marks of short and long answer questions on optional topic.

Compulsory Summer Work

Part 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	

Task 1: Converting practice

Convert the figures into the units required.

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

Task 2: Conversions for wave speed

The equation for wave speed is:

(/) = ( ) × h ()

Whenever this equation is used, the quantities must be in the units stated above. At GCSE we accepted m/s but at 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.

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

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.

Part 2: Rearranging equations

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

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

Part 3: Graph skills

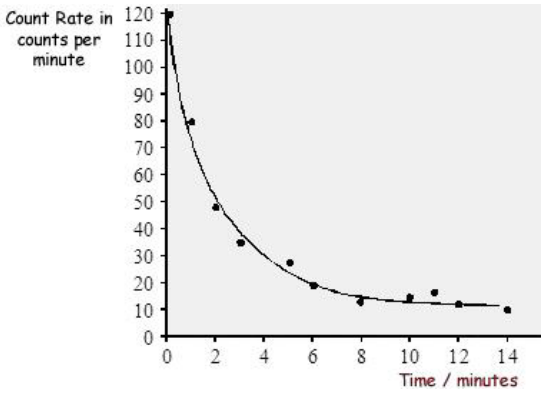
Task 1: Drawing lines of best fit

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."

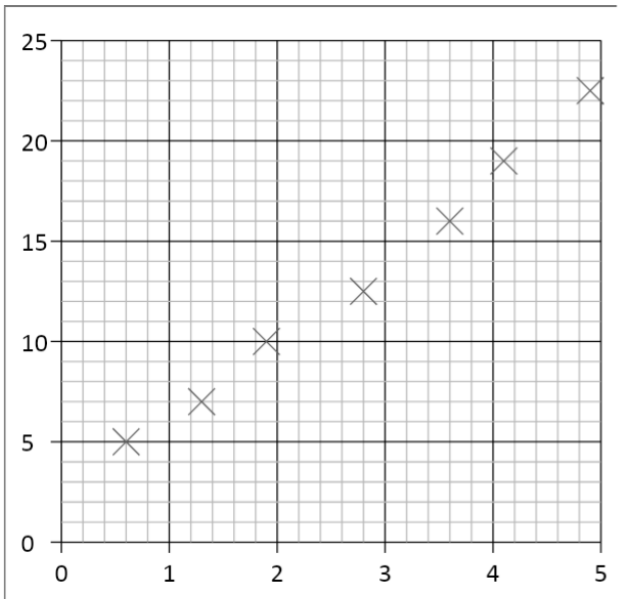
Substitute the quantities into X and Y, and choose either of the two options to describe the graph.

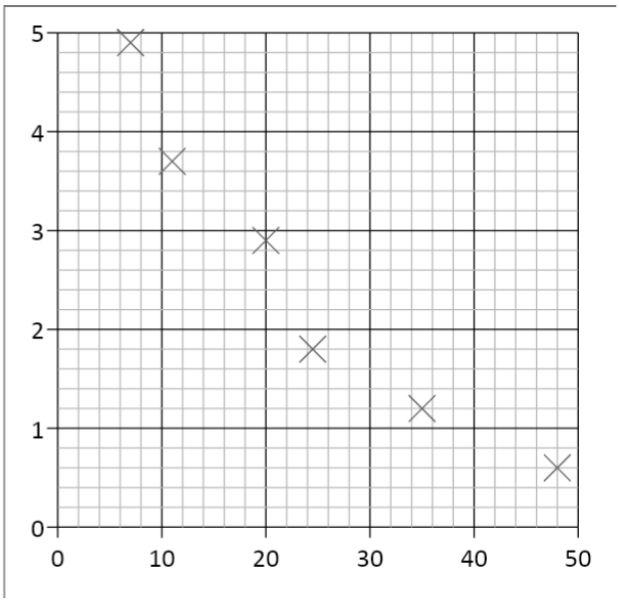


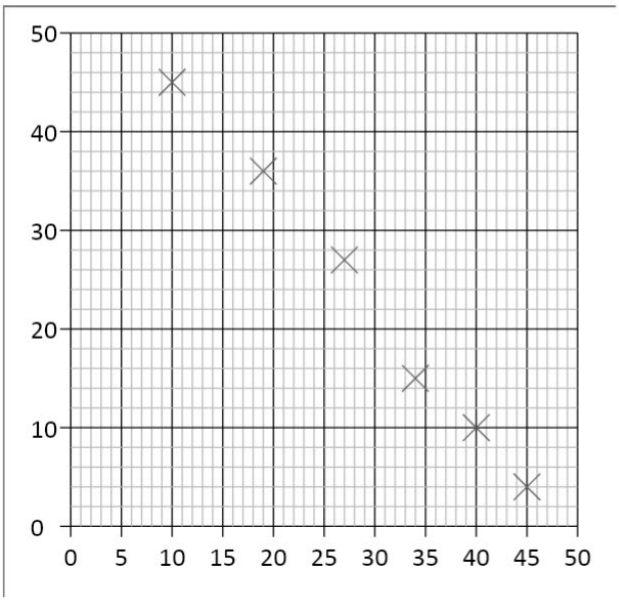
Eg.

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).



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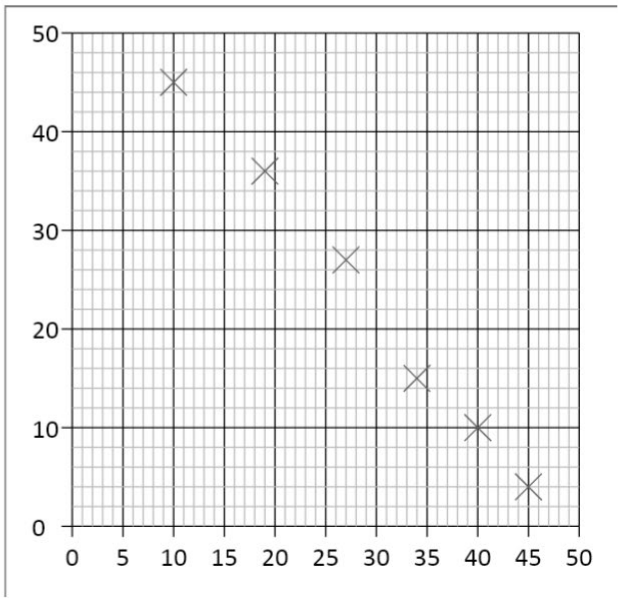
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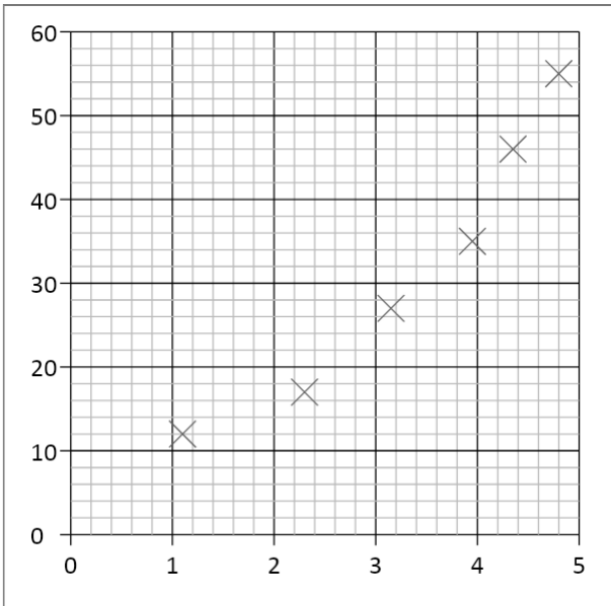
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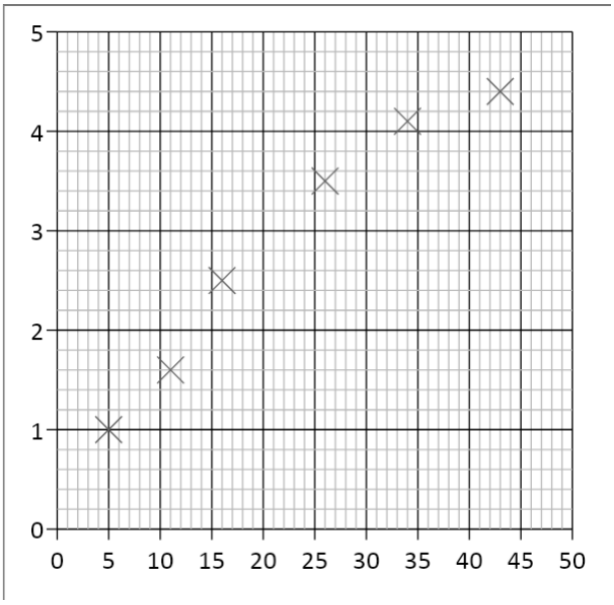
5
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0 5 10 15 20 25 30 35 40 45 50

Task 2: Constructing graphs

When drawing graphs, you will be marked on the following criteria:

1) Axes – Your independent variable is on the x axis, and your dependent variable is on the y axis. Both axes need to be labelled.
2) Units – Add units to your axes when labelling.
3) Scale – Make your scale as large as possible so that your data fills most of the page. **You don't have to start your axes at the origin**. *Make sure you have a regular scale that goes up in nice numbers – 1, 2, 5, 10 etc…*
4) Points – mark each point with a cross using a sharp pencil. Don't use circles or dots as points.
5) Line of best fit – draw a smooth line of best fit – straight or curved depending on what pattern your data follows.

An easy way to remember these points is…..

S cale
L ine
A xes
P oints
U nits

Plot graphs for the following sets of data, including a line of best fit for each.

Surface area of pendulum / cm^2	Time taken for pendulum to stop/ s
5.0	170
6.2	127
7.4	99
8.0	86
8.8	70
9.9	56

Current / A	Voltage / V
0.07	1.46
0.14	1.44
0.21	1.42
0.30	1.40
0.41	1.38
0.57	1.33
0.81	1.29

Task 3: 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.

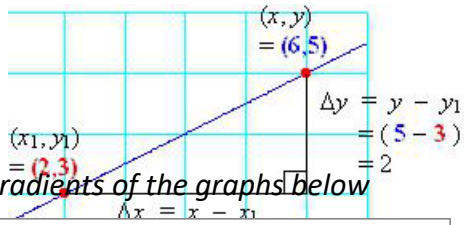
To calculate the gradient, pick any two points on the line as far away as possible and draw a large triangle between them.
The gradient is given by:

$$\text{Gradient} = \frac{\text{change in } y}{\text{change in } x}$$

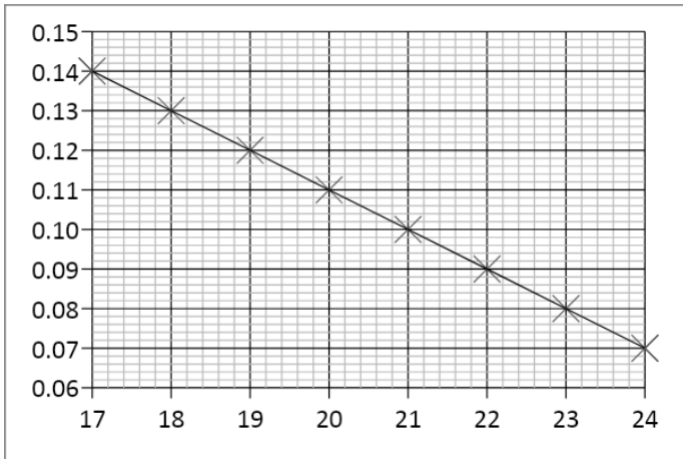
But make sure that you subtract the values in the same order! Remember – if the line slopes up, the gradient should be positive; if the line slopes down, then the gradient should be negative.

$$\text{Gradient} = \frac{5-3}{6-2} = \frac{2}{4}$$

= 0.5



Calculate the gradients of the graphs below



Task 4: Calculating gradients – curved lines

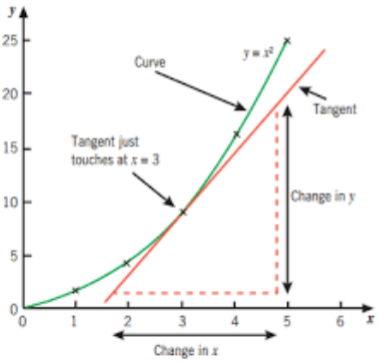
Most graphs in real life are not straight lines, but curves; however it is still useful to know how the quantity changes over time, hence we still need to calculate gradients.

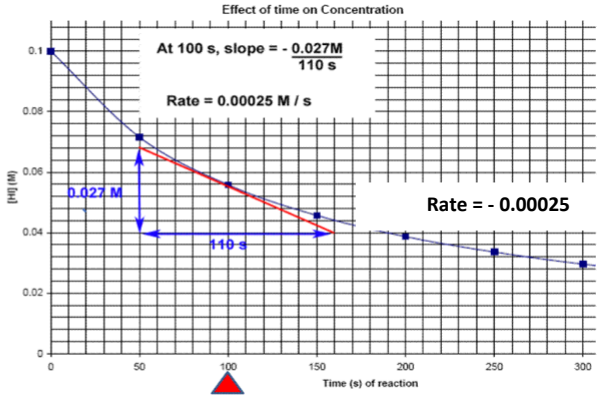
If we want to know the gradient at a particular point, firstly we need to draw a *tangent* to the curve at that point.

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.

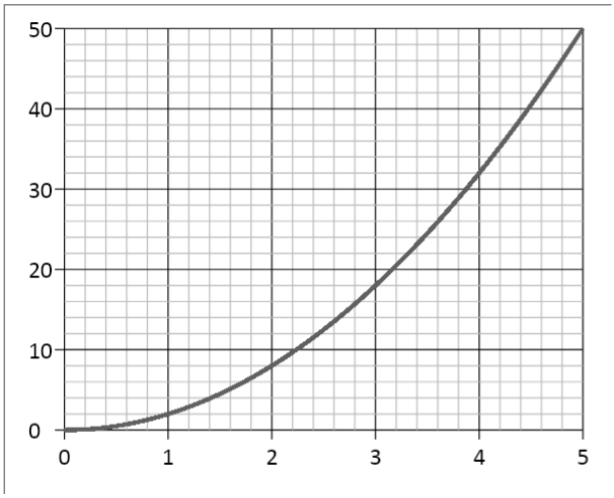
Tip – make sure your tangents and gradient triangles are as big as possible to be as accurate as you can!

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

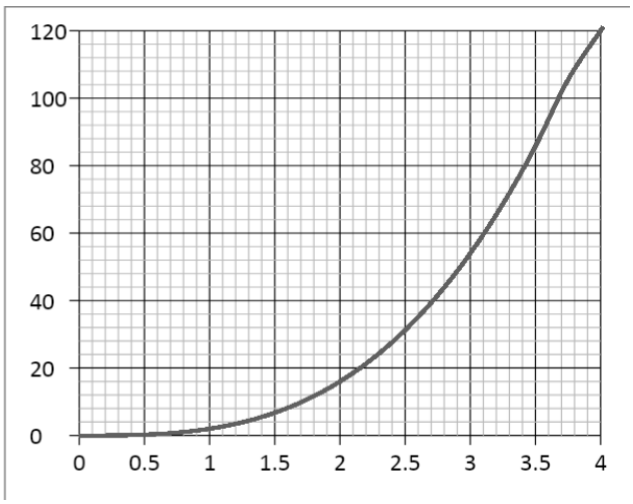




Draw a tangent to the line and calculate its gradient at the following x-axis values:



2.0 and 4.0



1.5 and 3.5

Suggested Reading List

• AQA Physics: A Level, Jim Breithaupt, Oxford Press (ISBN 978-0-19-835187-0)
• AQA A Level Physics Year 1 Revision Guide, Jim Breithaupt, Oxford Press (ISBN 9780198351887)
• Physics Review: magazine from Hodder Education.
• Physics: A very short introduction, Sidney Perkowitz published by Oxford (ISBN 9780198813941)

Further Reading & Resources

• "Brief history of time"- Stephen Hawking
• "Paradox", Jim Al-Khalili
• "Why does E = mc2 ", "Brian Cox and Jeff Forshaw
• "Storm in a teacup: The physics of everyday life", Helen Czerski
• (Advanced) "Surely you're joking Mr Feynman?", Richard Feynman
• Titanium physics podcast

Other Sources of Information

- AQA Physics Course website: https://www.aqa.org.uk/subjects/science/as-and-alevel/physics-7407-7408
- www.isaacphysics.org
- www.phet.colorado.edu/en/
- www.sixtysymbols.com
- www.physicsworld.com
- home.cern/science/accelerators/large-hadron-collider

Places of Interest

- Science Museum, London
- National Space Centre, Leicester
- The Discovery Museum, Newcastle upon Tyne
- Thinktank Birmingham Science Museum, Birmingham
- Herschel Museum of Astronomy, Bath

Expectations and Workload

A Level Physics will give you incredibly strong analytical and research skills. You will be able to come at problems and solve them in a methodical and logical way. You will be able to investigate theories, devise tests and explore new ideas. Such strong problem-solving skills are highly sought after. In fact, qualifications in physics and maths are two of the most desirable qualifications for employers. Considering the heavily mathematical element in physics, it's a qualification that carries weight. To that end, it is expected that you arrive promptly to all lessons and suitably equipped in order for you to reach your full potential.