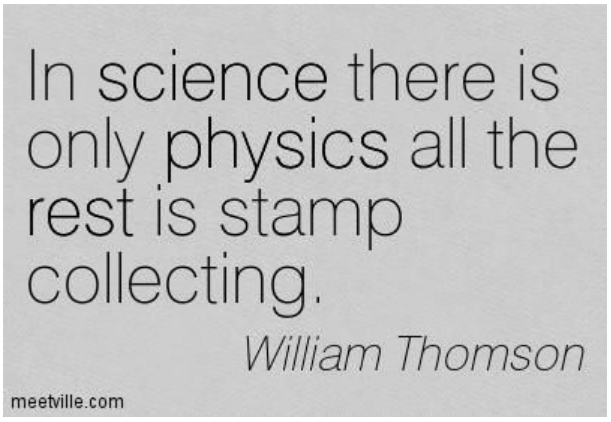
BCCS

Physics Induction



Welcome to AS Physics!

This course is intended to provide, through well designed studies of theoretical and practical Physics, a worthwhile educational experience for all candidates, whether or not they go on to study Physics at a higher level. The Physics teachers at BCCS are passionate about their subject and enjoy sharing their enthusiasm with students.

The government has recently changed the format of A-levels so that AS-levels are a stand-alone qualification that does not contribute to the full A-level qualification. The specification we follow allows for co-teaching of AS and A-level. It is likely that no students will be entered for the external AS Levels at the end of Year 12, but all will be assessed internally. Those with the necessary grades and work ethic will continue through to Year 13 and complete the full A-level.

Alongside the content, you will be undertaking 6 Required Practicals each year. These will allow you to develop your understanding of practical techniques and data analysis – a skillset that universities find highly desirable.

AQA Physics at a Glance

The first year of study will cover topics 1-5. The rest of the content will be learned the following year.

Subject content

Core content

- 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

Options

- 9 Astrophysics
- 10 Medical physics
- 11 Engineering physics
- 12 Turning points in physics
- 13 Electronics

The 'Turning Points' option module is taught in A2. We have chosen this one as it covers many exciting and varied aspects of Physics, including the discovery of the electron, wave-particle duality and special relativity.

Assessment

The AS assessment is split into two papers as follows:

Paper 1	Paper 2
What's assessed Sections 1–5	**What's assessed** Sections 1–5
Assessed • written exam: 1 hour 30 minutes • 70 marks • 50% of AS	**Assessed** • written exam: 1 hour 30 minutes • 70 marks • 50% of AS
Questions 70 marks of short and long answer questions split by topic.	**Questions** Section A: 20 marks of short and long answer questions on practical skills and data analysis Section B: 20 marks of short and long answer questions from across all areas of AS content Section C: 30 multiple choice questions

As the A2 is now a stand-alone qualification, the papers will contain content from both the first and second years of the course. They will be divided up as follows:

Paper 1	Paper 2	Paper 3
What's assessed Sections 1–5 and 6.1 (Periodic motion)	**What's assessed** Sections 6.2 (Thermal Physics), 7 and 8 Assumed knowledge from sections 1 to 6.1	**What's assessed** Section A: Compulsory section: Practical skills and data analysis Section B: Students enter for **one** of sections 9, 10, 11, 12 or 13
Assessed • written exam: 2 hours • 85 marks • 34% of A-level	**Assessed** • written exam: 2 hours • 85 marks • 34% 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.

Required Practicals

AQA has issued a list of 12 Required Practicals that you must complete throughout your course; 6 for Y12 and 6 for Y13.

The AS required practicals are:

Required activity	Apparatus and technique reference
1 Investigation into the variation of the frequency of stationary waves on a string with length, tension and mass per unit length of the string.	a, b, c, i
2 Investigation of interference effects to include the Young's slit experiment and interference by a diffraction grating.	a, j
3 Determination of g by a free-fall method.	a, c, d, k
4 Determination of the Young modulus by a simple method.	a, c, e
5 Determination of resistivity of a wire using a micrometer, ammeter and voltmeter.	a, b, e, f
6 Investigation of the emf and internal resistance of electric cells and batteries by measuring the variation of the terminal pd of the cell with current in it.	b, f, g

Over the two years, they will develop your skills in the use of the following apparatus and techniques:

	Apparatus and techniques
ATa	use appropriate analogue apparatus to record a range of measurements (to include length/distance, temperature, pressure, force, angles, volume) and to interpolate between scale markings
ATb	use appropriate digital instruments, including electrical multimeters, to obtain a range of measurements (to include time, current, voltage, resistance, mass)
ATc	use methods to increase accuracy of measurements, such as timing over multiple oscillations, or use of fiduciary marker, set square or plumb line
ATd	use stopwatch or light gates for timing
ATe	use calipers and micrometers for small distances, using digital or vernier scales
ATf	correctly construct circuits from circuit diagrams using DC power supplies, cells, and a range of circuit components, including those where polarity is important
ATg	design, construct and check circuits using DC power supplies, cells, and a range of circuit components
ATh	use signal generator and oscilloscope, including volts/division and time-base
ATi	generate and measure waves, using microphone and loudspeaker, or ripple tank, or vibration transducer, or microwave / radio wave source
ATj	use laser or light source to investigate characteristics of light, including interference and diffraction
ATk	use ICT such as computer modelling, or data logger with a variety of sensors to collect data, or use of software to process data
ATl	use ionising radiation, including detectors

Laser Investigation

Theory

What happens when a light wave passes through a single slit?

How about a double slit?

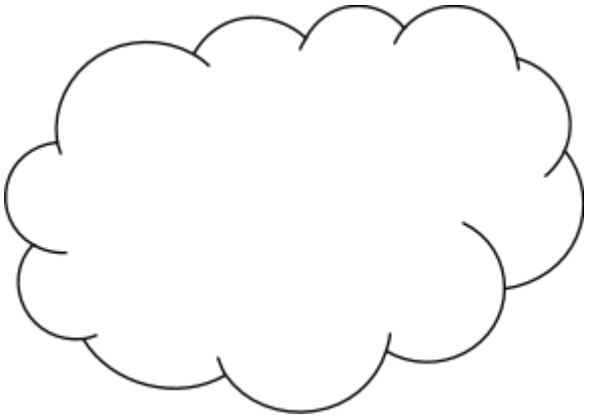
PEAK + PEAK =

TROUGH + TROUGH =

PEAK + TROUGH =

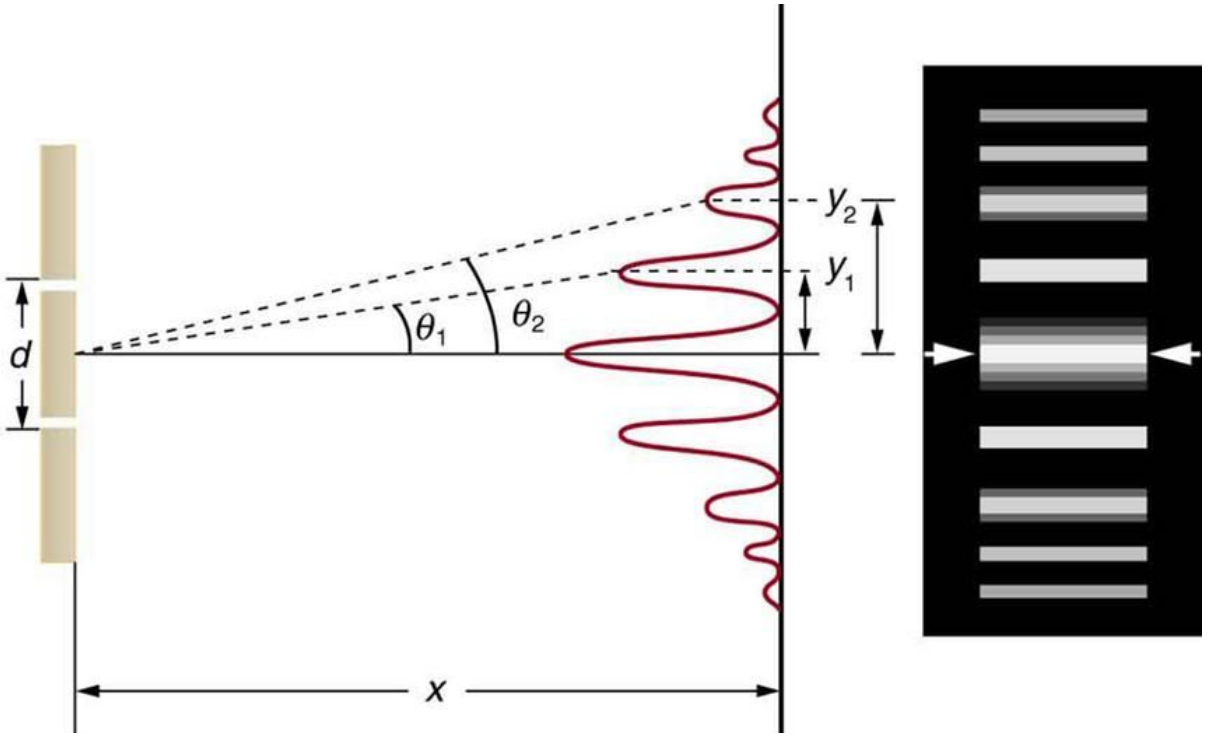
How can we calculate the wavelength of the light?

Equation:



Where:

- D =
- w =
- λ =
- s =



Practical Method

Observe health and safety:

1. Collect a tray with the laser and double slit set up. Carefully take the stand out of the tray and place onto the sheet of white paper.

2. Gently press the laser button so that the beam shines through the slits and makes a diffraction pattern on the paper.

3. Measure the distance (x) between the two widest visible fringes using a ruler:

$x =$ m

4. Count the number of fringes visible (N), including the two widest ones:

$N =$

5. Calculate the distance between each pair of fringes (w) using this equation:

$w = x \div (N\text{-}1)$

= m

6. Measure the distance between the slits and the paper (D):

D = m

7. The slits will have their separation (s) written on them. Use these values in the equation to calculate a value for λ:

s = m

Extension

8. Adjust the clamp stand so that it is approximately 5cm lower and repeat steps 3 to 6. Do this for at least 4 more lengths, recording your results in the table below:

x (m)	N	w (m)	D (m)	$D \div s$

9. Plot a graph of w on the y-axis and $D \div s$ on the x-axis. Draw a straight line of best fit. Draw a triangle to calculate gradient. This is your value for λ!

Holiday Tasks

1. The ABSOLUTE UNCERTAINTY of a measurement is ±half the smallest scale division.

For example, if I use a thermometer to measure the temperature of the room my result could be:

$$20°C \pm 0.5$$

What was the absolute uncertainty in your first measurement of *w*?

2. The PERCENTAGE UNCERTAINTY of a measurement is:

$$(\text{absolute uncertainty} \div \text{value}) \times 100.$$

What was the percentage uncertainty in your first value of *w*?

3. Thinking about errors – what was the biggest source of error in this experiment?

How could you reduce it if you did the experiment again?

4. The real value for the wavelength of the laser light is 630nm (0.00000063m). Find the percentage difference between this value and your value using the equation:

Percentage difference = ((your value – real value) ÷ real value) x 100

Write your answer as a positive percentage:

A percentage difference of 5% or less is considered to be a good level of accuracy. Comment on the accuracy of your value.

Complete these tasks to prepare you for the AS Level Content:

Topic 1 - Electricity

1. Write definitions for these key terms:
   - Current
   - Voltage
   - Power
   - Ammeter
   - Voltmeter
   - Resistance

2. Draw characteristic graphs for a diode, filament lamp, thermistor and LDR. Explain the shape of each.

3. How does current behave in a) a series circuit? b) a parallel circuit?

4. Find out what resistivity is and what equation is used to calculate it?

5. What is a superconductor? What are they used for?

Topic 2 – Particle Physics

1. Find out what Plum-pudding model of the atom was, who came up with it, and what experimental results led that person to propose it.

2. Rutherford later proposed the nuclear model of the atom following some experimental results from Geiger and Marsden's experiment with gold leaf. Draw a picture of his model and find out five facts about the experiment.
3. Complete the table below

Constituent of the atom	Symbol	Relative Charge	Charge (C)	Mass
Proton				

Neutron				
Electron				

4. What are the four fundamental forces of nature?
5. What is a quark?

Complete these tasks to prepare you for the AS Level mathematical skills requirements:

Prefixes

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 prefixes required.

s	ms	μs	ns	ps
134.6				
96.21				
0.773				

m	km	mm	Mm	Gm
12873				
0.295				
57.23				

kg	Mg	mg	g	Gg
94.76				
0.000765				
823.46				

A	mA	µA	nA	kA
0.000000678				
3.56				
0.00092				

Significant Figures

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	4130		
500	600	900		
3.038	4.925	3.6		
720	498	168		
1655	2996	140		
0.230	925.8	56300		
26017	19.1	0.186		
2238	80.1324	1.427		
9160.97	2011	34		
62.99	127.416	326.19		
155.56	11.97	1.4		

Rearranging and Deriving Equations

Rearrange $v^2 = u^2 + 2as$ to make *a* the subject	
Substitute this into $F = ma$	
Substitute this into the equation $P = Fv$	
Substitute this into the equation $E = Pt$	
Use $v = \frac{s}{t}$ to simplify the equation	

Substitute $v = u + at$ into the equation $\lambda = \frac{h}{mv}$	
Multiply out the brackets	
Substitute this into the equation $d \sin\theta = n\lambda$	
Rearrange the equation to find the angle to the 3rd maxima	

Substitute $R = \frac{V}{I}$ into the equation $\rho = \frac{RA}{l}$	
Substitute $V = \frac{E}{Q}$ into the equation	
Substitute $E = Pt$ into the equation	
Use $I = \frac{Q}{t}$ to remove *t* from the equation	
Simplify this	

Units

Write down the standard (SI) units for the following quantities.

Energy
Wavelength
Frequency
Power
Moment
Velocity
Acceleration
Mass
Weight
Force
Work Done
Density
Tensile Strength
Tensile Stress
Extension
Young's modulus
Refractive Index
Momentum
Impulse

You will have a test on these tasks in your second week back.