SUMMER PREPARATORY WORK

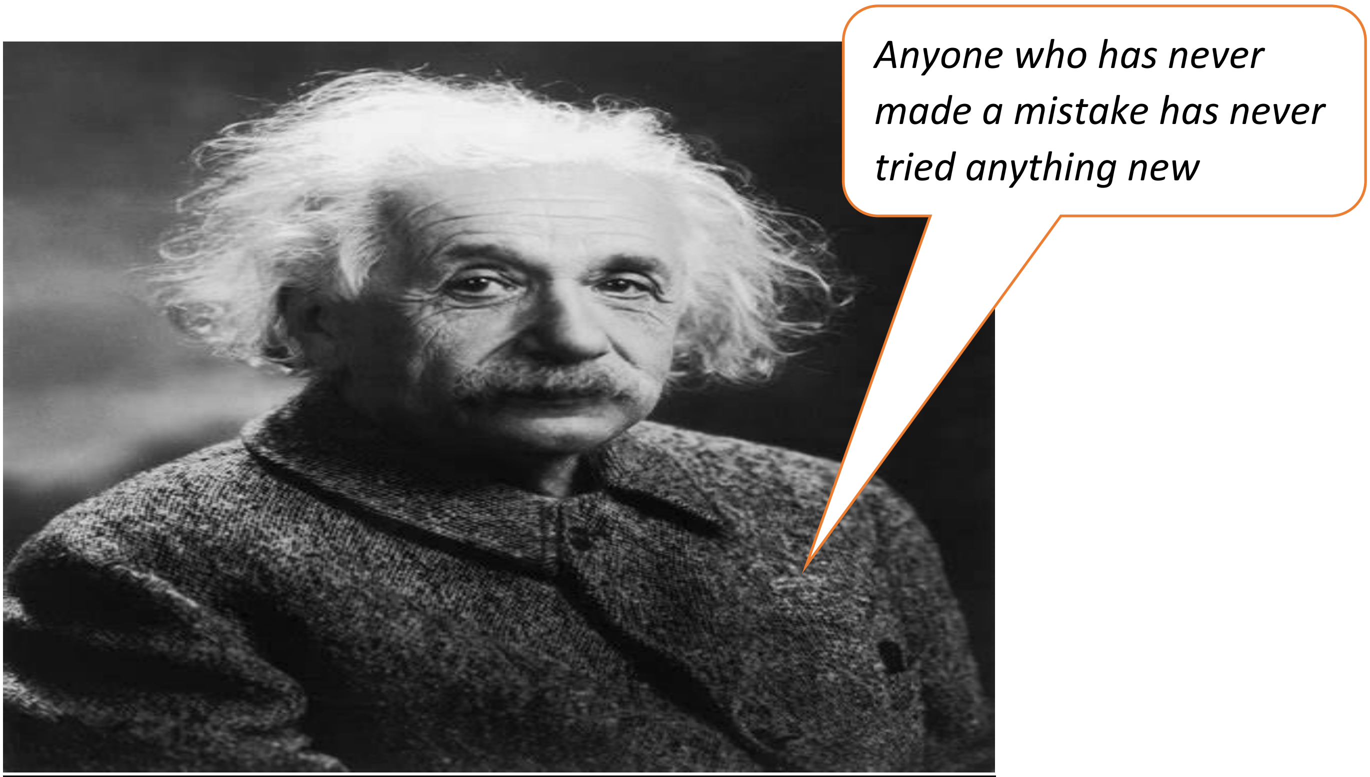
AS LEVEL PHYSICS

Central
Saint Michael's
Sixth Form

A UNIVERSITY-STYLE SIXTH FORM

A Level Physics

Bridging the Gap.



Welcome to Physics at Central Saint Michael's Sixth Form! This is your 'Bridging the Gap' task for A level Physics, which you've chosen to take at A level this September. The pack is designed to give you a flavour of what A level Physics is all about. The pack will introduce you to some basic concepts, to aid your understanding of physics ready for sixth form. You will also be set an independent research project. The work in these packs will take a long time, so you can break it up. Don't feel you need to complete it all in one go! You can complete the tasks in this booklet in the spaces provided or type them up separately.

You will need to bring your completed work along with you when you start sixth form in September.

If you have any questions please do not hesitate to contact me on Avtar.singh@sandwell.ac.uk

A Level Physics AQA course outline		
First Year:	**Second years (A Level):**	**Options include:**
Measurements and their errors	Further mechanics	Astrophysics
Particles, Waves & Radiation	Thermal Physics	Medical physics
Mechanics and materials	Fields and their consequences	Engineering physics
Electricity	Nuclear physics	*Turning points in physics*

A Level Physics.

Physics Induction

Objectives:

- *To give you the skills needed for the successful study of Physics.*
- *To help you to identify areas in which you might need help.*

There are several areas in which students struggle:

- Use of symbols;
- Use of SI units;
- Use of a calculator;
- Use of formulae;
- Presentation of data;
- Plotting of the data in a graph;
- Interpretation of graphical data.

These notes and activities are to help you to become confident with these basic skills, which will help your studies to be more productive and enjoyable.

Using Symbols

An **equation** is a mathematical model that sums up how a system behaves. For example, we know that, if we have a current flowing through a wire and double the voltage, the current will double as well. We know that the quantities of current and voltage are related by the simple rule:

$$V = IR$$

In physics problems we are given certain quantities and use them to find an unknown quantity with an equation. There are some basic equations that you will have to learn for the exams. These are written down for you in a data booklet which you can use in the exam.

1. Write down three equations that you can remember from GCSE (3)

Symbols

In GCSE you were often given equations in words:

Distance (m) = speed (m/s) × time (s)

The symbols all mean something; they are abbreviations. The symbols used in exams and most textbooks are those agreed by the Association of Science Education.

Some symbols are easy; *V* stands for voltage. Some are not so easy. *I* for current comes from the French *intensité du courant*, since it was a French physicist who first worked on it. In print you will always find the codes written in *italics*.

2. What are the meanings for these symbols? (7)
a
A
F
M
I
P
Q

You will come across codes written in Greek letters. The normal (Latin) alphabet has 26 characters, including:

Greek	*Name*	*Letter*	*Greek*	*Name*	*Letter*
α	alpha	a	ν	nu	n
β	beta	b	ξ	xi	x
γ	gamma	g	ο	omicron	Short o (ŏ)
λ (Λ)	lambda	l (L)	ψ (Ψ)	psi	ps
μ	mu	m	ω (Ω)	omega	Long o [ō (Ō)]

3 The wave equation is $c = f\lambda$. What do the codes refer to? (3)
c
f
λ

4 Find two other formulae that use Greek letters (2)

Units

Physics formulae use **SI** (Système International) **units** based on seven **base units**:

- **Distance** – metre (m);
- **Mass** – kilogram (kg);
- **Time** – second (s);
- **Temperature** – Kelvin (K);
- **Current** – ampere (A);
- **Amount of substance** – mole (mol);
- **Intensity of light** – candela (cd) [which you will not come across at A-level.]

Many physics formulae will give you the right answer ONLY if you put the quantities in SI units. This means that you have to convert. You will often find units that are prefixed, for example <u>kilo</u>metre. The table below shows you the commonest prefixes and what they mean:

Prefix	***Symbol***	***Meaning***	***Example***
pico	p	$\times 10^{-12}$	1 pF
nano	n	$\times 10^{-9}$	1 nF
micro	μ	$\times 10^{-6}$	1 μg
milli	m	$\times 10^{-3}$	1 mm
centi	c	$\times 10^{-2}$	1 cm
kilo	k	$\times 10^{3}$	1 km
Mega	M	$\times 10^{6}$	1 MΩ
Giga	G	$\times 10^{9}$	1 GWh

When converting, it is perfectly acceptable to write the number and the conversion factor. For example:

$$250 \text{ nm} = 250 \times 10^{-9} \text{ m} = 2.5 \times 10^{-7} \text{ m}$$

5 Convert the following quantities to SI units: (5)	
15 cm	
500 g	
3 km	
35 mV	
220 nF	

When you write out your answer, you must always put the correct **unit** at the end. The number 2500 on its own is meaningless; 2500 J gives it a meaning.

Failure to put units in loses 1 mark in the exam, which is 2 %. Repeated across a paper, it can mean the difference of two grades.

This little character is about to walk into a common bear trap by failing to convert into SI units.

Converting areas and volumes causes a lot of problems.

$1 \text{ m}^2 \neq 100 \text{ cm}^2$.

$1 \text{ m}^2 = 100 \text{ cm} \times 100 \text{ cm} = 10\,000 \text{ cm}^2 = 10^4 \text{ cm}^2$

6 Convert the following:	(4)
$1\ m^2 =$	mm^2
$0.45\ mm^2 =$	m^2
$1\ cm^3 =$	m^3
$22.4\ dm^3 =$	m^3

Standard Form

Standard form consists of a number between 1 and 10 multiplied by a **power** of 10. For big numbers and very small numbers standard form is very useful.

7. Comment on what happens if you try to put the following numbers into your calculator as they are. Can you do any calculations on them? (a) 3200 (b) 5 600 000 (c) 2 800 000 000 000 (d) 0.000000000000341 (2)

You should have found that very small numbers entered into a calculator are read as 0, unless they are entered as standard form. The following number is shown in standard form:

$$\mathbf{3.28 \times 10^5}$$

$$= 3.28 \times 100\,000 = 328\,000$$

Look at this number:

4 505 000 000 000 000 000

Start counting from here to get the power of 10.

We find that there are 18 digits after the first digit, so we can write the number in standard form as:

$$4.505 \times 10^{18}$$

For fractions we count how far back the first digit is from the decimal point:

0.00000342

In this case it is six places from the decimal point, so it is:

$$3.42 \times 10^{-6}$$

A negative power of ten (negative index) means that the number is a fraction, i.e. between 0 and 1.

8. Convert these numbers to standard form: (7)
86
381
45300
1 500 000 000

Too Many Significant Figures

Consider this calculation:

$$V_{rms} = \frac{13.6}{\sqrt{2}}$$

Your calculator will give the answer as Vrms = 9.6166526 V

There is no reason at all in A-level Physics to write any answer to any more than 3 significant figures. Three significant figures is claiming accuracy to about one part in 1000. Blindly writing your calculator answer is claiming that you can be accurate to one part in 100 million, which is absurd.

The **examination mark schemes** give answers that are no more than 2 significant figures. So our answer becomes:

Vrms = 9.62 V (3 s.f.)

Vrms = 9.6 V (2 s.f.)

Do any **rounding** up or down at the end of a calculation. If you do any rounding up or down in the middle, you could end up with rounding errors.

9. Use your calculator to do the following calculations. Write your answers to no more than three significant figures. (10)

	ANSWER
(a) $\frac{3.4 \times 10^{-3} \times 6.0 \times 10^{23}}{235}$	
(b) $\frac{27.3^2 - 24.8^2}{\sqrt{38}}$	
(c) 1.4509^3	
(d) sin 56.4	
(e) $\cos^{-1} 0.4231$	

Some other tips on use of calculators:

- On most calculators the number is keyed in before the function (sin, cos, log)
- Take one step at a time and write intermediate results.
- It is easy to make a mistake such as pressing the × key rather than the ÷ key. It is a good idea to do the calculation again as a check.
- As you get more experienced, you will get a feel for what is a reasonable answer. 1000 N is a reasonable force that a car would use to accelerate; 2×10^{-10} N is most certainly not.

Task two: Write an essay on *your* favourite Physicist

10 famous physicists and their contributions are listed below, you may want to choose one on the list:

1. Isaac Newton quantified and qualified the laws of motion and gravity. He also invented the reflecting telescope and co-invented the mathematic process of calculus.

2. Albert Einstein developed theories of relativity, and won a Nobel Prize for his work on the photoelectric effect.

3. Galileo Galilei improved on the refracting telescope and discovered the four largest moons of Jupiter, but he is most well-known for standing up for Copernican theories of a heliocentric universe against church authority and opposition.

4. Michael Faraday showed how a changing magnetic field can be used to generate an electric current, used today in modern electric generators.

5. Johannes Kepler outlined the three laws of planetary motion and described the motion of planets around the sun as elliptical. Much of Kepler's work laid the groundwork for Newton's discoveries.

6. Archimedes was an ancient Greek, one of the first physicists. He developed many formulas for area of various shapes, and he also worked extensively with levers. In addition, he described the concept of buoyancy and invented Archimedes' screw to raise water.

7. Nikola Tesla championed the alternating current of electric flow, which is the means by which electric current is carried in the modern world. Tesla also improved upon the transformer and the electric bulb, and invented the Tesla coil.

8. Max Planck is known as the father of quantum mechanics, and showed how the energy of a photon is proportional to its frequency.

9. James Maxwell developed equations for electromagnetism and the kinetic theory of gases, and predicted that there were types of radiation beyond visible light.

10. Marie Curie discovered radioactivity and isolated plutonium and radium.

Task Three: Write about a practical you enjoyed at school or one that you have heard about e.g. discovery of Gravitational waves or the Higgs Boson?

http://www.iop.org/resources/topic/archive/gravitational-waves/page_67003.html

https://beta.iop.org/standard-model

Have a good summer and I will see you in September!

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