

# Bridging the Gap between GCSE and A level Physics

Many students find that Physics is a challenging but rewarding course, that develops their skills in practical work and mathematics as well as deepening their knowledge of the way the universe works. At first, AS and A-level physics can seem quite a jump from GCSE, these activities are designed to help ease the transition. You may find yourself returning to some of this information throughout the course, so keep this work safe and bring it in to your first physics lesson in Year 12.

## SI units

Every measurement must have a size (eg 2.7) and a unit (eg metres or ° C). Sometimes, there are different units available for the same type of measurement. For example, ounces, pounds, kilograms and tonnes are all used as units for mass.

To reduce confusion and to help with conversion between different units, there is a standard system of units called the SI units which are used for most scientific purposes.

These units have all been defined by experiment so that the size of, say, a metre in the UK is the same as a metre in China.

The seven SI base units are:

Physical quantity	Usual quantity symbol	Unit	Abbreviation
mass	$m$	kilogram	kg
length	$l$ or $x$	metre	m
time	$t$	second	s
electric current	$I$	ampere	A
temperature	$T$	kelvin	K
amount of substance	$N$	mole	mol
luminous intensity	(not used at A-level)	candela	cd

The most common prefixes you will encounter are:

Prefix	Symbol	Multiplication factor		
Tera	T	$10^{12}$	1000000000000	
Giga	G	$10^9$	1000000000	
Mega	M	$10^6$	1000000	
kilo	k	$10^3$	1000	
deci	d	$10^{-1}$	0.1	1/10
centi	c	$10^{-2}$	0.01	1/100
milli	m	$10^{-3}$	0.001	1/1000
micro	$\mu$	$10^{-6}$	0.000001	1/1000000
nano	n	$10^{-9}$	0.000000001	1/1000000000
pico	p	$10^{-12}$	0.000000000001	1/1000000000000

## Activity 1: Which SI unit and prefix would you use for the following quantities?

1. The mass of water in a test tube
2. The time taken for the Earth to spin on its axis
3. The distance to the Moon
4. The thickness of a piece of paper
5. The amount of particles in a beaker of sand
6. The temperature of the Sun

## Activity 2: Important vocabulary for practical work

There are many words used in practical work. You will have come across most of these words in your GCSE studies. It is important you are using the right definition for each word.

Join the boxes below to link the word to its definition.

Accurate	The interval within the true value can be expected to lie.
Data	Measurements where repeated measurements show very little spread.
Precise	An experiment that gives the same results when the same experimenter uses the same method and equipment.
Prediction	A variable that is changed by the person carrying out an experiment.
Range	An experiment that gives the same results when a different person carries it out, or a different set of equipment or technique is used.
Repeatable	A variable that is kept constant during an experiment.
Reproducible	A statement suggesting what may happen in the future.
Resolution	A variable that is measured as the outcome of an experiment.
Uncertainty	Information, in any form, that has been collected.
Variable	The spread of data, showing the maximum and minimum values of the data.
Control variable	Physical, chemical or biological quantities or characteristics.
Dependent variable	This is the smallest change in the quantity being measured (input) of a measuring instrument that gives a perceptible change in the reading.
Independent variable	Close to the true value

## Maths for Physics

Physics uses the language of mathematics to make sense of the world. It is important that you are able to use maths. The following exercises will help you to practise some of the maths you will have covered during your GCSE studies to help with your A-level course.

### Activity 3: Standard form

1 Write in standard form

(a) 379.4

(b) 0.0712

2 Write as ordinary numbers (use the data sheet at the end of the document)

a) The speed of light

(b) The charge on an electron

3 Write one quarter of a million in standard form.

4 Write these numbers in ascending order (ignoring units):

permeability of free space; the Avogadro constant; proton rest mass;

acceleration due to gravity; mass of the Sun

5 Work out the value of the following. Give your answer in standard form.

The mass of an electron / the mass of the Earth

6 Solve  $(2.4 \times 10^7) x = 1.44 \times 10^9$  Give your answer in standard form.

### Activity 4: Decimal places, significant figures and rounding

1 How many rockets would be needed to deliver 30 tonnes of material to a space station, if every rocket could hold 7 tonnes?

2 A power station has an output of 3.5 MW. The coal used had a potential output of 9.8 MW

Work out the efficiency of the power station. Give your answer to one decimal place.

3 A radioactive source produces 17804 beta particles in 1 hour.

Calculate the mean number of beta particles produced in 1 minute.

Give your answer to one significant figure.

### Activity 5: Rearranging formulas

- 1 Rearrange  $y = 2x + 3$  to make  $x$  the subject.
- 2 Rearrange  $C = 2\pi r$  to make  $r$  the subject.
- 3 Rearrange  $E = \frac{1}{2}mv^2$  to make  $v$  the subject.
- 4 Rearrange  $s = ut + \frac{1}{2}at^2$  to make  $u$  the subject.
- 5 Rearrange  $s = ut + \frac{1}{2}at^2$  to make  $a$  the subject.
- 6 Rearrange  $\omega = \frac{v}{r}$  to make  $r$  the subject.
- 7 Rearrange  $T = 2\pi \sqrt{\frac{r}{g}}$  to make  $r$  the subject.
- 8 Rearrange  $v = \omega \sqrt{A^2 - x^2}$  to make  $x$  the subject
- 9 Rearrange  $F = \frac{Gm_1m_2}{r^2}$  to make  $m_2$  the subject.
- 10 Rearrange  $F = \frac{Gm_1m_2}{r^2}$  to make  $r$  the subject.

### Activity 6 : Wider reading and research

These are important skill to develop to achieve success at A level. To get you started choose one of the activities below. Bring in your research on the first Physics lesson in September.

EITHER: **Search Youtube minute physics**

[https://www.youtube.com/results?search\\_query=minute+physics](https://www.youtube.com/results?search_query=minute+physics) Choose any one minute physics topic that you are interested in and produce a short review using the criteria below.

OR: **Search new scientist**

<http://www.newscientist.com/topic/lastword/> Choose any physics related article you are interested in and produce a short summary using the criteria below

You should include

- **The topic**
- **An overview/ quick summary**
- **At least 5 bullet point facts from the video**

## Data sheet

Quantity	Symbol	Value	Units
speed of light in vacuum	$c$	$3.00 \times 10^8$	$\text{m s}^{-1}$
permeability of free space	$\mu_0$	$4\pi \times 10^{-7}$	$\text{H m}^{-1}$
permittivity of free space	$\epsilon_0$	$8.85 \times 10^{-12}$	$\text{F m}^{-1}$
magnitude of the charge of electron	$e$	$1.60 \times 10^{-19}$	C
the Planck constant	$h$	$6.63 \times 10^{-34}$	J s
gravitational constant	$G$	$6.67 \times 10^{-11}$	$\text{N m}^2 \text{kg}^{-2}$
the Avogadro constant	$N_A$	$6.02 \times 10^{23}$	$\text{mol}^{-1}$
electron rest mass	$m_e$	$9.11 \times 10^{-31}$	kg
proton rest mass	$m_p$	$1.67(3) \times 10^{-27}$	kg
neutron rest mass	$m_n$	$1.67(5) \times 10^{-27}$	kg
gravitational field strength	$g$	9.81	$\text{N kg}^{-1}$
acceleration due to gravity	$g$	9.81	$\text{m s}^{-2}$
atomic mass unit	u	$1.661 \times 10^{-27}$	kg
mass of the Sun		$1.99 \times 10^{30}$	kg
mean radius of the Sun		$6.96 \times 10^8$	m
mass of the Earth		$5.98 \times 10^{24}$	kg
mean radius of the Earth		$6.37 \times 10^6$	m