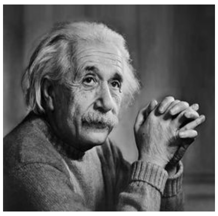
AQA A Level Physics

Transition from Year 11 to Year 12

"If you can't explain it simply, you don't understand it well enough."



Albert Einstein

You Do Not need to print this entire booklet.
If you can, please print the EXERCISE answer pages.
If you are unable to print, set out your answers NEATLY on paper or in your exercise book.
Make sure your name is on every Answer Sheet

AQA A Level Physics

Transition from Year 11 to Year 12 Physics

Entry Requirements

At least a grade B in Physics or grades BB in Double Science plus a grade B in mathematics

Specification

We follow the AQA A Physics 'A' course 7407

https://filestore.aqa.org.uk/resources/physics/specifications/AQA-7407-7408-SP-2015.PDF

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
9 Astrophysics

Assessments

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.

Assessment of practical work

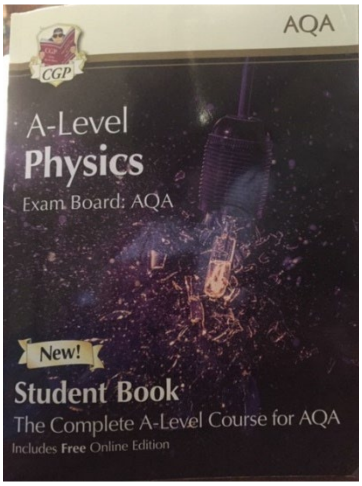
There is no coursework. Practical skills are assessed in the written papers. There will also be a set of core-practical activities that students will complete. The students' performance in this will be reported separately, with an endorsement to those who pass.

The A Level grades will be based only on marks from written exams, but the exams contains questions on the practical skills assessed.

Recommended Text Book

AQA A – Level Physics Student Book by CGP

Please do NOT BUY this until after you have your results and are sure this is the right course for you.



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Maths Skills

Chapter 1: Introduction

You started to look at formulae at KS4. The purpose of this introductory unit is to help you develop the core skills needed to solve the numerical problems met at A level.

The key to success is to break numerical problems, where calculations are necessary, into smaller, simpler steps which can be followed every time. The steps can be summarised as follows:-

EXERCISE 1 – Answering Numerical questions

Read the following very, very carefully!

Step 1: *Write down the values of everything you are given and put a question mark next to what you are asked to work out.*

Step 2: *Convert all the values into SI units i.e. time in seconds, distances in metres and so on.*

Step 3: *Pick an equation that contains the values we know and the quantity we are trying to work out.*

Step 4: *Re-arrange the equation so what we are trying to work out is the subject.*

Step 5: *Insert the values into the equation including the units.*

Step 6: *Type it into our calculator to get the answer and quote the answer to a reasonable number of significant figures and with units.*

Step 7: *Pause for one moment and think about if our answer is sensible.*

With experience some of these steps can be done more quickly or in your head but you should always show your working. This is for several reasons:-

1. If you don't show your working, you will needlessly lose many marks in the exam (probably enough to drop your score by one whole grade, i.e. from B → C).
2. It will help make the steps outlined above more apparent and easy to follow when tackling numerical problems.
3. It makes it easier for the teacher to see where you have gone wrong and therefore help you learn more quickly and effectively.

Chapter 2: Physical Quantities/Units

When we first look at numerical problem in Physics then we need to be able to recognise what quantities we are given in the question. We can classify physical quantities as either Basic or Derived.
There are seven basic quantities, (or SI Units).

BASIC		
These are **fundamental** which are **defined** as being independent		
Basic Quantity	**Name**	**Symbol**
Mass	Kilogram	kg
Length	Metre	m
Time	Second	s
Electric current	Ampere	A
Temperature	Kelvin	K
Amount of a substance	Mole	mol
Luminous intensity	Candela	cd

You need to be able to recall all of the Base quantities and their units

EXERCISE 2a – memorise the base units – we WILL test you!

All other quantities and their units are DERIVED		
These are obtained by multiplication or division of the basic units **without** numerical factors (no numbers) – here are some examples		
Derived quantity	**Name**	**Symbols used**
Volume	Cubic metre	m^3
Velocity	Metre per second	ms^{-1}
Density	Kilogram per cubic metre	kgm^{-3}

Some derived SI units are complicated so are given a new simpler name and unit, defined in terms of the base units. eg

Farad (F) is given as $m^{-2}kg^{-1}s^4A^2$ **Watt** (W) is given as m^2kgs^{-3}

On the next page is a table of quantities with their units, along with the most commonly used symbols for both the quantities and units. Note that in GCSE we wrote units like metres per second in the format of m/s, in A-level it is written as ms^{-1} (Although m/s is still fine).

Table of base and then derived quantities, and their units			
Quantity	**Quantity Symbol**	**SI Unit**	**unit symbol**
Length	L or l	Metre	m
Distance	s	Metre	m
Height	h	Metre	m
Thickness (of a Wire)	d	Metre	m
Wavelength	λ	Metre	m
Mass	m or M	kilogram	kg
Time	t	second	s
Period	T	second	s
Temperature	T	Kelvin	K
Current	I	Ampere	A
Potential Difference	V	Volt	V
Area	A	Metres squared	m^2
Volume	V	Metres cubed	m^3
Density	ρ	Kilograms per metre	$kg\ m^{-3}$
Force	F	Newton	N
Initial Velocity	u	Metres per second	ms^{-1}
Final Velocity	v	Metres per second	ms^{-1}
Energy	E	Joule	J
Kinetic Energy	E_K	Joule	J
Work Done	W	Joule	J
Power	P	Watt	W
Luminosity	L	Watt	W
Frequency	f	Hertz	Hz
Charge	Q	Coulomb	C
Resistance	R	Ohm	Ω
Electromotive Force	ε	Volt	V
Resistivity	ρ	Ohm Metre	Ωm
Work Function	ϕ	Joule	J
Momentum	p	kilogram metres per	$kg\ ms^{-1}$
Specific Charge		Coulombs per kilogram	$C\ kg^{-1}$
Planck's Constant	h	Joule seconds	Js
Gravitational Field	g	Newtons per kilogram	$N\ kg^{-1}$

This table needs to be memorised

It will significantly improve your ability to answer numerical questions.

EXERCISE 2b - identify the information you have been given **Name ________________**

For each of the following questions write down the quantities you are trying to work out and write a question mark next to the quantity you are asked to find out with SI units shown. Note - you don't have to know any equations or any physics, it is a simply an exercise in recognising what you are being given in the question and what you are being asked to find out.

You are NOT expected to calculate an answer,!!!

For many of these you will not know the equation!

Example

Find the momentum of a 70 kg ball rolling at 2 ms^{-1}.

m=70 kg

v= 2 ms^{-1}

p= ? kg ms^{-1}

1. The resultant force on a body of mass 4.0 kg is 20 N. What is the acceleration of the body?
2. A particle which is moving in a straight line with a velocity of 15 ms^{-1} accelerates uniformly for 3.0s, increasing its velocity to 45 ms^{-1}. What distance does it travel whilst accelerating?
3. A man of mass 75 kg climbs 300 m in 30 minutes. At what rate is he working?
4. What is the maximum speed at which a car can travel along a level road when its engine is developing 24kW and there is a resistance to motion of 800 N?
5. Find the current in a circuit when a charge of 40 C passes in 5.0s.
6. What is the resistance of a copper cylinder of length 12 cm and cross-sectional area 0.40 cm^2 (Resistivity of copper = 1.7×10^{-8} Ωm)?
7. When a 12 V battery (i.e. a battery of EMF 12 V) is connected across a lamp with a resistance of 6.8 ohms, the potential difference across the lamp is 10.2 V. Find the current through the lamp.
8. Calculate the de Broglie wavelength of an electron moving at 3.0×10^{6} ms^{-1} (Planck's constant = 6.63×10^{-34} Js, mass of electron = 9.1×10^{-31} kg).

Chapter 3: Standard Form

You will already be familiar with Standard Form from GCSE Maths. Why use standard form? Standard form is used to make very large or very small numbers easier to read. Standard form also makes it easier to put large or small numbers in order of size.

In Physics, we often deal with quantities that are either really large…
1 parsec = 30,900,000,000,000,000 m

…or really small
Planck's Constant, h = 0.000000000000000000000000000000000663 Js

It would be time consuming to write out numbers like this over and over again and so we use a different notation, standard form. Standard form shows the magnitude (size) of the number as powers of ten. We write a number between 1 and 10 and then show it multiplied by a power of 10.

For example

	1.234×10^4	1.234×10^{-4}
This means	$1.234 \times (10 \times 10 \times 10 \times 10)$	$1.234 \times (1 \div 10 \div 10 \div 10 \div 10)$
Which is	12340	0.0001234

More examples

$0.523 = 5.23 \times 10^{-1}$	(note that $\times 10^{-1}$ means divide 5.23 by 10)
$52.3 = 5.23 \times 10^{1}$	(note that $\times 10^{1}$ means multiply 5.23 by 10)
$523 = 5.23 \times 10^{2}$	(note that $\times 10^{2}$ means multiply 5.23 by 100)
$5230 = 5.23 \times 10^{3}$	(note that $\times 10^{3}$ means multiply 5.23 by 1000)

(To go back to the examples from above:- 1 pc = 3.09×10^{16} m, h = 6.63×10^{-34} Js)

This is a much shorter way of writing these numbers.
To put a list of large numbers in order of magnitude is difficult because it takes time to count the number of digits and hence determine the magnitude of the number.

EXERCISE 3- Standard Form Name ____________________

1. Put these numbers in order of size,
   5239824 , 25634897 , 5682147 , 86351473 , 1258964755 , 142586479, 648523154

But it is easier to order large numbers when they are written in standard form.

2. Put these numbers in order of size,
   5.239×10^6 , 2.563×10^7 , 5.682×10^6 , 8.635×10^7 , 1.258×10^9 , 1.425×10^8 , 6.485×10^8

You can see that it is easier to work with large numbers written in standard form. To do this we must be able to convert from one form into the other.

3. Convert these numbers into normal form.

a) 5.239×10^3
b) 4.543×10^4
c) 9.382×10^2
d) 6.665×10^6
e) 1.951×10^2
f) 1.905×10^5
g) 6.005×10^3

4. Convert these numbers into standard form.

a) 65345
b) 28748
c) 548454
d) 486856
e) 70241
f) 65865758

Standard form can also be used to write small numbers e.g. 0.00056 = 5.6×10^{-4}

5. Convert these numbers into normal form.

a) 8.34×10^{-3}
b) 2.541×10^{-8}
c) 1.01×10^{-5}
d) 8.88×10^{-1}
e) 9×10^{-2}
f) 5.05×10^{-9}

6. Convert these numbers to standard form.

a) 0.000567
b) 0.987
c) 0.0052
d) 0.0000605
e) 0.008
f) 0.0040302

7. Calculate, giving answers in standard form,

a) $(3.45 \times 10^{-5} + 9.5 \times 10^{-6}) \div 0.0024$

b) $2.31 \times 10^5 \times 3.98 \times 10^{-3} + 0.0013$

Chapter 4: Converting Units to SI Units

Some common non-SI units that you will encounter during Year 12 Physics:-

Quantity	Quantity Symbol	Alternative Unit	Unit Symbol	Value in SI Units
Energy	E	electron volt	eV	1.6×10^{-19} J
Charge	Q	charge on electron	e	1.6×10^{-19} C
Mass	m	atomic mass unit	u	1.67×10^{-27} kg
Mass	m	tonne	t	10^{3} kg
Time	t	hour	hr	3,600 s
Time	t	year	yr	3.16×10^{7} s
Distance	d	miles	miles	1,609 m
Distance	d	astronomical unit	AU	3.09×10^{11} m
Distance	d	light year	ly	9.46×10^{15} m
Distance	d	parsec	pc	3.09×10^{16} m

You should recognise these units and also be able to change them to SI units and back again.

Example

The nearest star (other than the Sun) to Earth is Proxima Centauri at a distance of 4.24 light years. What is this distance expressed in metres?

4.24 light years = $4.24 \times 9.46 \times 10^{15}$ m = 4.01×10^{16} m

What is this distance expressed in parsecs? Ans 4.01×10^{16} m = $4.01 \times 10^{16} / 3.09 \times 10^{16}$ m = 1.30 pc

EXERCISE 4a - Convert the following quantities:- **Name ___________________**

1. What is 13.6 eV expressed in joules?
2. What is a charge of 6e expressed in coulombs?
3. An atom of Lead-208 has a mass of 207.9766521 u, convert this mass into kg.
4. What is 2.39×10^8 kg in tonnes?
5. It has been 44 years since England won the World Cup, how long is this in seconds?
6. A TV program lasts 2,560s, how many hours is this?
7. The semi-major axis of Pluto's orbit around the Sun is 5.91 × 1012m, what is this distance in AU?

Converting Speeds

Things get a little more complicated when you have to convert speeds. For example, if Usain Bolt runs at an average speed of 10.4 ms^{-1}, what is this speed in miles per hour?

1. Change from ms^{-1} to miles s^{-1}:- **Ans** 10.4 ms^{-1} = 10.4 /1609 miles s^{-1} = 6.46×10^{-3} miles s^{-1}
2. Change from miles s^{-1} to miles hr^{-1} **Ans** 6.46×10^{-3} miles s^{-1} = $6.46 \times 10^{-3} \times 3{,}600$ miles hr^{-1} = 23.3 miles hr^{-1}

EXERCISE 4b

1. Convert 0.023 kms^{-1} into ms^{-1}.
2. Express 3456 m hr^{-1} into km hr^{-1}
3. What is 30 miles hr^{-1} in ms^{-1}?
4. Convert 33 km hr^{-1} into ms^{-1}.
5. Express 234 miles hr^{-1} in km hr^{-1}.

Chapter 5: Prefixes & Converting Unit Magnitudes - How to use and convert prefixes

Often in Physics, quantities are written using prefixes which is an even shorter way of writing numbers than standard form. For example instead of writing 2.95×10^{-9} m we can write 2.95 nm where n means nano and is a short way of writing $\times 10^{-9}$. Here is a table that shows all the prefixes you need to know in Year 12 Physics.

Prefix	Symbol	Name	Multiplier
femto	f	quadrillionth	10^{-15}
pico	p	trillionth	10^{-12}
nano	n	billionth	10^{-9}
micro	µ	millionth	10^{-6}
milli	m	thousandth	10^{-3}
centi	c	hundredth	10^{-2}
deci	d	tenth	10^{-1}
deka	da	ten	10^{1}
hecto	h	hundred	10^{2}
kilo	k	thousand	10^{3}
mega	M	million	10^{6}
giga	G	billion†	10^{9}
tera	T	trillion†	10^{12}
peta	P	quadrillion	10^{15}

It is essential that you know these, to ensure that you don't lose easy marks when answering numerical problems. **NOTE: The prefixes in pink are not required knowledge for this specification.**

When you are given a variable with a prefix you must convert it into its numerical equivalent in standard form before you use it in an equation.

FOLLOW THIS! Always start by replacing the prefix symbol with its equivalent multiplier.

For example: 0.16 µA = 0.16×10^{-6} A

3 km = 3000m = 3×10^{3} m

10 ns = 10×10^{-9} s

NOTE for the first example – don't write it out like this, '0.00000016 A', as you are bound to get the number of zeros wrong!!!)

EXERCISE 5a – using Prefixes

Name ____________________

1. 1.4 kW =	2. 10 μC =
3. 24 cm =	4. 340 MW =
5. 46 pF =	6. 0.03 mA =
7. 52 Gbytes =	8. 43 kΩ =

EXERCISE 5b – distance prefixes

Convert the following: (Remember that milli = 10^{-3} and centi = 10^{-2})

1. 5.46m to cm
2. 65mm to m
3. 3cm to m
4. 0.98m to mm
5. 34cm to mm
6. 76mm to cm

Converting between unit magnitudes for areas and volumes

When we convert areas and volumes, we MUST NOT forget to square or cube the unit.

Example

Let's take the example of converting a sugar cube of volume 1 cm^3 into m^3.

If we just use the normal conversion, then 1 cm^3 = 1×10^{-2} m^3 ← **Wrong Answer!**

STOP! Let's think about this one second:

Imagine in your head a box 1m by 1m by 1m, how many sugar cubes could you fit in there?

A **lot** more than 100! That would only fill up one line along one of the bottom edges of the box!

So our answer must be wrong.

What we have to do is do the conversion and then cube it, like this:- 1 cm^3 = $1 (\times 10^{-2}\ m)^3 = 1 \times 10^{-6}\ m^3$.

So this means we could fit a million sugar cubes in the box, which is right.

EXERCISE 5c – converting between areas and volumes

1. What is 5.2 mm^3 in m^3?
2. What is 24cm^2 in m^2?
3. What is 34 m^3 in μm^3?
4. What is 0.96 x 10^6 m^2 in km^2?
5. Convert 34 Mm^3 into pm^3.

Chapter 6: Re-arranging Equations

You can rearrange an equation , $a = b \times c$ with

b as the subject $\quad b = \frac{a}{c}$

or

c as the subject $\quad c = \frac{a}{b}$

Worked examples

Equation	First Rearrangement	Second Rearrangement
$v = f \times \lambda$	$f = \frac{v}{\lambda}$	$\lambda = \frac{v}{f}$
$T = \frac{1}{f}$	$1 = T \times f$	$f = \frac{1}{T}$
$\frac{1}{v} = \frac{1}{u} + \frac{1}{f}$	$1 = v \times \left(\frac{1}{u} + \frac{1}{f}\right)$	$v = \frac{1}{\frac{1}{u} + \frac{1}{f}}$

THINK!

As you can see from the third worked example, not all rearrangements are useful.

In fact, for the lens equation only the second rearrangement can be useful in problems.

So, in order to improve your critical thinking and know which rearrangement is the most useful in every situation, you must practise with as many equations as you can.

From now on the multiplication sign will not be shown, so

$a = b \times c$

will be simply written as

$a = bc$

EXERCISE 6 – Rearranging Equations

Name____________________

Equation	First Rearrangement	Second Rearrangement
(Power of lens) $P = \frac{1}{f}$	$1 =$	$f =$
(Magnification of lens) $m = \frac{v}{u}$	$v =$	$u =$
(refractive index) $n = \frac{c}{v}$	$c =$	$v =$
(current) $I = \frac{\Delta Q}{\Delta t}$		
(electric potential) $V = \frac{\Delta E}{\Delta Q}$		
(power) $P = \frac{\Delta E}{\Delta t}$		
(power) $P = VI$		
(conductance) $G = \frac{I}{V}$		
(resistance) $R = \frac{V}{I}$		
(resistance) $R = \frac{1}{G}$		
(power) $P = I^2 R$		
(power) $P = \frac{V^2}{R}$		
(stress) $\sigma = \frac{F}{A}$	$F =$	$A =$
(strain) $\varepsilon = \frac{x}{l}$	$x =$	$l =$

EXERCISE 6b - Further Rearranging Practice

1. a = bc + d, c=?
2. a = b/c – d, c=?
3. a = bc/d, d=?, b=?
4. a = (b + c)/d, c=?
5. a = b/c + d/e, e=?

Chapter 7: Using Your Calculator

we make no assumptions- hopefully this will be easy for most of you!

Quick Exercise

- Using your calculator, evaluate:- $\dfrac{30}{5\times 3}=?$

What answer did you get? 18? If you did it may surprise you to know that you are wrong. Nope – there's nothing wrong with your calculator we just need to establish exactly how it works.

Order of Operations

Your calculator has a rule to decide which operation to do first which is summarised by the word BODMAS, which stands for the order in which operations are done:

1. B - Brackets first
2. O - Orders (i.e. Powers and Square Roots, etc.)
3. DM - Division and Multiplication (left-to-right)
4. AS - Addition and Subtraction (left-to-right)

So if we type in the numbers like this:-

30 ÷ 5 × 3 = 6 × 3= 18 ← Left to Right is the conventional order and is what your calculator does.
But if we use brackets we can get the right answer:-
30 ÷ (5 × 3) =30 ÷ 15= 2

Note that the fact that the 5 and 3 are put on the bottom implies they should be multiplied first.
You will need to be able to use your calculator correctly and be familiar with scientific notation, such as standard form, brackets etc.
To enter 3.67 x 10^6 into your calculator press: 3.67 exp 6

Note that 10^8 means 1 x 10^8 and so must be keyed in as 1 exp 8 not 10 exp 8!
As a result when I write out what I know, I write out 1 x 10^8 to remind myself to do this.

EXERCISE 7a - Using a calculator

Name________________

Always give your answer in standard form,

e.g. 7.0×10^{-3} and not as 7.0^{-3}, which is how it is displayed on the calculator.

Your answer should have the same amount of significant figures as the question.

1. $(7.5 \times 10^{3}) \times (24) =$
2. $(6.2 \times 10^{-5}) \times (5.0 \times 10^{-3}) =$
3. $(1.4 \times 10^{5}) \times (2.0 \times 10^{4}) =$
4. $4.5 \times 10^{3} / 7.0 \times 10^{4} =$
5. $4.3 \times 10^{-6} / 6.0 \times 10^{3} =$

EXERCISE 7b – Using a calculator

In each case, find the value of "y".

1. $y = (7.5 \times 10^{3})^{2}$
2. $y = \dfrac{(1.3 \times 10^{3}) \times (1.6 \times 10^{-4})}{(6.6 \times 10^{6}) + (3.27 \times 10^{-3})}$
3. $y = \dfrac{(5.6 \times 10^{-4})^{2} \times (7.8 \times 10^{8})}{(6.6 \times 10^{-11}) \times (9.1 \times 10^{-2})^{2}}$
4. $y = \sqrt{\dfrac{(4.12 \times 10^{3}) + (6.5 \times 10^{2})}{(2.3 \times 10^{4}) \times (8.1 \times 10^{2})}}$

Chapter 8: Significant Figures

You can lose a mark if you quote too many significant figures in an answer.

1) ALL non-zero numbers (1,2,3,4,5,6,7,8,9) are ALWAYS significant.
2) ALL zeroes between non-zero numbers are ALWAYS significant.
3) ALL zeroes which are SIMULTANEOUSLY to the right of the decimal point AND at the end of the number are ALWAYS significant.
4) ALL zeroes to the left of a written decimal point and in a number >= 10 are ALWAYS significant.

Examples

39.389 → 5 s.f. 120000000000000→ 2 s.f 3400.000 → 7 s.f. 34224000 → 5 s.f. 200000.0004 → 10 s.f.

EXERCISE 8a

How many significant figures are the following numbers quoted to?

1. 224.4343	
2. 0.00000000003244654	
3. 3442.34	
4. 200000	
5. 43.0002	
6. 24540000	
7. 543325	
8. 23.5454353	
9. 4.0000000000	

EXERCISE 8b

For the numbers above that are quoted to more than 3s.f., convert the number to standard form and quote to 3 s.f.

Using a Reasonable Number of S.F.

Example:

A man runs 110 metres in 13 seconds, calculate his average speed.

Distance = 110 m

Time = 13 s

Speed = Distance/Time = 110 metres / 13 seconds = 8.461538461538461538461538461538 m/s

This is a ridiculous number of significant figures! = 8.46 m/s seems acceptable (3 s.f.) because the figures we were given in the question we given to 2 s.f, so we've used just one more than that in our answer.

Rule - You should not quote to more significant figures than were used in the question.
If in doubt quote answers to no more than 3 s.f. in the exam.

Chapter 9: Example Numerical Problems **Name ____________________**

Use the ideas met in Chapters 1-8 to produce full worked answers for the following. (You will need to use the formulae learned at GCSE)

EXERCISE 9 – Numerical Problems

1) If g on Earth is 10N/kg, what is the weight of a 5mg stone?
2) What is the momentum of a 500kg asteroid moving at a constant speed of 4km/s?
3) How much GPE is gained when a 40µg particle is lifted up a distance of 3mm. (g on Earth is 10N/kg)?
4) How much KE does a 60mg pebble skimmed at a constant speed of 10m/s have?
5) What is the frequency of a 550nm wave travelling at 3×10^8 m/s?

Practical Skills

Chapter 10: Practical Terminology

Using the link to the specification given at the start, research the meaning of the key terminology terms, and correctly match the term to its meaning. Use the answer grid on page 21.

1. Accuracy	A These cause readings to be spread about the true value, due to results varying in an unpredictable way from one measurement to the next. These errors are present when any measurement is made, and cannot be corrected. The effect of these errors can be reduced by making more measurements and calculating a new mean.
2. Anomalies	B These can have values (called a quantity) that can be given a magnitude either by counting (as in the case of the number of shrimp) or by measurement (eg light intensity, flow rate etc).
3. Calibration	C A measurement is this if the investigation is repeated by another person, or by using different equipment or techniques, and the same results are obtained.
4. Measurement Error	D A measurement result is considered accurate if it is judged to be close to the true value.
5. Random Error	E Suitability of the investigative procedure to answer the question being asked. For example, an investigation to find out if the rate of a chemical reaction depended upon the concentration of one of the reactants would not be this type of procedure if the temperature of the reactants was not controlled.
6. Systematic Error	F This is the smallest change in the quantity being measured (input) of a measuring instrument that gives a perceptible change in the reading
7. Zero Error	G These measurements are ones in which there is very little spread about the mean value. It depends only on the extent of random errors – it gives no indication of how close results are to the true value.
8. Interval	.H This is one which may, in addition to the independent variable, affect the outcome of the investigation and therefore has to be kept constant or at least monitored.
9. Precision	I Any indication that a measuring system gives a false reading when the true value of a measured quantity is nothing, eg the needle on an ammeter failing to return to 0 when no current flows. This error may result in a systematic uncertainty.
10. Range	J This is the variable for which values are changed or selected by the investigator.

11. Repeatable	K The maximum and minimum values of the independent or dependent variables; important in ensuring that any pattern is detected. May be quoted as eg 'From 10cm to 50 cm'
12. Reproducible	L These variables have values that are labels. Eg names of plants or types of material.
13. Resolution	M Marking a scale on a measuring instrument. This involves establishing the relationship between indications of a measuring instrument and standard or reference quantity values, which must be applied. For example, placing a thermometer in melting ice to see whether it reads 0^0C, in order to check if it has been calibrated correctly.
14. Uncertainty	N This is the variable of which the value is measured for each and every change in the independent variable.
15. Validity	O These cause readings to differ from the true value by a consistent amount each time a measurement is made. Sources of these errors can include the environment, methods of observation or instruments used. These errors cannot be dealt with by simple repeats. If this type of error is suspected, the data collection should be repeated using a different technique or a different set of equipment, and the results compared.
16. Categoric Variable	P These are values in a set of results which are judged not to be part of the variation caused by random uncertainty.
17.Continuous Variable	Q The interval within which the true value can be expected to lie, with a given level of confidence or probability, eg "the temperature is 20 °C ± 2 °C, at a level of confidence of 95 %.
18. Control Variable	R The quantity between readings, eg a set of 11 readings equally spaced over a distance of 1 metre would give gaps of 10 centimetres
19. Dependent Variable	S The difference between a measured value and the true value.
20. Independent Variable	T A measurement is this if the original experimenter repeats the investigation using same method and equipment and obtains the same results.

EXERCISE 10 – Practical Terminology Name ______________________

Practical Terminology Answer grid Enter the correct letter that matches the numbered term	
1.	2.
3.	4.
5.	6.
7.	8.
9.	10.
11.	12.
13.	14.
15.	16.
17.	18.
19.	20.

Research

Chapter 11 – significant Physicists

EXERCISE 11 – 4 Significant Physicists

Produce 4 x A4 Posters or Power point slides.
Each should present information about a key physicist of your choice.

- Name date of Birth – death and photo if possible.
- Share their ideas, research and key contribution they have made to science.
- Why you have chosen them.

Given as much information as you can find, and fit onto, the page/slide.
These will be shared with the class on return.

Thinking Ahead to A level, be organised from the start.

We look forward to seeing you in September.

Please **bring this work with you**;

At some point **in the first 2 weeks you will have a 'Maths skills' and terminology test based on this summer work**.

For the start of term you will need

Your usual Pen Pencil, Rubber and Ruler, (please make sure it's a 30cm ruler to use for your graph work) include a protractor and a compass.
A scientific calculator that you know how to use.
An A4 ring binder, or exercise book to keep your lesson notes in,
we will provide you with a Lab book.
Highlighters are very useful too!

Have a lovely break, see you soon.

Mrs West and Mr Clarkson