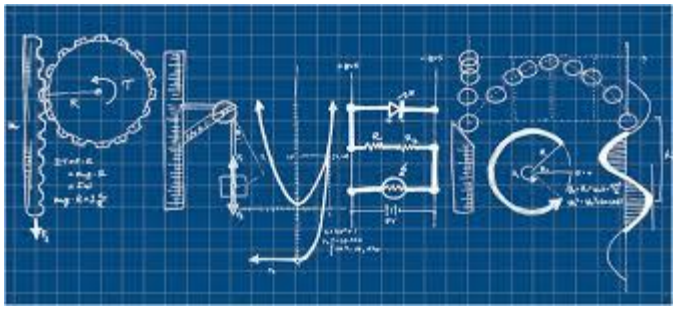
# AS Physics Summer Transition work




Name:

The work in this booklet is designed to help you make the leap from GCSE to AS and A2 Physics.

It is important that you complete all of the work in this booklet and bring it to your first lesson in September.

Remember you also have a variety of tasks to complete in order to gain your points for your pre-U challenge.

# Physics transition tasks

## 1. Dealing with symbols and SI units

One of the highest jumps between GCSE and AS physics is the way things are written down. At AS level you're expected to start using standard scientific notation.

Standard notation means:

- using the conventional symbols for quantities
- writing all quantities in terms of SI units (Système International)
- writing very large and very small numbers in standard form (e.g. $10^{-6}$ instead of 0.000001)

You will need to have memorised the unit prefixes shown in the table on the right – they are used in exams and it is assumed that you know what they mean.

| multiple | prefix | symbol |
|---|---|---|
| $10^{12}$ | tera- | T |
| $10^{9}$ | giga- | G |
| $10^{6}$ | mega- | M |
| $10^{3}$ | kilo- | k |
| $10^{-3}$ | milli- | m |
| $10^{-6}$ | micro- | μ |
| $10^{-9}$ | nano- | n |
| $10^{-12}$ | pico- | p |

Of course people in the real world don't use standard scientific notation – you don't see car speedometers with $ms^{-1}$ scales on them or tyre pressure gauges calibrated in $kNm^{-2}$. You'll also encounter non-standard units in the physics course itself – megaparsecs, electronvolts and a.m.u. for example.

In the following ten pairs of quantities, circle the quantity which is greater.

a. 12 mW or 12 MW
b. 3.0 μs or 3.0 ns
c. 27 kV or 27 GV
d. 6 pm or 6 μm
e. 1024 TW or 1024 GW
f. $22\times10^{-2}$ Ω or 220 Ω
g. 300 kg or $3\times10^{3}$ kg
h. 121 kN or $0.0121\times10^{6}$ N
i. $30\times10^{-6}$ F or 0.003 pF
j. 14000 MHz or $1.4\times10^{9}$ Hz

When you write out the name of a unit in full it is always written completely in lower case letters. For example: the unit of power is the watt (symbol W). In the box above, next to each question write the full name of the SI unit in the question. Bonus points if you find out why some symbols are written using upper case (e.g. N) whereas other unit symbols are written using lower case (e.g. s).

## Significant Figures and Standard Form

### Significant Figures

You need to be able to quote answers to the correct number of significant figures.

1) Write the following numbers to the quoted number of significant figures.

a) 345789 4 sig figs …… d) 6 3 sig figs ……

b) 297300 3 sig figs …… e) 0.001563 3 sig figs ……

c) 0.07896 3 sig figs …… f) 0.01 4 sig figs ……

2) Complete the following sums and give the answers to 3 significant figures.

a) 6125 x 384…… d) 750 ÷ 25 ……

b) 25.00 x 0.01…… e) 0.000152 x 13 …….

c) 13.5 + 0.18…… f) 0.0125 x 0.025 …….

**Standard Form**

You need to be able to work with numbers in standard form.

3) Write the following numbers in non standard form.

a) 1.5 x 10-3 …….. d) 0.0534 x 104……

b) 0.046 x 10-2 …….. e) 10.3 x 105 ……

c) 3.575 x 105…….. f) 8.35 x 10-3 ……

4) Write the following numbers in standard form.

a) 0.000167 …….. d) 34500……

b) 0.0524…….. e) 0.62……

c) 0.000000015…….. f) 87000000 ……

5) Complete the following calculations and give the answers to 3 significant figures.

a) 6.125 x 10-3 x 3.5 ……..

b) 4.3 x 10-4 ÷ 7.0……..

c) 4.0 x 108 + 35000……..

d) 0.00156 + 2.4 x 103…….

e) 6.10 x 10-2 – 3.4 x 10-5 …….

# Dealing with equations

Forces stretch things, squash things and twist things. When we consider things as whole objects ("bodies" in physics language) then Newton's Second Law of Motion deals with the way that forces make bodies go faster, slower or change direction. The resultant force acting on a body makes it accelerate, and the size of the acceleration is directly proportional to the size of the force.

**resultant force (N) = mass of body (kg) × acceleration ($ms^{-2}$)**

or, in symbols

**F = m a**

Example: A car of mass 1000 kg accelerates uniformly from rest at a rate of 0.75 $ms^{-2}$. What is the size of the resultant force accelerating it?

Solution: F = m a = 1000 kg × 0.75 $ms^{-2}$ = 750 N

Answer the following in the spaces provided:

a. A bus of mass 10000 kg accelerates at 0.25 $ms^{-2}$. What is the resultant force acting on it?

b. A car pulls a caravan of mass 800 kg. If it accelerates at 0.4 $ms^{-2}$, what force must the caravan experience?

Example: What would the acceleration of a 0.5 kg body be if a force of 10 N acted on it?

Solution: F = ma. Dividing both sides by m gives F/m = a, so a=F / m = 10 N /0.5 kg = 20 $ms^{-2}$.

Answer the following in the spaces provided:

a. What would be the initial acceleration of an arrow of mass 0.3 kg shot from a bow if the force from the bow-string is 200 N?

b. What would be the acceleration of a train of mass $10^4$ kg if the force form the engine is 8kN?

Example: What is the mass of a body if a force of 250 N produces an acceleration of 2 $ms^{-2}$?

Solution: F = ma. Dividing both sides by a gives F/a = m, so m = F/a = 250 N / 2 $ms^{-2}$ = 125 kg

Answer the following in the spaces provided:

a. What is the mass of a sailing boat if a force of 120 N produces an acceleration of 0.5 $ms^{-2}$?

b. What is the mass of an electron if a force of $1.8\times10^{-14}$ N produces an acceleration of $2.0\times10^{16}$ $ms^{-2}$?

# 1 Join the Institute of Physics

join the Institute of Physics – it is completely free for A-level students, although if you want to receive paper copies of the monthly 'Physics World' magazine then there is an annual fee. At the very least you can get a monthly update on the latest physics news, and also read in-depth articles about current cutting-edge physics topics. The direct link is

**http://members.iop.org/16-19.asp**

# 2 Read books

It will help to stand back and see physics in its wider context, and also to look in more detail at some areas of physics that you may currently know very little about. I consider reading the two books in bold below to be the easiest way for you to do this, and they're something that would be easy to obtain and simple for you to take away with you on holiday. Both books are written at a level that assumes very little about your prior subject knowledge, but reading them will stretch you into areas that go beyond university level. The other books are also highly recommended.

- ***A Short History of Nearly Everything* by Bill Bryson**
- ***Big Bang: The Most Important Scientific Discovery of All Time and Why You Need to Know About It* by Simon Singh**
- *A Brief History of Time* by Stephen Hawking
- *The Universe in a Nutshell* by Stephen Hawking
- *The Making of the Atomic Bomb* by Richard Rhodes
- *Carrying the Fire: An Astronaut's Journeys* by Michael Collins (the Apollo 11 astronaut).
- *13 Things That Don't Make Sense: The Most Intriguing Scientific Mysteries of Our Time* by Michael Brooks
- *Surely you're joking Mr Feynman* by Richard P Feynman and Ralph Leighton.
- *Six Easy Pieces: Fundamentals of Physics Explained* by Richard P Feynman (or any other book by the same author)

# 3 Watch online video

- Watch any or all of the "Schools Lecture series" videos made by the Institute of Physics. Don't be put off by the title – they are all presented by experts in physics at the right kind of level, and the topics covered will really help you understand some of the details of the A level course. The link is: http://www.iop.org/resources/videos/education/
- You could spend your whole life watching physics video clips on youtube. No need, however, as the **minutephysics** is all you'll ever really need – and all clips are only a minute long. Subscribe. Watch them all. http://www.youtube.com/user/minutephysics
- Richard Feynman's "**Messenger Lectures**" on physics, archived with transcripts on Microsoft's Project Tuva website. http://research.microsoft.com/apps/tools/tuva/

These are some extra ideas for you along with the pre-U unit. If you review any of these it can go towards your points total.

## Energy and energy resources

**1** Thermal energy can be transferred in different ways.

Match the words in the list with the numbers **1** to **4** in the sentences.

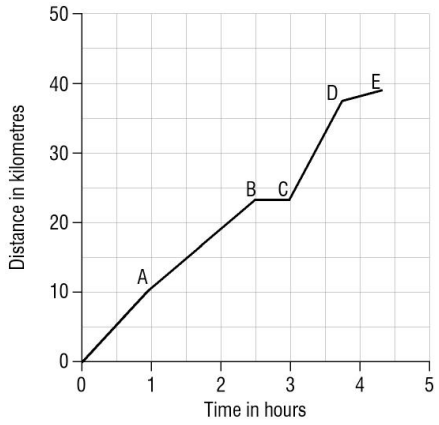
**A** electrons .....  **B** liquids .....

**C** particles .....  **D** solids .....

Conduction occurs mainly in ……**1**…… All metals are good conductors because they have a lot of free ……**2**……. Convection occurs in gases and ……**3**…… Radiation does not involve ……**4**…… *(4 marks)*

## Motion

**2** The graph shows how far a marathon runner travels during a race.




(a) What was the distance of the race?

..... (1)

(b) How long did it take the runner to complete the race?

..... (1)

(c) What distance did the runner travel during the first 2 hours of the race?

..... (1)

(d) For how long did the runner rest during the race?

..... (1)

(e) Ignoring the time for which the runner was resting, between which two points was the runner moving the slowest?

Give a reason for your answer.

.....

..... (2)

## Speeding up Slowing down

**3** a) When two objects interact, they exert …… and …….. forces on each other.

b) The unit of force is the ……. (symbol ….. ).

c) A moving object acted on by a resultant force:

i) in the same direction as the direction of its motion ……..,

ii) in the opposite direction to its direction of motion …….. .

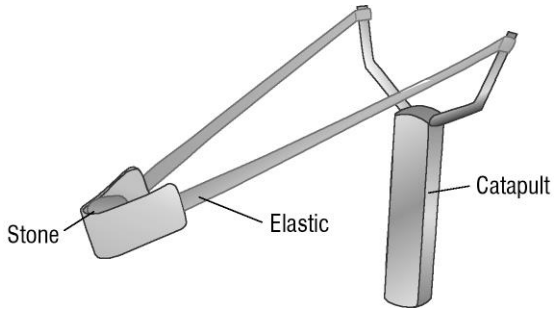
d) Resultant force = …….. × ……..

(in ……) (in kg) (in ……)

(11)

## Work energy and momentum

**4** The picture shows a catapult.




(a) When a force is applied to the stone, work is done in stretching the elastic and the stone moves backwards.

(i) Write down the equation you could use to calculate the work done.

..... (1)

(ii) The average force applied to the stone is 20 N. This moves it backwards 0.15 m. Calculate the work done and give its unit.

.....

.....

..... (3)

(b) The work done is stored as energy.

(i) What type of energy is stored in the stretched elastic?

..... (1)

(ii) What type of energy does the stone have when it is released?

…… (1)

## Turning forces

**5** There are many satellites orbiting the Earth in circular paths.

(a) (i) What force provides the centripetal force that allows satellites to maintain their circular orbits?

..... (1)

(ii) A satellite moving at a steady speed in a circular orbit is continuously accelerating.

Explain why.

.....

..... (2)

(b) Some satellites are in *geostationary orbits*.

(i) What is meant by a *geostationary orbit*?

..... (1)

(ii) What is the time period of a geostationary orbit?

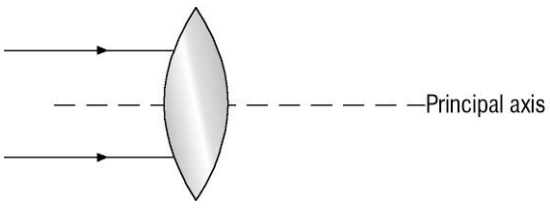
..... (1)

(iii) What type of satellite is usually put into a geostationary orbit?

..... (1)

## Light and sound

**6** (a) (i) Complete the diagram below to show what happens to the two rays of light after they enter the lens.

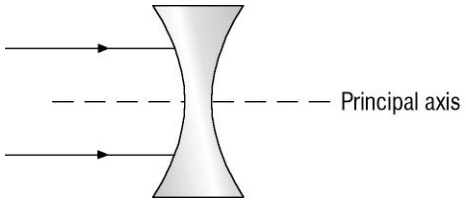



(ii) Put an **F** on the diagram to label the principal focus of the lens.

(iii) What word can be used to describe this type of lens?

..... (1)

(b) (i) Complete the diagram below to show what happens to the two rays of light after they enter the lens.



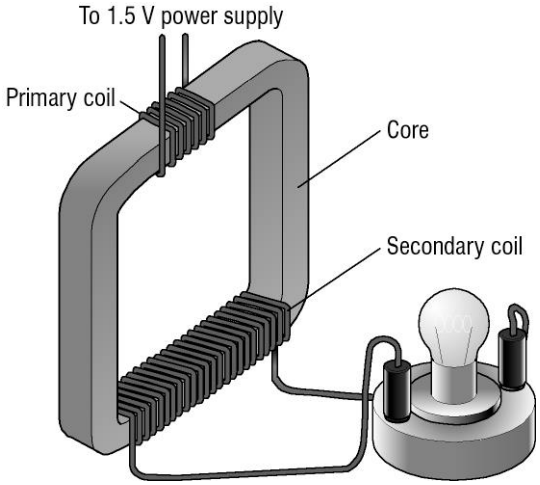

(ii) Put an **F** on the diagram to label the principal focus of the lens.

(iii) What word can be used to describe this type of lens?

..... (1)

## Electromagnetism

**7** The diagram shows a transformer.




(a) Explain how an alternating current in the primary coil produces an alternating current through the lamp.

.....

.....

..... (4)

(b) The potential difference across the primary coil is 1.5 V. There are 6 turns on the primary coil and 24 turns on the secondary coil.

Calculate the potential difference across the lamp.

.....

.....

(4)

## Stars and space

**8** The sentences below describe the life cycle of a star such as the Sun.

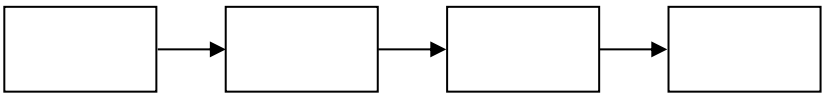
**A** The star contracts to form a white dwarf.

**B** The star is in a stable state.

**C** The star expands to form a red giant.

**D** Gravitational forces pull dust and gas together and the star is formed.

(a) Put the sentences in the correct order.



(b) At which stage in its life is the Sun, **A**, **B**, **C** or **D**?

..... (1)

(c) What balances the gravitational forces to make a star stable?

.....

.....

..... (2)