A-Level Physics Transition Activities

Congratulations for choosing one of the most challenging and rewarding courses of study at A-Level! In September, you will be working towards a qualification in science that is both worthwhile in itself and highly respected by employers and universities.

The secret to learning physics is to spend lots of time solving problems and answering questions. While you might have been able to get by in your GCSE's by reading though your notes and revision guides and just letting the information soak into your brain, for A-Level you'll have to adopt a much more active learning style. *Real* learning happens when you spend time reasoning through questions and working stuff out for yourself. There really is a big difference between the strategy that probably got you by in school and the work you will need to do for your A-Levels

The tasks below give you the opportunity practice some of the basic skills that you'll need to be successful on the course. You'll need to have worked though these tasks before September. At the end of these tasks there's a list of (optional) books and websites that you might find useful for developing your general appreciation of physics. If you're already thinking about studying physics or maths at university then these will equip you with lots of ammunition for your UCAS personal statement and university interviews. In both of these you'll want to talk about some of the big ideas in physics that have captured your imagination.

Best wishes

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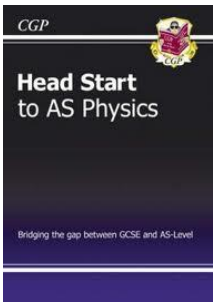
Task 1 – Head Start to AS Physics

Work through 'Head Start to AS Physics'. ISBN: 978 1 84762 115 3

Available from Amazon quite cheaply.



Task 2 – The Following summary questions are taken from the course text book

They cover Standard Form, trigonometry, rearrangements and converting units. These are key skills in physics, and being proficient in them will mean that you can focus on understanding the other topics

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

Summary questions

Write your answers to each of the following questions in standard form, where appropriate, and to the same number of significant figures as the data.

1 Copy and complete the following conversions.

a **i** 500 mm = _____ m

ii 3.2 m = _____ cm

iii 9560 cm = _____ m.

b **i** 0.45 kg = _____ g

ii 1997 g = _____ kg

iii 54 000 kg = _____ g.

c **i** $20\ \text{cm}^2$ = _____ m^2

ii $55\ \text{mm}^2$ = _____ m^2

iii $0.050\ \text{cm}^2$ = _____ m^2.

2 **a** Write the following values in standard form:

i 150 million km in metres

ii 365 days in seconds

iii 630 nm in metres

iv 25.7 μg in kilograms

v 150 m in millimetres

vi 1.245 μm in metres.

b Write the following values with a prefix instead of in standard form.

i 3.5×10^4 m = _____ km

ii 6.5×10^{-7} m = _____ nm

iii 3.4×10^6 g = _____ kg

iv 8.7×10^8 W = _____ MW = _____ GW.

3 **a** Use the equation average speed = distance/time to calculate the average speed in m s^{-1} of:

i a vehicle that travels a distance of 9000 m in 450 s

ii a vehicle that travels a distance of 144 km in 2 h

iii a particle that travels a distance of 0.30 nm in a time of 2.0×10^{-18} s

iv the Earth on its orbit of radius 1.5×10^{11} m, given the time taken per orbit is 365.25 days.

b Use the equation

$$\text{resistance} = \frac{\text{potential difference}}{\text{current}}$$

to calculate the resistance of a component for the following values of current I and pd V:

i $V = 15$ V, $I = 2.5$ mA

ii $V = 80$ mV, $I = 16$ mA

iii $V = 5.2$ kV, $I = 3.0$ mA

iv $V = 250$ V, $I = 0.51$ μA

v $V = 160$ mV, $I = 53$ mA.

4 **a** Calculate each of the following:

i 6.7^3

ii $(5.3 \times 10^4)^2$

iii $(2.1 \times 10^{-6})^4$

iv $(0.035)^2$

v $(4.2 \times 10^8)^{1/2}$

vi $(3.8 \times 10^{-5})^{1/4}$.

b Calculate each of the following:

i $\dfrac{2.4^2}{3.5 \times 10^3}$

ii $\dfrac{3.6 \times 10^{-3}}{6.2 \times 10^2}$

iii $\dfrac{8.1 \times 10^4 + 6.5 \times 10^3}{5.3 \times 10^4}$

iv $7.2 \times 10^{-3} + \dfrac{6.2 \times 10^4}{2.6 \times 10^6}$.

Summary questions

1 **a** Calculate the circumference of a circle of radius 0.250 m.

b Calculate the length of the arc of a circle of radius 0.250 m for the following angles between the arc and the centre of the circle:

i 360° **ii** 240° **iii** 60°.

2 For the right-angled triangle XYZ in Figure 6, calculate:

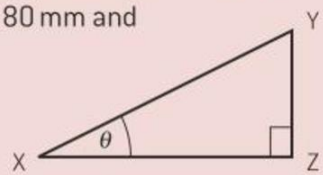
a angle YXZ $(= \theta)$ if XY = 80 mm and

i XZ = 30 mm

ii XZ = 60 mm

iii YZ = 30 mm

iv YZ = 70 mm



▲ Figure 6

b XZ if

i XY = 20 cm and $\theta = 30°$

ii XY = 22 m and $\theta = 45°$

iii YZ = 18 mm and $\theta = 75°$

iv YZ = 47 cm and $\theta = 25°$.

3 **a** A right-angled triangle XYZ has a hypoteneuse XY of length 55 mm and side XZ of length 25 mm. Calculate the length of the other side.

b An aircraft travels a distance of 30 km due north from an airport P to an airport Q. It then travels due east for a distance of 18 km to an airport R. Calculate

i the distance from P to R

ii the angle QPR.

4 **a** Calculate the horizontal component A and the vertical component B of:

i a 6.0 N force at 40° to the vertical

ii a 10.0 N force at 20° to the vertical

iii a 7.5 N force at 50° to the horizontal.

b Calculate the magnitude and direction of the resultant of a 2.0 N force acting due north and a 3.5 N force acting due east.

Summary questions

1 Complete each of the following statements:

a if $x > 5$, then $1/x <$

b if $4 < x < 10$, then ____ $< 1/x <$

c if x is positive and $x^2 > 100$ then $1/x$ ____.

2 **a** Make t the subject of each of the following equations:

i $v = u + at$ **iii** $y = k(t - t_0)$

ii $s = \frac{1}{2}at^2$ **iv** $F = \frac{mv}{t}$.

b Solve each of the following equations:

i $2z + 6 = 10$ **iii** $\frac{2}{z-4} = 8$

ii $2(z + 6) = 10$ **iv** $\frac{4}{z^2} = 36$.

3 **a** Make x the subject of each of the following equations:

i $y = 2x^{1/2}$ **iii** $yx^{1/3} = 1$

ii $2y = x^{-1/2}$ **iv** $y = \frac{k}{x^2}$.

b Solve each of the following equations:

i $x^{-1/2} = 2$ **iii** $\frac{8}{x^2} = 32$

ii $3x^2 = 24$ **iv** $2(x^{1/2} + 4) = 12$.

4 Use the data given with each equation below to calculate:

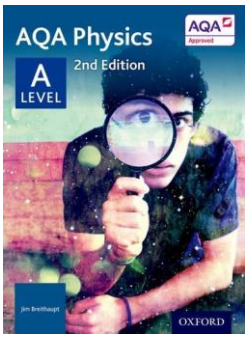
a the volume V of a wire of radius $r = 0.34$ mm and length $L = 0.840$ m, using the equation $V = \pi r^2 L$

b the radius r of a sphere of volume $V = 1.00 \times 10^{-6}$ m^3, using the equation $V = \frac{4}{3}\pi r^3$

c the time period T of a simple pendulum of length $L = 1.50$ m, using the equation $T = 2\pi(L/g)^{0.5}$, where $g = 9.8$ m s^{-2}

d the speed v of an object of mass $m = 0.20$ kg and kinetic energy $E_k = 28$ J, using the equation $E_k = \frac{1}{2}mv^2$.

Task 3 – Reading up on some A-Level work



The textbook for the physics course is available on Amazon[1] for about £35. You might be able to find it cheaper second hand somewhere. Other books are available, but this is the one that we'll be using in class.

In September we'll be starting with particle physics. You'll find things much easier if you have gained some familiarity with some of the important new words before we get started. Particle physics will require us to use many words that are not familiar, so the more practice we get the better! You can use the text book, the internet or whatever source of information you choose to answer the following questions.

1. Write a sentence describing what is meant by the term *fundamental particle*…

2. Complete the following table(s)

Sub atomic particle	Mass in kg	Charge in Coulombs	Location

3. There are two families of fundamental particle. Write down their names…

4. Particles such as protons and neutrons are made up of even smaller particles. Write down the names of each of the three particles that are inside a proton.

5. Write down the names of the three particles that make up a neutron.

Task 4 – Specific Charge

Background

The specific charge of a charged object is its charge divided by its mass. As the unit of charge is the coulomb (C) and the unit of mass is the kilogram (kg), the unit of specific charge is the coulomb per kilogram (C kg–1).

Every atom contains a positively charged nucleus surrounded by electrons, which are negatively charged. Every nucleus contains protons and neutrons, except the hydrogen-1 nucleus, which is a single proton. Neutrons and protons in a nucleus are called nucleons.

Questions

1) Calculate the specific charge of the 3 subatomic particles
2) Complete the following table (note ignore the electrons as we are concerned with the nucleus)

Nucleus	No of nucleons (mass number)	Overall mass in kg (mass number x 1.67 x 10^{-27} kg)	Number of Protons (proton number)	Overall Charge (no of protons x 1.60 x 10^{-19} C)	Specific Charge = (charge / mass)
$^{52}_{24}Cr$					
$^{12}_{6}C$					
$^{56}_{26}Fe$					
$^{7}_{3}Li$					

Further Reading

Read any, all or none of these. It's up to you! You won't be disadvantaged by not reading these, but if you think you might want to go on to study physics or maths at university then picking up at least one of these at some point would be a good idea. Hawking's book is probably the most accessible one on the list so you might want to start there. Most of these can be picked up quite cheaply second hand.

Hawking, S. (1998) A Brief History of Time, ISBN: 0553380168 - This is a very good general physics book. The early chapters provide a neat account of our how our understanding of the universe has evolved over history.

Allday, J. (2001) Quarks, Leptons and the Big Bang, ISBN: 0750308060 – This book contains lots of modern physics and should provide you with plenty to think about.

Feynman, R. (1994) The Character of Physical Law, ISBN 0679601279 – The opening chapters provide a good account of why physics is mathematical. Interesting stuff.

Joining the Institute of Physics as a 16-19 student is free. You'll get a free electronic copy of *Physics World* magazine each month. You can join by going to:

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