Post-16 Transition Support
A Level Physics

Transition Project

In preparation for your course, you should complete the following tasks:

Dealing with symbols and SI units

One of the highest jumps between GCSE and A level Physics is the way things are written down. At A level you are expected to start using *standard scientific notation*.

multiple	prefix	symbol
1012	tera-	T
109	giga-	G
106	mega-	M
103	kilo-	k
10–3	milli-	m
10–6	micro-	µ
10–9	nano-	n
10–12	pico-	p

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.
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.

1. In the following ten pairs of quantities, 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. 22×10^{-2} Ω or 220 Ω
   g. 300 kg or 3×10^{3} kg
   h. 121 kN or 0.0121×10^{6} N
   i. 30×10^{-6} F or 0.003 pF
   j. 14000 MHz or 1.4×10^{9} Hz

2. Without a calculator, calculate the following:
   a. $10^{6} \times 10^{9}$
   b. 2 m × 4 m
   c. 10^{-3} m × 10^{5} m
   d. 1.2×10^{2} N × 2.0×10^{-3} m
   e. 5.0×10^{3} kg ÷ 2.0×10^{-2} m^{3}
   f. 12 Ω × 5 m

Post-16 Transition Support
A Level Physics

3. Without a calculator, calculate the following:
   a. A certain car engine can produce 95 kW (kilowatts) of power. Write this number out in full.
   b. A laser produces light of wavelength 633 nm (nanometres). Write this value in standard form.
   c. Which is the highest frequency, 96.4 MHz (megahertz) or 17000 kHz (kilohertz)?
   d. The speed of light in a vacuum is 3.0×10^8 m s^{-1}. Write this in kilometres per second and in gigameters per second.
   e. The age of the universe is about 1.4 x 1010 yr (years). How many Gyr (gigayears) is this?

4. Rearrange the following equations so that x is on its own:
   a. $2x = a$
   b. $2y + 2x = c$
   b. $4(x + y) = 2y$
   c. $v^2 = x^2 – 2as$
   d. $T = Lx^2$
   e. $a^2 = b^2 + x^2$

5. You will require a working scientific calculator in all of your physics lessons and exams. Your calculator has a button labelled ‘ENG’. Find out what this ‘ENG’ button does, and why it will be useful to you on your physics course. Describe the function and its usefulness.

Post-16 Transition Support
A Level Physics

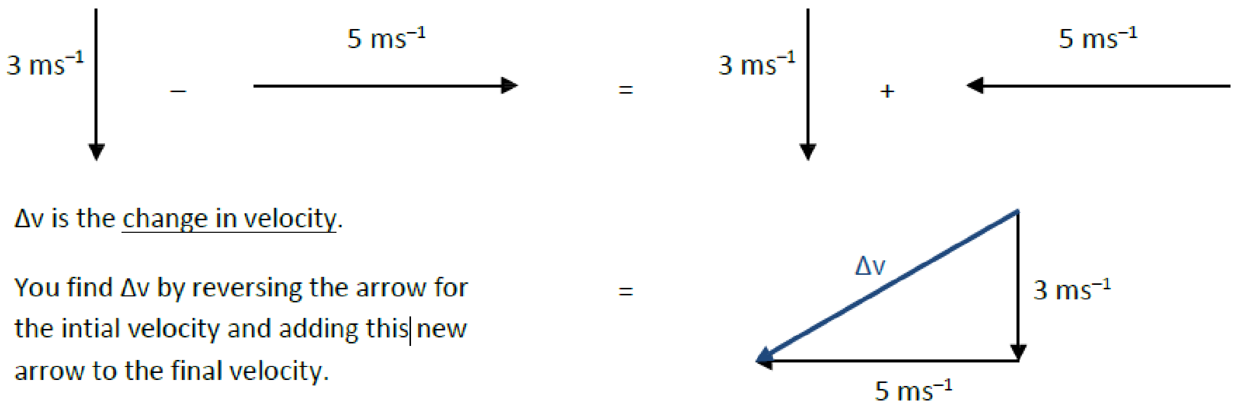
Dealing with vector quantities

You should already know that a quantity like speed only has a size (e.g. 13 ms^{-1}), but there is another type of quantity (called a vector) that has a size and direction, e.g. a velocity of 13 ms^{-1} *to the left*. You can represent velocities with arrows – the longer the arrow the greater the size (speed) of the velocity. At A level you will become proficient at working in more than one dimension, and in order to do this you will need to master vectors. For example, the formula for working out the change in velocity looks simple enough:

change in velocity (ms^{-1}) = final velocity (ms^{-1}) – initial velocity (ms^{-1})

However, you can't just subtract one speed from the other – you have to account for the directions of the two velocities.

Example: find the magnitude (size) of the change in velocity if you have an initial velocity of 5 ms^{-1} to the right and a final velocity of 3 ms^{-1} downwards.



Either by measuring from a scale drawing, or by using Pythagoras' theorem, the answer is **Δv = 5.8 ms^{-1}**.

Have a go at finding the changes in velocity in these two cases – make some up yourself when you've finished:

a. initial velocity = 4 ms^{-1} upwards; final velocity = 4 ms^{-1} to the right
b. initial velocity = 3 ms^{-1} down; final velocity = 4 ms^{-1} to the left.

Post-16 Transition Support
A Level Physics

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. Remember always to apply DERNU to every calculation you perform: Data (remember to convert to SI units if required), Equation (in its original form); Rearrangement (if necessary); Numbers; answer with UNIT.

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

or, in symbols **F = m a**

Example:

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

Solution:

D: m= 1000 kg ; a= 0.75 ms^{-2} ; F=?

E: F = m a

R: (no rearrangement required)

N: F= 1000 kg x 0.75 ms^{-2}

U: F=750 N

You obviously do not need to write DERNU in the margin – it is just there to show you the layout

Now answer the following, using DERNU every time:

1. A bus of mass 10000 kg accelerates at 0.25 ms^{-2}. What is the resultant force acting on it?
2. A car pulls a caravan of mass 800 kg. If it accelerates at 0.4 ms^{-2}, what force must the caravan experience?
3. What would the acceleration of a 0.5 kg body be if a force of 10 N acted on it?
4. 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?
5. What would be the acceleration of a train of mass 1040 kg if the force form the engine is 8kN?
6. What is the mass of a sailing boat if a force of 120 N produces an acceleration of 0.5 ms^{-2}?
7. What is the mass of an electron if a force of 1.8x 10^{-14} N produces an acceleration of 2.0 x 10^{16} ms^{-2}?

Post-16 Transition Support
A Level Physics

Excellence & Opportunity

What does an A level paper look like?

For some actual A level exam questions:

SECTION A

Answer ALL questions.

All multiple choice questions must be answered with a cross ☒ in the box for the correct answer from A to D. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 Which of the following is a correct statement?

☐ **A** charge is a base quantity

☐ **B** velocity is a base quantity

☐ **C** mass is a derived quantity

☐ **D** resistance is a derived quantity

(Total for Question 1 = 1 mark)

---

2 Which of the following is an equivalent unit to the newton?

☐ **A** $kg\ m\ s^{-1}$

☐ **B** $kg\ m\ s^{-2}$

☐ **C** $kg\ m^{-1}\ s^{-2}$

☐ **D** $kg\ m^{2}\ s^{-2}$

(Total for Question 2 = 1 mark)

---

3 Which of the following is a scalar quantity?

☐ **A** displacement

☐ **B** force

☐ **C** weight

☐ **D** work

(Total for Question 3 = 1 mark)

Post-16 Transition Support
A Level Physics

7 A potential difference is applied to a wire.

The current in the wire

☐ **A** depends only on the potential difference applied.

☐ **B** depends only on the resistance of the wire.

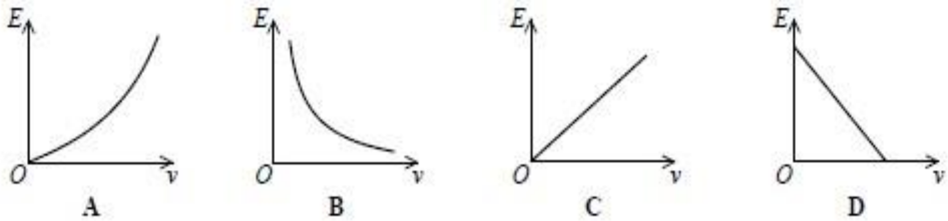
☐ **C** depends on both the potential difference and the resistance of the wire.

☐ **D** does not depend on the potential difference or the resistance of the wire.

(Total for Question 7 = 1 mark)

8 A ball is dropped from a student's hand and falls to the ground.

Which graph correctly shows the variation of kinetic energy *E* with velocity *v* for the ball?



☐ **A**

☐ **B**

☐ **C**

☐ **D**

(Total for Question 8 = 1 mark)

9 An electric motor takes 45.0 s to lift a mass of 800 kg through a vertical height of 14.0 m. The potential difference across the motor is 230 V and the current is 13.0 A.

Calculate the efficiency of the motor.

Efficiency = ...

(Total for Question 9 = 3 marks)

10 The photograph shows cars travelling on a straight section of a motorway.

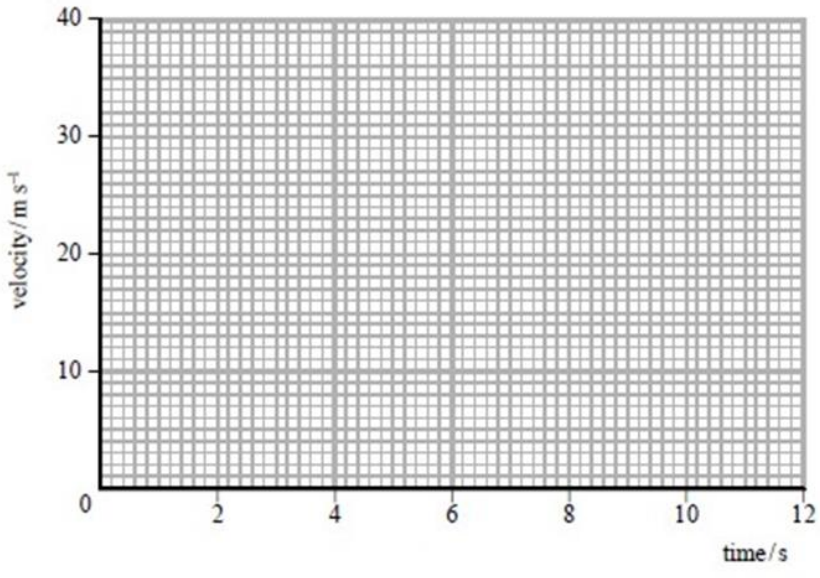
The maximum speed limit on a motorway in the U.K. is 31 m s^{-1}.

(source: http://tracksideviews.com/tag/motorway/)

(a) A car is travelling along the motorway at 31 m s^{-1}. The driver sees stationary traffic 180 m ahead. After 0.6 s the driver reacts by applying a constant braking force that stops the car in 10 s.

(i) Draw a velocity-time graph of the car's motion, from the instant the driver sees the stationary traffic until the car stops.

(1)



(ii) Analyse the data to determine whether the car stops without colliding with the stationary traffic.

(2)

....

....

....

....

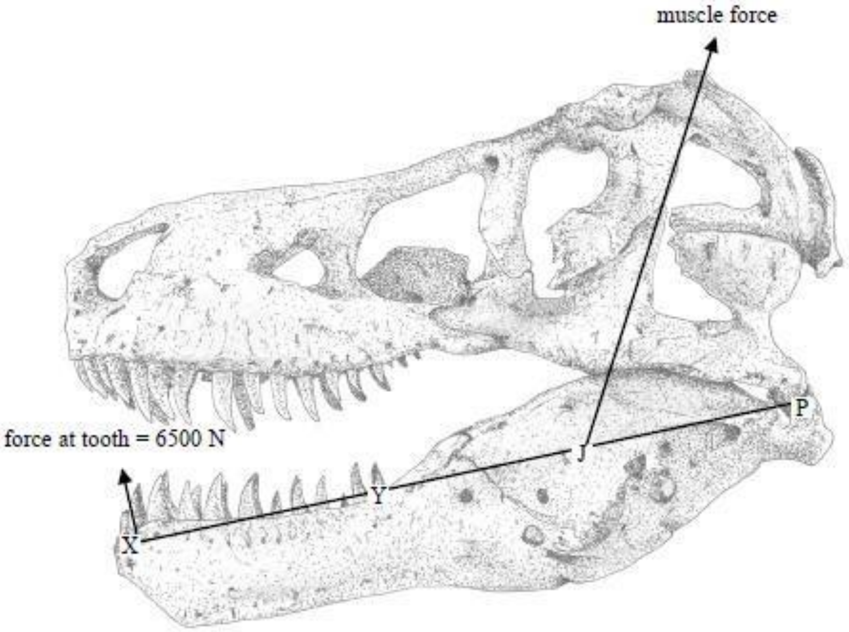
....

Post-16 Transition Support
A Level Physics

Excellence & Opportunity

11 Extinct animals can be studied by using their fossils. 70-million-year-old fossils from the *Tyrannosaurus rex* and *Triceratops* dinosaurs show that a *Triceratops* was sometimes eaten by a *Tyrannosaurus rex*.

The diagram shows a *Tyrannosaurus rex* skull.



© Markwitton.com

On the diagram, the position of the main biting muscle is indicated by the line labelled 'muscle force'. The muscle is connected to the jaw at point J. This produces a moment about point P where the jaw is hinged. Teeth marks found in fossilised *Triceratops* bones show that the force exerted by a tooth at the front of the jaw X could reach 6500 N.

The skull is drawn to a scale of 1 to 10. The force arrows are **not** drawn to scale.

(a) Take measurements from the diagram to determine the size of the muscle force when the force exerted by the tooth at X is 6500 N.

(5)

....

....

....

....

....

....

....

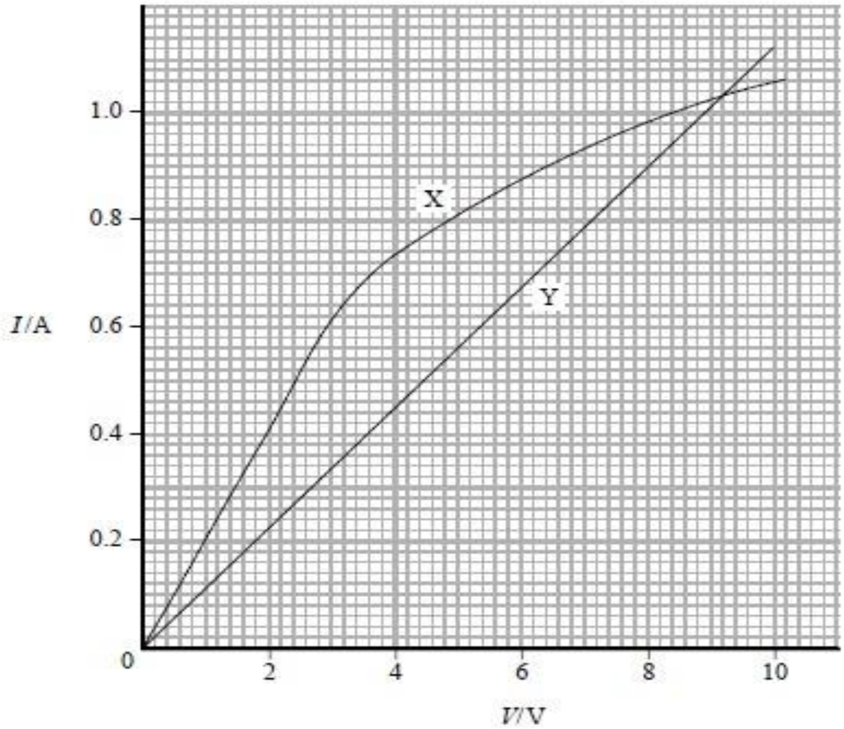
....

....

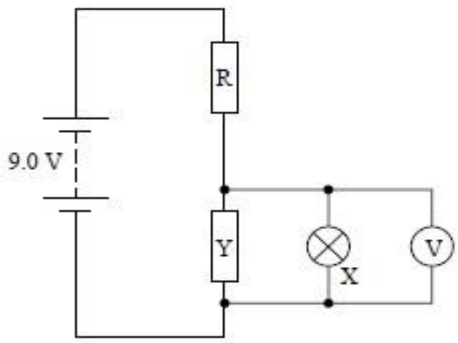
Muscle force = ...

(b) The graph shows the variation of current I with potential difference V for two electrical components X and Y.

X is a filament bulb and Y is a fixed resistor.



A potential divider circuit consisting of components X and Y is connected to a 9.0 V supply in series with a fixed resistor R as shown. The supply has a negligible internal resistance.



The reading on the voltmeter is 3.0 V.

(i) Determine the current in the fixed resistor R.

(2)

....

....

....

....

Current in the fixed resistor R = ...

Post-16 Transition Support
A Level Physics

Suggested Reading or Viewing

Websites

http://www.iop.org/resources/videos/education/

http://www.youtube.com/user/minutephysics

http://research.microsoft.com/apps/tools/tuva/

https://www.zooniverse.org/

http://phet.colorado.edu/

Books

Read anything written by Richard Feynman