A-level Physics

Essential understanding and knowledge

Your understanding of the following sections is essential before you start AS Physics. This is not a test, you can use additional resources to help you when you get stuck but see how much you can do on your own first. Remember, this is to inform yourself of your understanding.

Measurements and units

Complete the gaps in the table, the first two have been done for you:

Measurement	Symbol	Unit	Symbol of unit
time	t	seconds	s
distance	D	meters	m
velocity			
acceleration			
momentum			
energy			
power			
force			
charge			
current			
potential difference			
resistance			
frequency			
wavelength			

Use of standard form

Standard form is a way of writing numbers that are really small, or really big. Most of the time it is easier to use standard form than write these numbers out due to the large amount of zeros they have.

Example, the speed of light is 300,000,000 m/s. This can be written in standard form as 3×10^8 m/s.

This works because of the following:

$1 = 10^0$
$10 = 10^1$
$100 = 10 \times 10 = 10^2$
$1000 = 10 \times 10 \times 10 = 10^3$
$10{,}000 = 10 \times 10 \times 10 \times 10 = 10^4$
$100{,}000 = 10 \times 10 \times 10 \times 10 \times 10 = 10^5$
$1{,}000{,}000 = 10 \times 10 \times 10 \times 10 \times 10 \times 10 = 10^6$

$0.1 = \frac{1}{10} = 10^{-1}$

$0.01 = \frac{1}{100} = 10^{-2}$

$0.001 = \frac{1}{1000} = 10^{-3}$

$0.0001 = \frac{1}{10{,}000} = 10^{-4}$

Complete the gaps in the table below:

Distance	Value in metres (m)	Value in metres (m) standard form
1 kilometre (km)	1000	
1 centimetre (cm)	0.01	
1 millimetre (mm)	0.001	
1 micrometre (µm)	0.000001	
1 nanometre (nm)		1×10^{-9}
1 picometre (pm)	0.000000000001	
1 light-year		9.467×10^{15}

Rearranging Formulae

Manipulating formula will be used in most lessons. Your understanding of algebra will be very important to succeed in Physics. If this is something you struggle with, I would recommend spending some time watching the various tutorials on YouTube before you complete the following task.

Answers:

1) Make ***time*** the subject

$$\text{Speed} = \frac{\text{distance}}{\text{time}}$$

2) Make ***energy*** the subject

$$\text{Power} = \frac{\text{energy}}{\text{time}}$$

3) Make ***c*** the subject

$$E = m \times c^2$$

4) Make ***v*** the subject

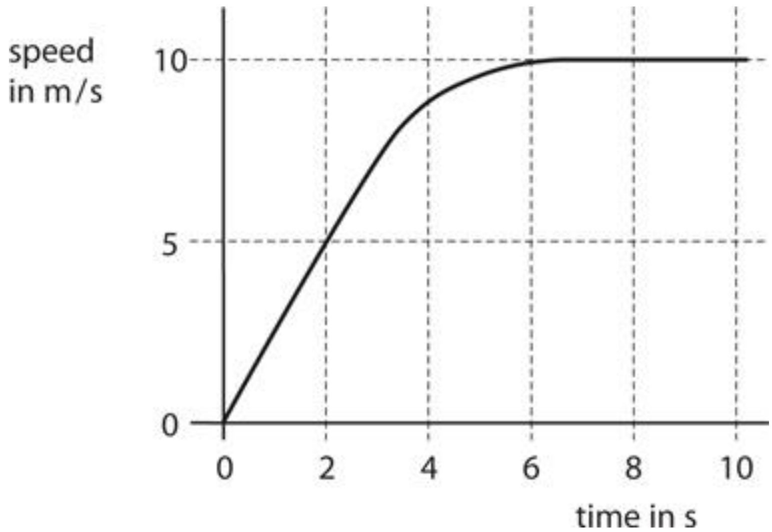
$$KE = \frac{1}{2} \times m \times v^2$$

5) Make ***u*** the subject of the formula

$$F = \frac{mv-mu}{t}$$

Exam Questions: Please complete the following exam style questions

Q1.
The graph below shows the movement of a different dog, chasing a ball.



(i) Use data from the graph to calculate the acceleration of the dog in the first 2 s.
State the unit.

(3)

acceleration = ... unit ....

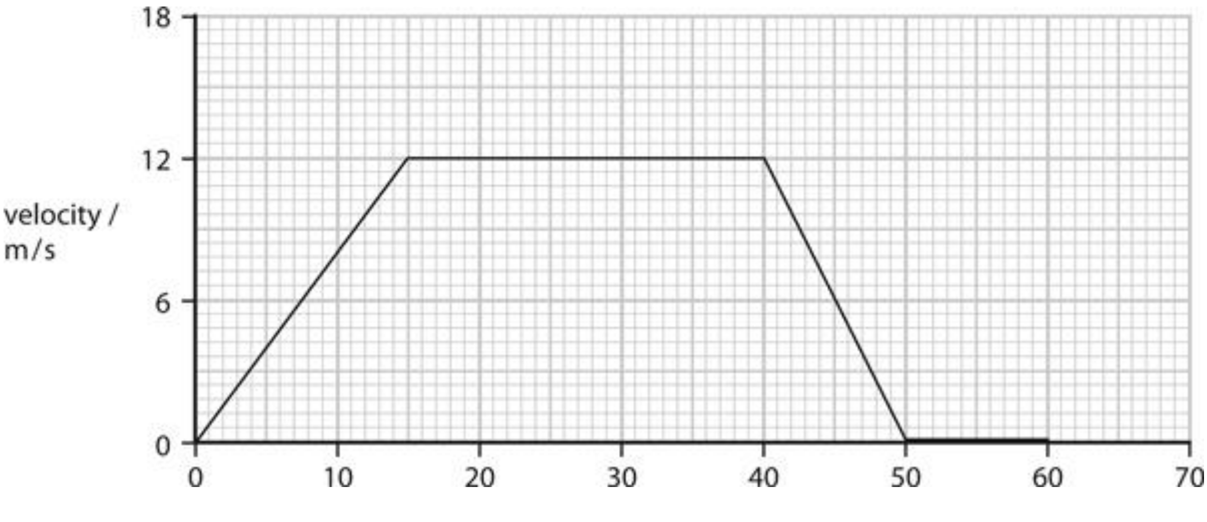
(ii) Calculate the distance the dog moves in the time between 8 s and 10 s.

(2)

distance = ... m

Q2.
Forces and motion

The graph shows a velocity-time graph for a cyclist over a time of 60 s.



(a) (i) When is the cyclist travelling with greatest velocity?

Put a cross (☒) in the box next to your answer.

(1)

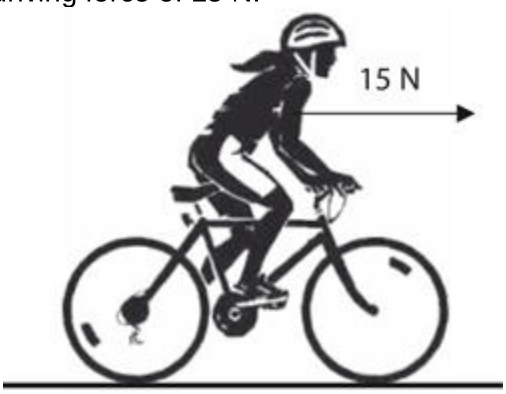
☐ **A** for the first 15 seconds
☐ **B** between 15 and 40 seconds
☐ **C** between 40 and 50 seconds
☐ **D** for the last 10 seconds

(ii) Calculate how long the cyclist is stationary for.

(1)

answer = ... seconds

(b) The cyclist in this picture is travelling at a constant velocity.
Her muscles produce a driving force of 15 N.



Draw an arrow on the diagram to show the size and direction of the overall resistive force acting on the cyclist.

(1)

(c) The cyclist accelerates at 1.4 m/s^2.

The mass of the cyclist and bicycle is 60 kg.

(i) Calculate the resultant force.

(2)

resultant force = ... N

(ii) The cyclist accelerates for 8 s.
Calculate the increase in velocity during this time.

(3)

increase in velocity = ... m/s

Q3.

(a) Skin cancer can be caused by radiation from the Sun.

Complete the sentence by putting a cross (☒) in the box next to your answer.

The radiation that causes skin cancer is

(1)

☐ **A** ultraviolet radiation
☐ **B** radio waves
☐ **C** microwaves
☐ **D** infrared radiation

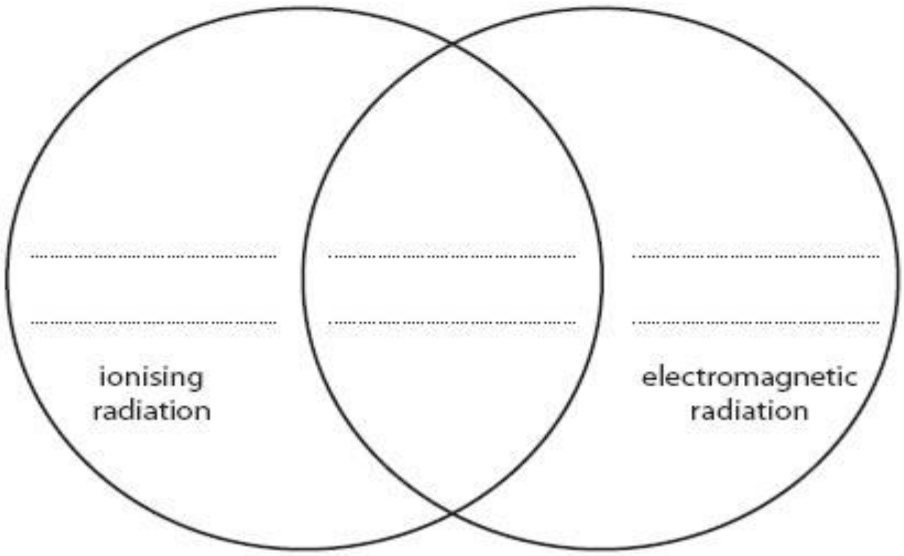
(b) The word box contains the names of three types of radiation.

gamma rays infrared radiation alpha particles

Use this diagram to classify the three types of radiation given in the word box.

Write the name of the radiation in the correct section of the diagram.

(2)



(c) Which of these is correct for all electromagnetic waves in a vacuum?

Put a cross (☒) in the box next to your answer.

(1)

☐ **A** they have the same frequency
☐ **B** they have the same wavelength
☐ **C** they are transverse waves
☐ **D** they are longitudinal waves

(d) Describe a use of gamma radiation.

(2)

....

....

....

....

Q4.

(i) Iodine-131 emits beta particles.

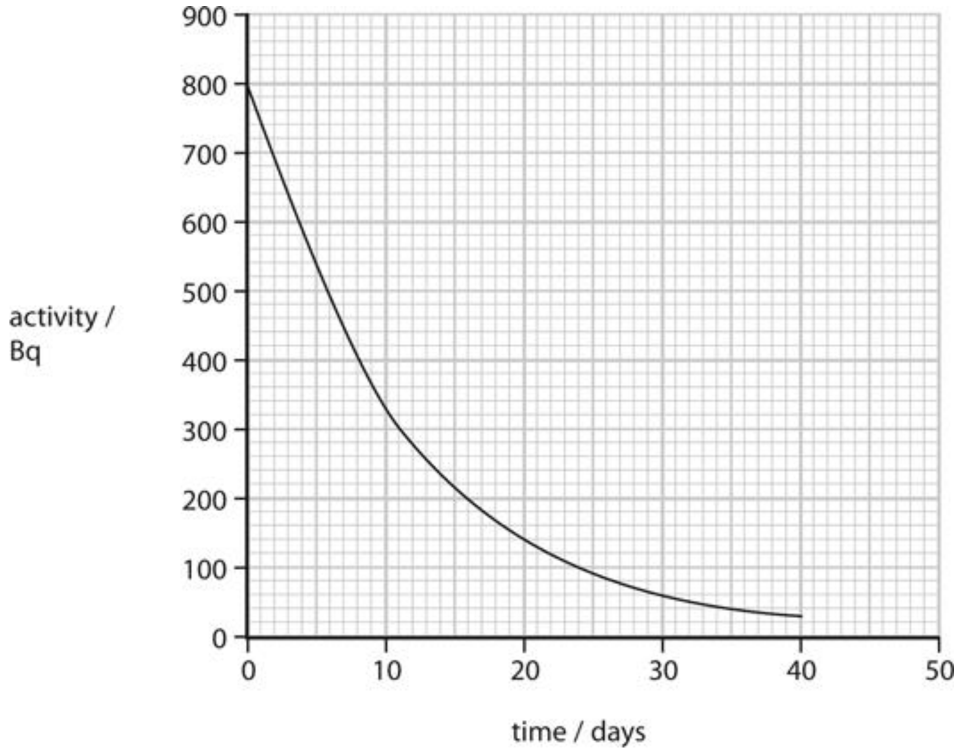
State what a beta particle is.

(1)

....
.

....
.

(ii) The graph shows how the activity of iodine-131 varies with time.



A sample of iodine-131 has a mass of 100 mg.

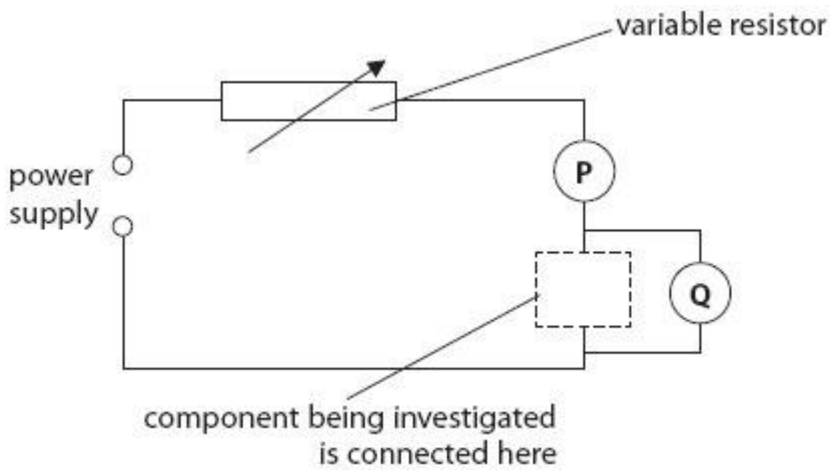
How much iodine-131 will remain after 24 days?

(3)

mass of iodine-131 = ... mg

Q5.

(a) Some students investigate the electrical resistance of different components using this circuit.



(i) Which row of the table is correct for both meters **P** and **Q**?

Put a cross (☒) in the box next to your answer.

(1)

	meter P is	**meter Q is**
☐ **A**	an ammeter	an ammeter
☐ **B**	an ammeter	a voltmeter
☐ **C**	a voltmeter	a voltmeter
☐ **D**	a voltmeter	an ammeter

(ii) One of the components being investigated is a 12 ohm resistor.
When it is in the circuit, the ammeter reading is 0.50 A.
Calculate the voltmeter reading.

(2)

....

(iii) The students reduce the resistance of the variable resistor.

State what happens to the readings on each of the meters **P** and **Q**.

(2)

....

....

....

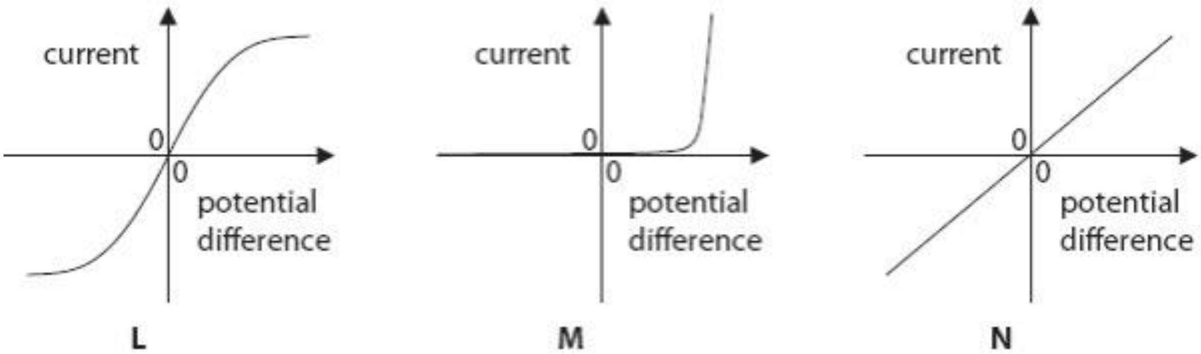
(iv) The students then reduce the voltage of the power supply.

State what happens to the current in the circuit.

(1)

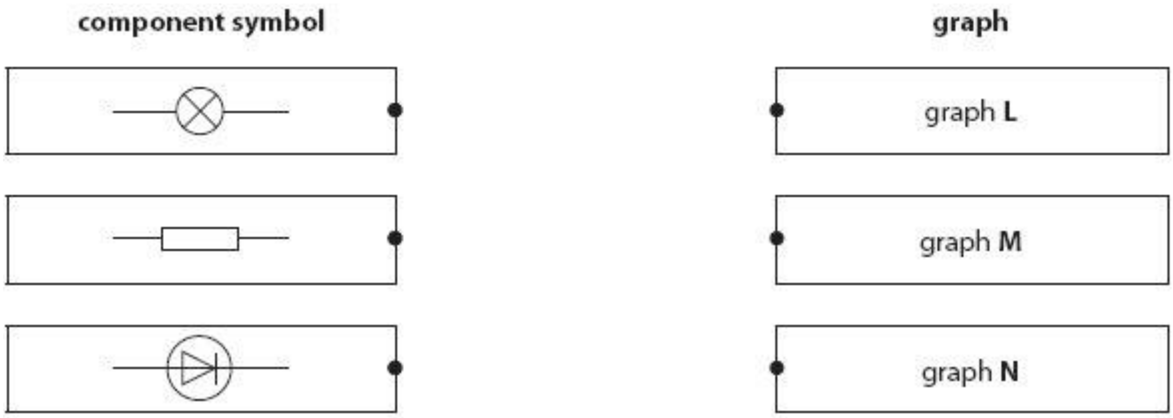
....
.

(b) The graphs **L**, **M** and **N** each show how the current in a component varies with the potential difference (voltage) across that component.



Match each graph with the symbol of the component to which it applies.

Draw lines to connect each symbol with its correct graph.



Q6.

A child is stationary on a swing.

(a) The child is given a push by his brother to start him swinging.

His brother applies a steady force of 84 N over a distance of 0.25 m.

(i) Calculate the work done by this force.

(2)

....
.

(ii) State how much energy is transferred by this force.

(1)

....
.

(iii) After several more pushes, the child has a kinetic energy of 71 J.

The mass of the child is 27 kg.

Show that the velocity of the child at this point is about 2.3 m/s.

(2)

(iv) Which one of these quantities changes in both size and direction while he is swinging?

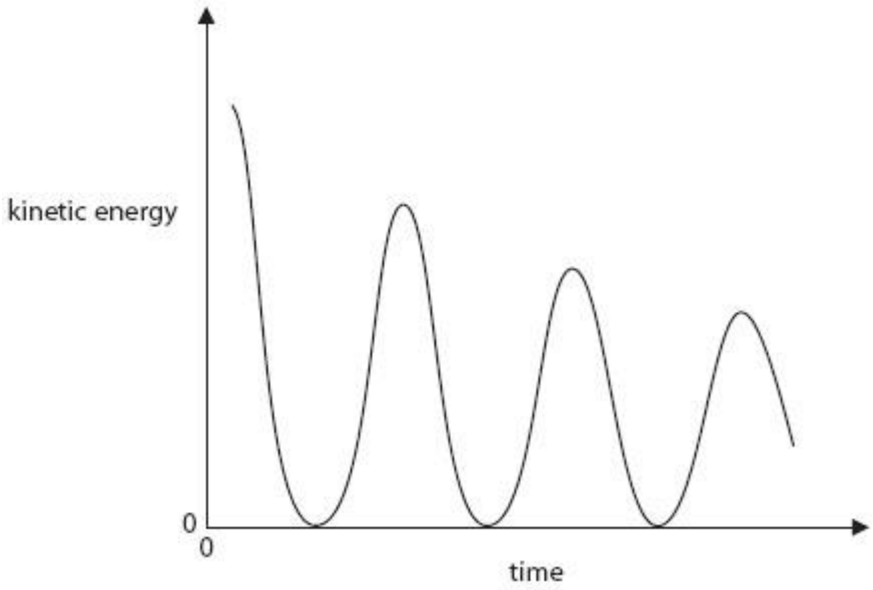
Put a cross (☒) in the box next to your answer.

(1)

☐ **A** his gravitational potential energy
☐ **B** his momentum
☐ **C** the force of gravity acting on him
☐ **D** his kinetic energy

*(b) The brother then stops pushing the child.

The graph shows how the kinetic energy of the child varies over the next few swings.



Explain the energy changes during this time.

(6)

Useful websites and optional tasks

Useful websites:
http://www.iop.org/
http://www.s-cool.co.uk/a-level/physics
http://www.aqa.org.uk/subjects/science/as-and-a-level/physics-7407-7408
http://www.asa2physics.co.uk/pages/
https://phet.colorado.edu/
http://schools.matter.org.uk/a-level.html
http://www.physicsclassroom.com/

YouTube channels to subscribe to:

- The Slo Mo Guys
- Veritasium
- NASA
- VSauce
- Smarter Every Day
- Sixty Symbols
- TED Talks
- Minute Physics

Optional tasks

What is the Higgs Boson and why was its discovery so important?

Proposed in the 1960's, and discovered in 2012 at the LHC, the Higgs Boson is the final fundamental particle to be discovered.

Summarise the difference between classical and quantum mechanics in just 3 sentences:

A 100 mile long army marches 100 miles. As they march, a messenger travels from the back of the army to deliver a message to the front of the army. The messenger then returns to the back, and arrives at the back of the army just as the army have completed the 100 miles. What is the total distance the messenger has travelled?

Answer: ___________miles

Note: the answer is not 100 miles, or 200 miles!