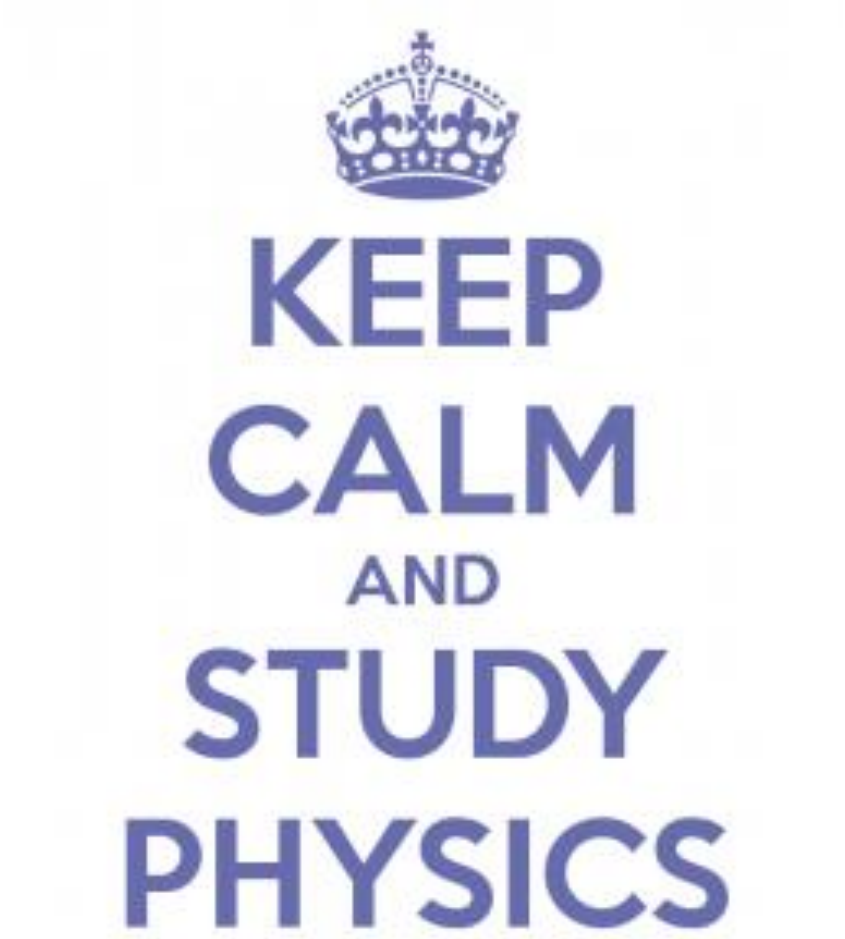
Transition Pack for A Level Physics

A guide to help you get ready for A-level Physics.



What you need to do

1. You need to learn the 30 definitions below word for word.

2. You need to work through every section of the 'pre-knowledge topics' and do all of the questions.

3. You should self-mark all of the questions using the answers at the back of this booklet and correct any that are wrong.

4. Hand in the work for checking by the end of the first week back.

Key terminology

A-level Physics contains some complex terminology. In the exams you may be asked to define key terms, or to explain previously unseen material using your knowledge of the key terms in the question. You therefore need to learn these terms word-for-word.

1. **Scalar** a quantity which has magnitude but not direction
2. **Vector** a quantity which has both magnitude and direction.
3. **Fiduciary marker** A pointer placed in the field of view as a reference.
4. **Absolute uncertainty** The range of values in which the 'true value' lies.

5. **Displacement** distance moved in a particular direction.
6. **Speed** the rate of change of distance.
7. **Average speed** distance covered per unit time
8. **Instantaneous speed** speed measured at a particular instant in time.
9. **Velocity** speed in a given direction or displacement per unit time
10. **Acceleration** the rate of change of velocity.
11. **Density** mass per unit volume
12. **Linear momentum** the product of mass and velocity.
13. **Equilibrium** when the resultant force is zero.
14. **Pressure** force per unit area.
15. **Moment** force x perpendicular distance from a pivot.

16. **Newton** the force which gives a mass of 1kg an acceleration of 1 ms^{-2}.
17. **Work done** force x distance moved_ *in the direction of the force*
18. **Joule** energy required to move a weight of 1N (through) a distance of 1 m
19. **Electronvolt (eV)** the energy transferred by an electron travelling through a potential difference of 1V.
20. **Watt** power required to move 1N through a distance of 1m in 1 sec
21. **Power** the rate at which work is done.
22. **Coulomb** the amount of charge that passes in 1 second when the current is 1 amp
23. **Volt** 1 Joule per Coulomb (JC^{-1})

24. **Current** rate of flow of charge
25. **Number density** the number of charged particles per unit volume.
26. **Potential difference** the energy transferred per unit charge into electrical energy from other forms,
27. **Electromotive force** the energy transferred per unit charge into electrical energy from other forms.
28. **Conventional current** moves from positive to negative terminals of a power supply.
29. **Electron flow** moves from negative to positive terminals of a power supply.
30. **Mean drift velocity** the average speed of charged particles along a conductor.

Pre-Knowledge Topics

Below are ten topics that are essential foundations for you study of A-Level Physics. Each topics has example questions and links where you can find our more information as you prepare for next year.

1)Prefixes

At A level, unlike GCSE, you need to remember all symbols, units and prefixes. Below is a list of quantities you may have already come across and will be using during your A level courses.

Solve the following:

1. How many metres in 2.4 km?

2. How many joules in 8.1 MJ?

Prefix	Symbol	Power of ten
Nano	n	x 10^{-9}
Micro	µ	x 10^{-6}
Milli	m	x 10^{-3}
Centi	c	x 10^{-2}
Kilo	k	x 10^{3}
Mega	M	x 10^{6}
Giga	G	

3. Convert 326 GW into W.

4. Convert 54 600 mm into m.

5. How many grams in 240 kg?

6. Convert 0.18 nm into m.

7. Convert 632 nm into m. Express in standard form.

8. Convert 1002 mV into V. Express in standard form.

9. How many eV in 0.511 MeV? Express in standard form.

10. How many m in 11 km? Express in standard form.

2) Standard Form

At A level, quantity will be written in standard form, and it is expected that your answers will be too.

This means answers should be written as ….x 10^{y}. E.g. for an answer of 1200kg we would write 1.2 x 10^{3}kg.

1. Write 2530 in standard form.

2. Write 280 in standard form.

3. Write 0.77 in standard form.

4. Write 0.0091 in standard form.

5. Write 1 872 000 in standard form.

6. Write 12.2 in standard form.

7. Write 2.4 x 10^{2} as a normal number.

8. Write 3.505 x 10^{1} as a normal number.

9. Write 8.31 x 10^{6} as a normal number.

10. Write 6.002 x 10^{2} as a normal number.

11. Write 1.5 x 10^{-4} as a normal number.

12. Write 4.3 x 10^{3} as a normal number.

3) Rearranging formulae

This is something you will have done at GCSE and it is crucial you master it for success at A level. For a recap of GCSE watch the following links:

www.khanacademy.org/math/algebra/one-variable-linear-equations/old-school-equations/v/solving-for-a-variable

Rearrange the following:

1. E=m x g x h to find h
2. Q= I x t to find I
3. E = ½ m v^2 to find m
4. E = ½ m v^2 to find v
5. v = u + at to find u
6. v = u + at to find a
7. $v^2 = u^2 + 2as$ to find s
8. $v^2 = u^2 + 2as$ to find u

4) Significant figures

At A level you will be expected to use an appropriate number of significant figures in your answers. The number of significant figures you should use is the same as the number of significant figures in the data you are given. You can never be more precise than the data you are given so if that is given to 3 significant your answer should be too. E.g. Distance = 8.24m, time = 1.23s therefore speed = 6.75m/s

The website below summarises the rules and how to round correctly.

http://www.purplemath.com/modules/rounding2.htm

Give the following to 3 significant figures:

1. 3.4527
2. 40.691
3. 0.838991
4. 1.0247
5. 59.972

Calculate the following to a suitable number of significant figures:

6. 63.2/78.1

7. 39+78+120

8. (3.4+3.7+3.2)/3

9. 0.0256 x 0.129

10. 592.3/0.1772

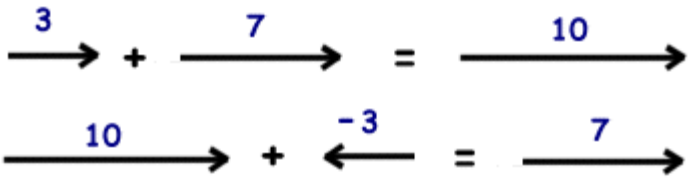
5) Vector and scalar quantities.

You may have touched on this at GCSE level with the idea that velocity is speed in a particular direction, whereas speed is the distance covered per unit time.

A vector quantity is one which has both magnitude and direction, for example displacement, velocity, force, acceleration, weight, momentum. A scalar quantity just has a magnitude, but no direction e.g. length, distance, volume, speed, pressure, energy, density, power.

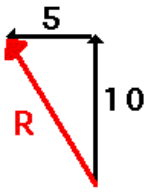
You need to be able to define both vector and scalar quantities and give examples. You may also be asked why a particular quantity, such as momentum, is a vector. The reason is that when you multiply or divide a scalar and a vector, the result is always a vector. In the case of momentum, mass is scalar and velocity is a vector, so the product of these two quantities, momentum, will be a vector.

Have a look at the link below and learn about adding and subtracting linear vectors. A few examples are also given below:



http://www.s-cool.co.uk/a-level/physics/vectors-and-scalars-and-linear-motion/revise-it/vectors-and-scalars-whats-the-differ

It is also possible to resolve vectors that are right angles to each other using Pythagoras' theorem. Imagine that you walk 10 m North and then 5 m East; as the crow flies, how far have you travelled from your starting point? The diagram to the left shows this problem with the distance you want to calculate marked as R (the resultant). Using Pythagoras you should be able to work out how many metres from your start point you are ($a^2 + b^2 = h^2$)



1 Divide these quantities into vectors and scalars.

density	mass
electric charge	momentum
electrical resistance	power
energy	voltage
field strength	volume
force	weight
friction	work done
frequency	

2 Divide these data into vectors and scalars.

3 m s^{-1}

+20 m s^{-1}

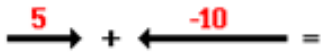
100 m NE

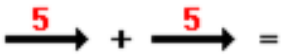
50 km

–5 cm

10 km S30°W

3 What are the resultants of these pairs of vectors?



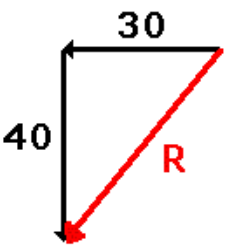


4 What is the magnitude of the resultant of these vectors?

30 km, West

+

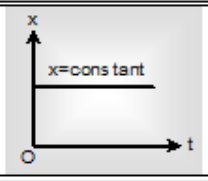
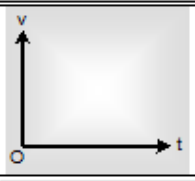
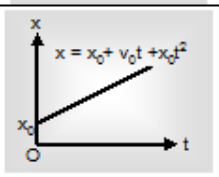
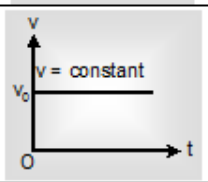
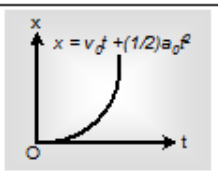
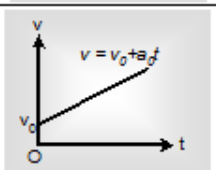
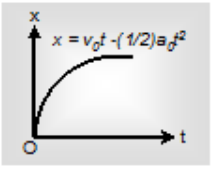
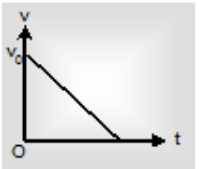
40 km, South



6) Graphs of motion.

This is something you will have done at GCSE, which we will be taking a bit further at A level. Look at the links and notes below and use your notes from P2 to revise the following points:

- The shapes of displacement time and velocity time graphs for different kinds of motion – pay particular attention to the differences in the shapes of graphs for constant acceleration and non-constant acceleration.

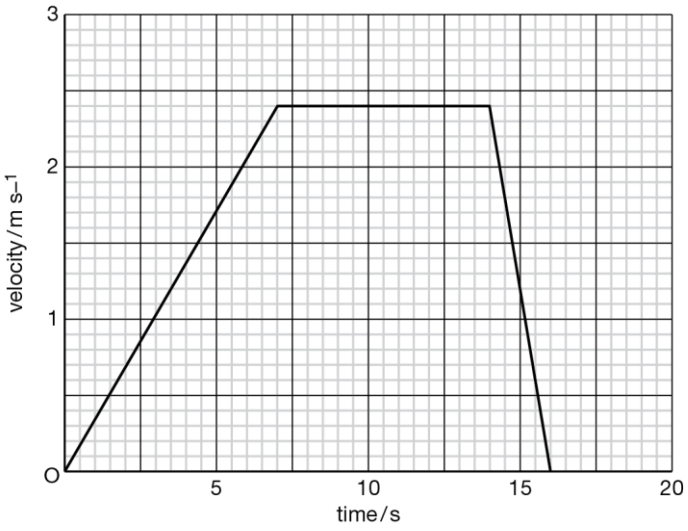
	Displacement(x)	Velocity(v)
a. At v=0;		
b. Motion with constant velocity		
c. Motion with constant acceleration		
d. Motion with constant deceleration		

- Calculating velocity from the gradient of a displacement time graph, calculating acceleration from the gradient of a velocity-time graph, calculating displacement from the area under a velocity-time graph.

  http://www.physicsclassroom.com/class/1DKin/Lesson-3/Determining-the-Slope-on-a-p-t-Graph
  http://www.physicsclassroom.com/class/1DKin/Lesson-4/Determining-the-Slope-on-a-v-t-Graph
  http://www.physicsclassroom.com/class/1DKin/Lesson-4/Determining-the-Area-on-a-v-t-Graph

- Calculating instantaneous velocity and instantaneous acceleration from the gradient of a tangent to a curve. This will probably be new to you so look at the links and instructions carefully.

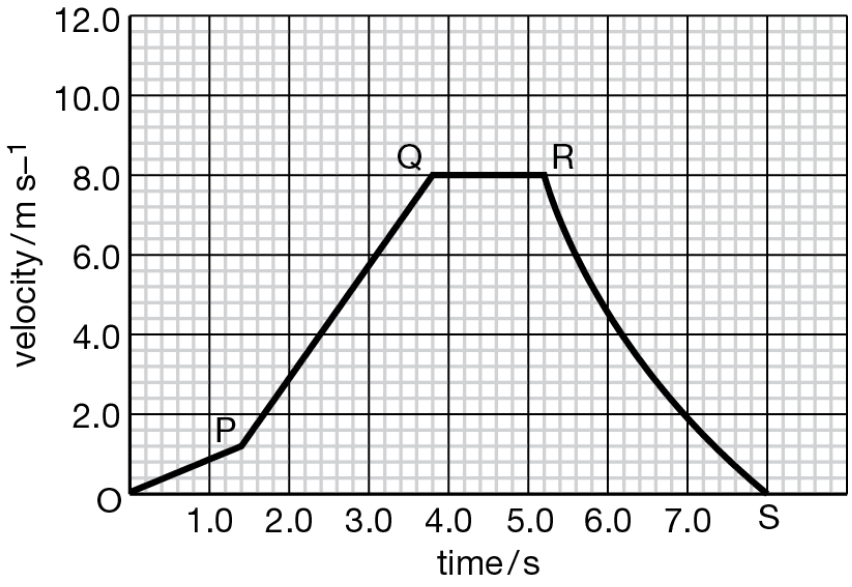
https://www.khanacademy.org/science/physics/one-dimensional-motion/displacement-velocity-time/v/instantaneous-speed-and-velocity



1. Describe, in as much detail as you can, the motion of the object depicted by this graph.

2. Calculate the magnitude of the acceleration, in both places where the object is accelerating. Show your working and give the correct units.

3. By dividing the graph into sections, and showing your working, calculate the displacement of the object depicted in the graph.



4. Describe the motion of the object between R and S.

5. By drawing a tangent to the curve, calculate the instantaneous acceleration at 6.0 seconds.

6. By reading from the graph, determine the instantaneous velocity at 7.0 seconds.

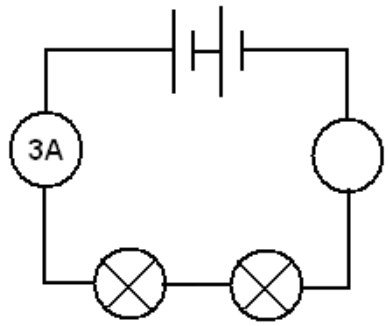
7) Electricity.

At A level you will learn more about how current and voltage behave in different circuits containing different components. You should be familiar with current and voltage rules in a series and parallel circuit as well as calculating the resistance of a device.

http://www.allaboutcircuits.com/textbook/direct-current/chpt-1/electric-circuits/

http://www.physicsclassroom.com/class/circuits

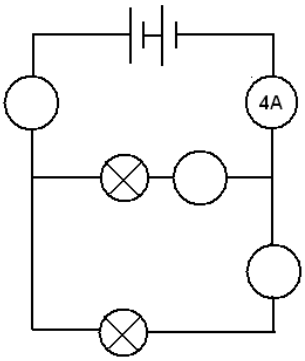
1a) Add the missing ammeter readings on the circuit below, assuming the bulbs are identical.



b) If the cells are supplying 9 volts in total, what is the potential difference across each bulb?

c)Using Ohm's law (V = IR), calculate the resistance of each bulb.

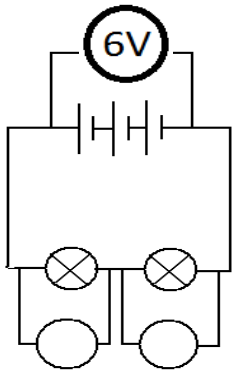
2a) Add the missing ammeter readings on the circuit below, assuming the bulbs are identical.

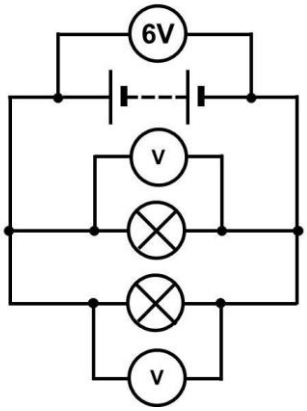


b) If the cells are supplying 6 volts in total, what is the potential difference across each bulb?

c) Using Ohms's law, calculate the resistance of each bulb.

2) Add the missing potential differences to the following circuits





1) Trigonometry

Look up (e.g. in your GCSE maths book) and write down the following:

1 – Pythagoras' theorem – to what kind of triangle does this apply?

2- sin θ =

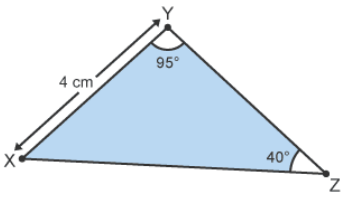
3 - cos θ =

4 – tan θ =

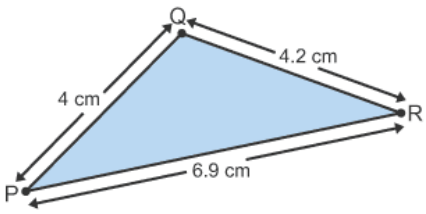
5 – Sine rule – to what kind of triangle does this apply?

6 – Cosine rule – to what kind of triangle does this apply?

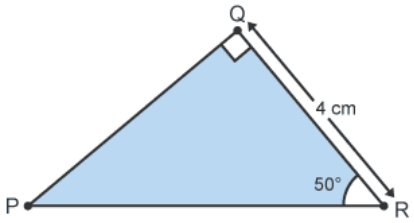
<u>Now try the following problems:</u>



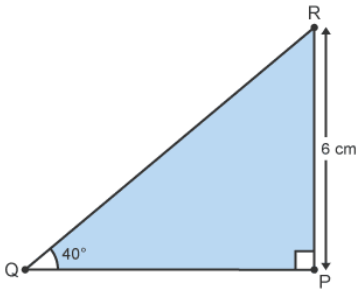
Find the length of YZ



Find the size of angle R



Find the length of PR



Find the lengths of QR and QP

Answers to summer work problems:

Symbols and prefixes

1. 2400
2. 8 100 000
3. 326 000 000 000
4. 54.6
5. 240 000
6. 1.8×10^{-8}
7. 6.32×10^{-7}
8. 1.002
9. 5.11×10^{-5}
10. 1.1×10^{4}

Standard Form:

1. 2.53
2. 2.8
3. 7.7
4. 9.1
5. 1.872
6. 1.22
7. 2400
8. 35.05
9. 8 310 000

10. 600.2
11. 0.00015
12. 4300

Rearranging formulae

1. $h = E / (m \times g)$
2. $I = Q/t$
3. $m = (2 \times E)/v^2$ or $E/(0.5 \times v^2)$
4. $v = \sqrt{((2 \times E)/m)}$
5. $u = v - at$
6. $a = (v-u)/t$
7. $s = (v^2 - u^2) / 2a$
8. $u = \sqrt{(v^2-2as)}$

Significant figures

1. 3.35
2. 40.7
3. 0.839
4. 1.02
5. 60.0
6. 0.809
7. 237
8. 3.4
9. 0.00330
10. 3343

Vectors and scalars

5 Scalars: density, electric charge, electrical resistance, energy, frequency, mass, power, voltage, volume, work done

Vectors: field strength, force, friction, momentum, weight

6 Scalars: 3 m s^{-1}, 50 km

Vectors: +20 m s^{-1}, 100 m NE, –5 cm, 10 km S30°W

3) 15, 5, 10, 0

4) 50 km

Graphs of motion

1. The first section shows constant acceleration over 7 seconds, from 0 ms^{-1} to 2.4 ms^{-1}
   The second section shows a constant velocity of 2.4 ms^{-1} for 7 seconds.
   The third section shows constant negative acceleration from 2.4 ms^{-1} to 0 ms^{-1} for 2 seconds.
2. (2.4-0)/7 = 0.34ms^{-2} and (0-2.4)/2 = -1.2 ms^{-1}
3. Area = $[\frac{1}{2} \cdot (7.0\ \text{s}) \cdot (2.4\ \text{m s}^{-1})] + [(14.0\ \text{s} - 7.0\ \text{s}) \cdot (2.4\ \text{m s}^{-1})] + [\frac{1}{2} \cdot (2.0\ \text{s}) \cdot (2.4\ \text{m s}^{-1})]$

   Area = 8.4 m +16.8 m + 2.4 m = 27.6 m = 28 m (2 significant figures)

4. Non-constant negative acceleration from 8 ms^{-1} to 0 ms^{-1}

5. $\text{Gradient} = \dfrac{(0 - 12.0)\ \text{m s}^{-1}}{(7.40 - 3.80)\ \text{s}} = -3.33\ \text{m s}^{-2}$

6. 2 ms^{-1}

Electrical circuits

1a) Series: 3A,

b) 4.5 V

c) R = V/I = 4.5/3 = 1.5 Ω

2) a) Parallel top to bottom: 4A,2A,2A

b) 6V

c)R = V/I = 6/2 = 3Ω

3)Series: 3V, 3V, Parallel: 6V 6V

Trigonometry

Please hand in for marking.