Physics

Year 11 to 12 bridging work

SALUS POPULI

Our Lady's Catholic College

Science Department

2020

Welcome to OLCC Physics!

I am sure you will find it both interesting and intellectually stimulating, as we look though from the smallest particles of matter in Y12 through to the scale of the Universe in Y13. On the way considering practical matters such as how to calculate if bridges can cope with the loads on them through to more esoteric matters such as what happens to objects near the speed of light.

You will develop impressive critical thinking, logic and problem-solving skills as well as massively improve your maths and practical abilities. All this will make you a much sort after person post A-Level!

If you have any queries about this bridging unit or the course in general, please feel free to e-mail me at: j.cloke@olcc.lancs.sch.uk

Preparing for A Level Physics

In order to have the best possible start to your A-Level it's important to ensure that you start with a secure knowledge of the GCSE content and skills. This is particularly the case this year as it will be 5 months between the start of lockdown and September.

The Y12 physics contains many areas that cross over and build upon the GCSE. Especially the earlier topics. In particular these include:

Forces & motion, Energy, Electricity, Waves, Atoms & radioactivity.

Important skills: rearranging formula, use of standard form, prefixes, converting units, percentages & ratios, Pythagoras' theorem, trigonometry, interpreting and using graphs – especially tangents and gradients.

To help you prepare we are asking you to complete this bridging work which is designed to help you to bridge the gap between your GCSE science studies and the AS/A Level physics course.

After completing these exercises, you will need to highlight any areas that you really had trouble understanding. This will help me plan suitable starting points in topics and/or support. I am expecting you to put 100% effort into these tasks to show your commitment to studying physics. All of these are essential in the understanding of the foundations of physics. We want you to be successful at A-level physics and some students find the change from GCSE quite a challenge. Although you have fewer subjects, there are different skills post-16 and the volume of work is greater due to the increased demand of depth and detail. Bridging work should help you to gauge your current understanding of the subject and introduce you to the depth of understanding that is required for study at post-16.

If you cannot remember the answers to these tasks from your GCSE learning, please use the internet (we have suggested relevant links for each topic) and your GCSE notes or revision guides to help you complete the booklet. We do not expect to see blank pages! You may also choose to keep evidence of notes you take from the internet and other resources in the file with your answers to the tasks. As part of your AS/A-Level studies you will have nine hours each fortnight in your timetable. In these lessons you will cover all the theory and practical work required for the course. You are also expected to spend at least five hours a week on your biology work outside of lessons. This will include homework tasks, pre-reading, independent study tasks, making additional notes, reviewing lesson materials and reading around the subject.

Is the bridging work assessed? You will be asked to bring your bridging work to your interview for sixth form, and to your first physics lesson. Please keep all the work you complete in a folder until then.

Resources to help prepare:

The A Level content & method of assessment can be found here: https://www.aqa.org.uk/subjects/science/as-and-a-level/physics-7407-7408/spec-at-a-glance

I can fully recommend the '**New Head Start to AS Physics'** book available at Amazon/eBay.

Publisher: Coordination Group Publications Ltd (CGP); 3rd Revised edition (2015)
ISBN: 978 1 78294 281 8

This is designed to bridge the gap between years 11 and 12.

Should you feel your maths skill could do with improving and/or if you are not taking Maths A level, I recommend getting and using:

"New A-Level Physics: Essential Maths Skills" by CGP Edition: Sept 2015

ISBN**:** 978 1 78294 471 3

Seneca is an excellent online free resource:
https://app.senecalearning.com/courses?Price=Free&Age+Group=GCSE&Subject=Physics

As is BBC bitesize: https://www.bbc.co.uk/bitesize/examspecs/zsc9rdm

Forces & Motion

Visit either https://www.bbc.co.uk/bitesize/topics/z82j97h or https://app.senecalearning.com/classroom/course/fe56ca00-05aa-11e8-9a61-01927559cfd5/section/0ad221d0-05ab-11e8-9a61-01927559cfd5/session

Answer the following:

1) Explain the difference between a vector and a scalar:

2) Name 2 scalar quantities:

3) Name 2 vector quantities:

4) Define the following forces

Force	definition
Weight	
Friction	
Air resistance	
Upthrust	
Tension	
Electrostatic	
Thrust	
Normal	

5) Explain why we use force arrows to represent forces and what information we can get from them when drawn to scale.

6) State Newton 3 Laws of motion as fully and accurately as you can

1st	
2nd	
3rd	

7) State what the term 'resultant force' means:

6) What is a free body diagram?

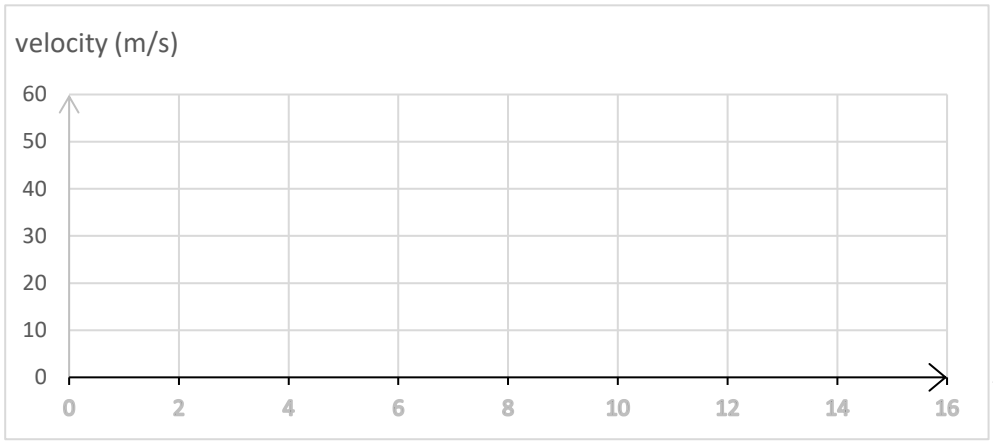
8) Draw & label a free-body diagram for a car accelerating along a horizontal road:

9) A rocket has a thrust of 510MN vertically upwards and a mass of 3.2×10^6 kg.
   a) Calculate its weight, showing your working out.

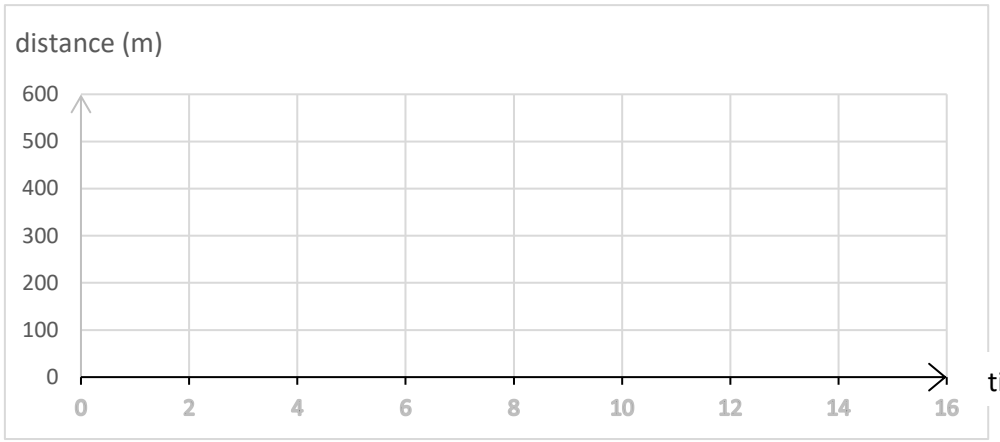
   b) Determine the resultant force on the rocket.

   c) So now workout the rockets acceleration.

10) Draw a velocity-time graph for a train that travels at a constant 50 m/s for 10s then brakes to a stop in the next 4s



11) Draw a distance-time graph for that train journey



12) State how you can use a velocity-time graph to find distance travelled:

13) Use this method to find the distance travelled by the train between 10 and 14s. Show all working out.

14) Write the equation to calculate acceleration in symbol and word form, include the units

15) What would a negative value of acceleration tell you about an objects motion?

16) Explain using Newtons 1st and 2nd laws of motion why a falling object accelerates at first but ends up reaching a terminal velocity. Ensure you use the terms: weight, air resistance, resultant force, unbalanced force, balanced force.

17) A football is kicked for a penalty, it leaves the boot at 17.2m/s and crosses the goal line 1.24s later and is travelling at 15.6 m/s. Calculate the acceleration of the ball, showing all working out.

18) State how to calculate momentum and give its unit.

19) State the principle of conservation of momentum:

20) An 90kg astronaut is stationary in space – state her momentum.

21) She throws a 500g spanner away from her at 9m/s. Calculate its momentum and use this to find the speed she moves away at.

22) Explain why she must move in exactly the opposite direction to the spanner.

Parts of the topic that I am still unsure about……..

Energy

Visit: https://app.senecalearning.com/classroom/course/fe56ca00-05aa-11e8-9a61-01927559cfd5/section/d1937e20-0698-11e8-b4ba-6954b711feed/session or

https://www.bbc.co.uk/bitesize/topics/zycbsrd

Tasks:

1) Write down the equations to calculate:

   a) Kinetic energy

   b) Gravitational potential energy

   c) Power

   d) Efficiency

2) State what is the principle of conservation of energy:

3) Describe the energy transfers that take place in an electric motor that operates a lift.

4) A petrol motor that transfers 20MJ of chemical energy to produce 8MJ kinetic and 0.1MJ of sound. How much thermal energy is produced?

5) Draw a labelled Sankey diagram for the petrol motor.

6) Calculate the motors efficiency. Show your working out, give your answer to 2 significant figures.

7) If a 4kW pump is 60% efficient what is its power output?

8) A crane lifts a pallet of bricks from a lorry 1.5m above the floor, up to a platform 9m above the floor. If the pallet mass is 2100kg what was its gain in g.p.e?

9) The crane completed the lift in 18s, Calculate its power output.

10) The foreman wants to speed up work, state and explain what he could change in the crane to achieve this?

Parts of the topic that I'm still unsure about……..

Electricity

Visit either:

https://www.bbc.co.uk/bitesize/topics/zp3ftv4 or

https://app.senecalearning.com/classroom/course/fe56ca00-05aa-11e8-9a61-01927559cfd5/section/88056f10-06a8-11e8-93f6-950eaf41a637/session

Tasks:

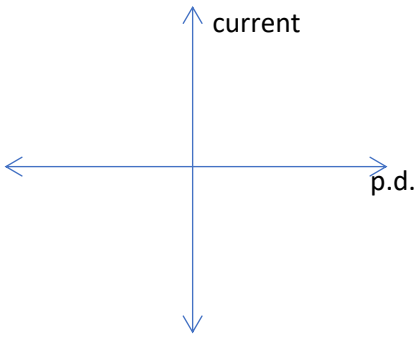
1) Complete the table

Quantity	Definition	symbol for	Unit of
Charge			
Current			
potential difference			
resistance			

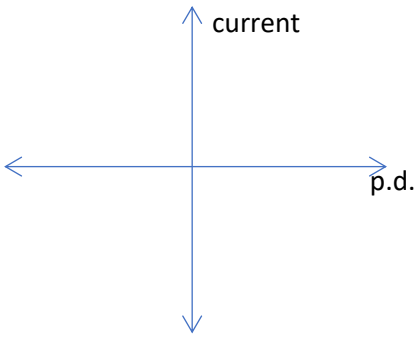
2) Draw a circuit used to measure the current and potential difference (p.d. or voltage) of a bulb

3) Sketch the current – p.d. graphs for

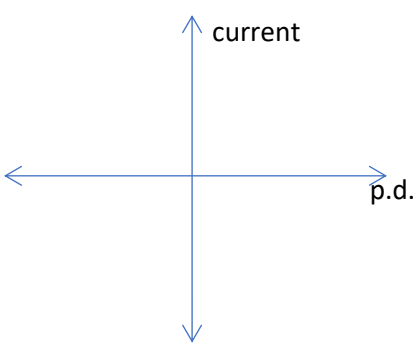
a) a fixed resistor



b) a bulb



c) a diode



4) Complete the table

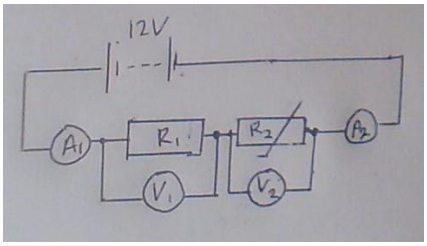
Component	Symbol	What it does
resistor		
voltmeter		
ammeter		
bulb/lamp		
cell		
variable resistor		
thermistor		
diode		

5) What makes a circuit either a series circuit or a parallel circuit?

6) a) Which type of circuit is this?

b) If V_1 reads 3.7V what does V_2 read?

c) If R_1 is 600Ω calculate the reading of A_1.

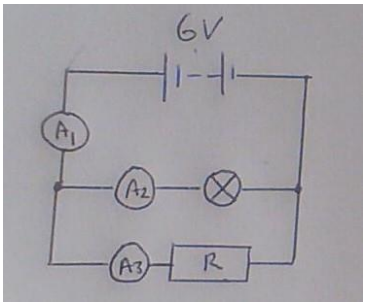


d) What is the reading of A_2?

e) Find R_2

f) Find the total resistance of the circuit.

7) a)Which type of circuit is this?



b) What is the p.d. across the bulb?

c)If R=15Ω find A_3

d) If A_1=1.1A, what is the current through the lamp?

e) Find the power of the bulb.

f) If the current flows for 3 minutes calculate the amount of charge that flows through the resistor.

g) Explain what would happen to ammeter 1 reading if the resistor had a lower resistance.

Parts of the topic that I'm still unsure about…….

Waves

Visit either https://www.bbc.co.uk/bitesize/topics/zcwkgdm or

https://app.senecalearning.com/classroom/course/fe56ca00-05aa-11e8-9a61-01927559cfd5/section/fef3bc16-c258-4f18-aa1a-48d60d271bb1/session

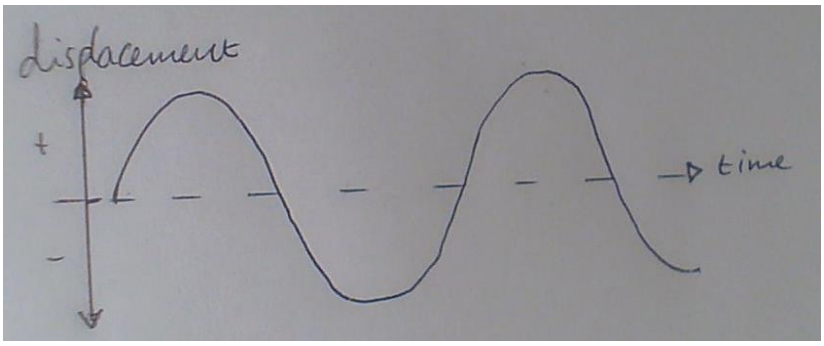
Tasks :

1) Write a definition for

Term	Symbol	Unit	Definition
wave speed			
oscillation			
wavelength			
amplitude			
frequency			
time period			

2) Describe the difference between transverse & longitudinal waves in terms of direction of vibration/oscillation and direction of wave travel.

3) Label time period and amplitude on this diagram:



4) How would it look if the frequency was higher? You could sketch it underneath…

5) A tsunami travels across an ocean at 500km/h if its wavelength is 800m what is its frequency? (hint: think about the unit of wave speed convert it if needed)

6) Name the sections of the electro-magnetic spectrum in order of longest wavelength to shortest. For each section give one use and one danger (if any).

Section of EM spectrum	Wavelengths	Use	Danger

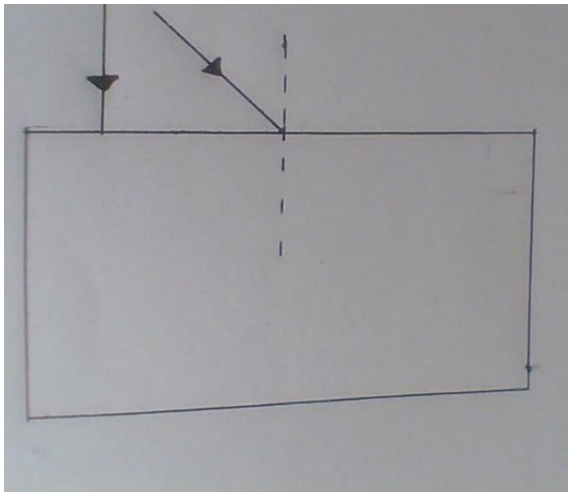
7) What is the law of reflection?

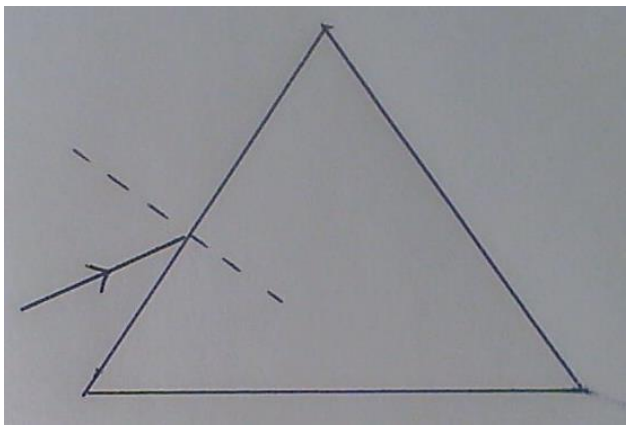
8) What is the name of the line that is perpendicular (90°) to a surface from which all angles are measured in ray diagrams?

9) When light is incident on a surface what are the 3 things that could happen to it?

10) When white light passes through a red filter and is then shone onto a green t-shirt, the t-shirt looks black, explain why.

11) Complete the rays and label the angles of incidence and refraction.





12) If white light enters a prism explain why a spectrum of colours leaves it.

Parts of the topic that I'm still unsure about…….

Practical Science

There are many important terms that you should be aware of in order to write well and understand, for a recap look at:
https://www.aqa.org.uk/resources/science/as-and-a-level/teach/subject-specific-vocabulary
then try this:

Join the boxes to link the word to its definition.

Accurate	A statement suggesting what may happen in the future.
Data	An experiment that gives the same results when a different person carries it out, or a different set of equipment or technique is used.
Precise	A measurement that is close to the true value.
Prediction	An experiment that gives the same results when the same experimenter uses the same method and equipment.
Range	Physical, chemical or biological quantities or characteristics.
Repeatable	A variable that is kept constant during an experiment.
Reproducible	A variable that is measured as the outcome of an experiment.
Resolution	This is the smallest change in the quantity being measured (input) of a measuring instrument that gives a perceptible change in the reading.
Uncertainty	The interval within the true value can be expected to lie.
Variable	The spread of data, showing the maximum and minimum values of the data.
Control variable	Measurements where repeated measurements show very little spread.
Dependent variable	Information, in any form, that has been collected.

Maths Skills

You may find this link helpful, it contains PowerPoints and worksheet on indices, units, standard form, ratio, and plotting equations:

https://www.aqa.org.uk/resources/science/as-and-a-level/teach/maths-skills-briefings

In physics we use a very wide range of numbers and hence prefixes, by Y13 we will meet:

Prefix	Symbol	Multiplication factor		
Tera	T	10^{12}	1 000 000 000 000	
Giga	G	10^{9}	1 000 000 000	
Mega	M	10^{6}	1 000 000	
kilo	k	10^{3}	1000	
deci	d	10^{-1}	0.1	1/10
centi	c	10^{-2}	0.01	1/100
milli	m	10^{-3}	0.001	1/1000
micro	μ	10^{-6}	0.000 001	1/1 000 000
nano	n	10^{-9}	0.000 000 001	1/1 000 000 000
pico	p	10^{-12}	0.000 000 000 001	1/1 000 000 000 000
femto	f	10^{-15}	0.000 000 000 000 001	1/1 000 000 000 000 000

Which SI unit and prefix would you use for the following quantities?

1. The length of a finger
2. The temperature of boiling water
3. The time between two heart beats
4. The width of an atom
5. The mass of iron in a bowl of cereal

Re-write the following quantities:

1. 1502 metres in kilometres

2. 0.000 45 grams in micrograms

3. 0.000 45 metres in millimetres

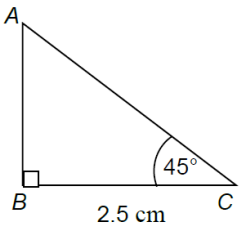
4. 1055 kilometres in metres

5. 180 megaseconds in seconds

6. 2500 centimetres in millimetres

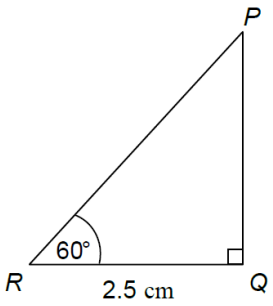
Trigonometry

1 (a) Work out the length of *AB*.



(Not drawn accurately)

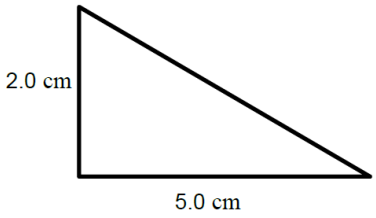
(b) Work out the length of *PR*.

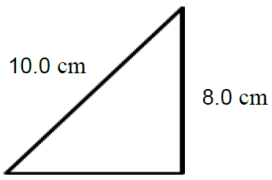


(Not drawn accurately)

Pythagoras' Theorem

Work out the lengths of the unlabelled side





Re-arranging equations

1. Rearrange $y = 2x + 3$ to make x the subject.

2. Rearrange $C = 2\pi r$ to make r the subject.

3. Rearrange $E = \frac{1}{2}mv^2$ to make v the subject.

4. Rearrange $s = ut + \frac{1}{2}at^2$ to make u the subject.

5. Rearrange $s = ut + \frac{1}{2}at^2$ to make a the subject.

7. Rearrange $T = 2\pi\sqrt{\frac{v}{r}}$ to make r the subject.

Challenge……

8. Rearrange $v = \omega\sqrt{A^2 - x^2}$ to make x the subject.

Parts of the maths that I'm still unsure about…….

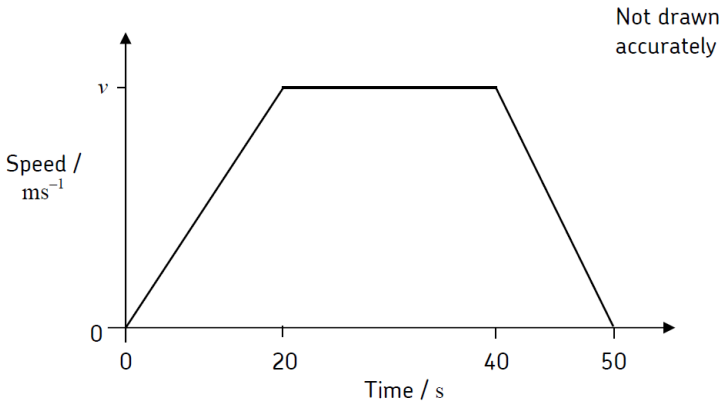
Extension work (optional but great preparation for the 1st topic)

1. The graph shows the speed of a car between two sets of traffic lights.

   It achieves a maximum speed of v metres per second.

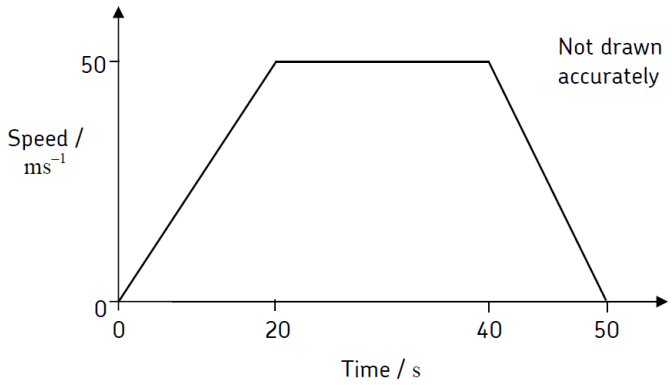
   It travels for 50 seconds.

   The distance between the traffic lights is 625 metres.



   Calculate the value of v

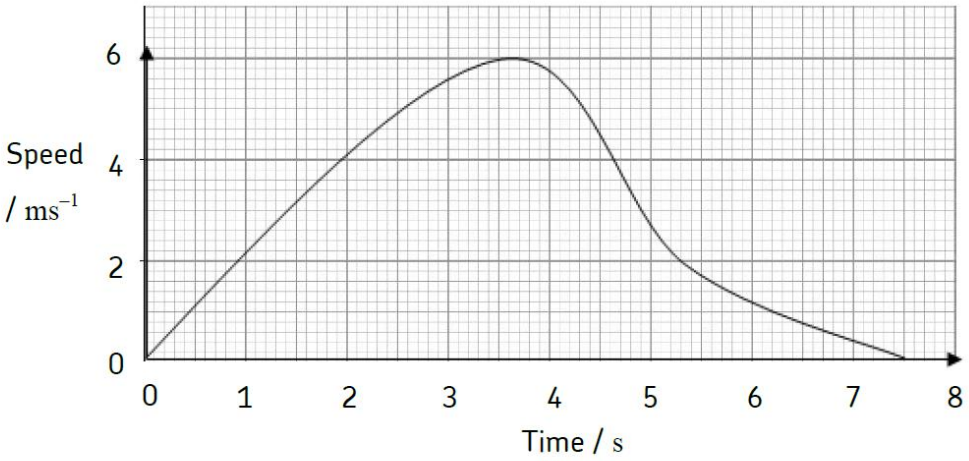
2. The graph shows the speed of a train between two stations.



   Calculate the distance between the stations.

Cont….

3 The graph shows the speed-time graph of a car.



Use the graph to work out:

a. The maximum speed of the car.

b. The total distance travelled.

c. The average speed for the journey.

d) The acceleration at 5.3s

Forces & Motion

Answers

1) Explain the difference between a vector and a scalar:

   A scalar only has a value, vectors have value **& direction**

2) Name 2 scalar quantities: Any 2: Temperature, length,/height/width etc. mass, energy, speed, resistance, charge,

3) Name 2 vector quantities: Any 2: Force or any named force, velocity, acceleration, current, potential difference,

4) Define the following forces

Force	definition
Weight	The size of the force of gravity on a mass, acts towards the centre of planet/moon/
Friction	Force between 2 solid surfaces when 1 or both are moving over the other. (Always acts against direction of motion)
Air resistance	Force between an object moves through a gas, caused by collisions with the gas particles. Increases with speed and acts against direction of motion.
Upthrust	An upward push from a liquid onto an object in the liquid. Caused by the displacement of the liquid and equal to the weight of the displaced liquid.
Tension	A pair of forces on wires/strings and rigid structure when both ends are pulled in opposite directions.
Electrostatic	A force between electrically charged objects , can be attractive or repulsive.
Thrust	Any mechanical force that propels an object forward, e.g. from an engine.
Normal	The reaction force of surface to having an object push on it, acts at 90° to the surface back onto the object on it.

5) Explain why we use force arrows to represent forces and what information we can get from them when drawn to scale.

   Arrows can show a forces direction by where they point and size by the length (or sometimes width) of the arrow

6) State Newton 3 Laws of motion as fully and accurately as you can

1st	An object will continue with the motion that it has unless an unbalanced force acts on it. Or…. If there is no resultant force, then an objects velocity does not change
2nd	If a resultant force acts on an object it will cause acceleration in the direction of the resultant force given by: $\sum F=ma$
3rd	Forces always act in pairs, of equal size,and same type but on 2 different objects. In opposite directions (often inaccurately stated as: for every force there is an equal and opposite reaction force– or even worse just 'action and reaction'!)

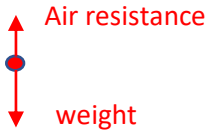
7) State what the term 'resultant force' means:

The sum of all the individual forces acting on an object /

6) What is a free body diagram?

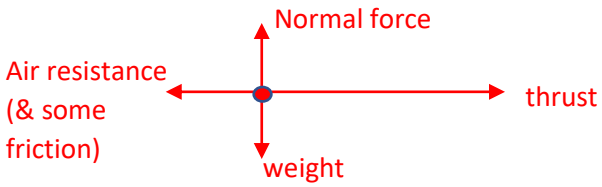
A diagram that shows all the forces acting on an object.

The object is represented by a circle/blob. e.g. for a person skydiving



8) Draw & label a free-body diagram for a car accelerating along a horizontal road:

- thrust must be greater than air resistance
- weight & normal force must be same size



9) A rocket has a thrust of 510MN vertically upwards and a mass of 3.2×10^6 kg.

a) Calculate its weight, showing your working out

W=mg

$W=3.2\times10^6$ kg x 9.8 N/kg (can use g=10N/kg at GCSE, but at A-level g=9.8 or 9.81)

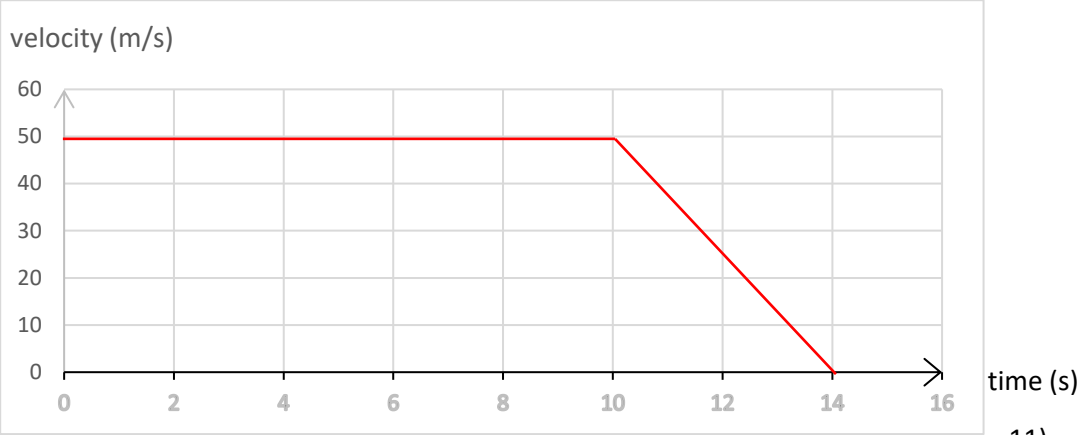
$W=3.14\times10^7$ N or 31.4MN (1 MN is 10^6 N)

b) Determine the resultant force on the rocket.

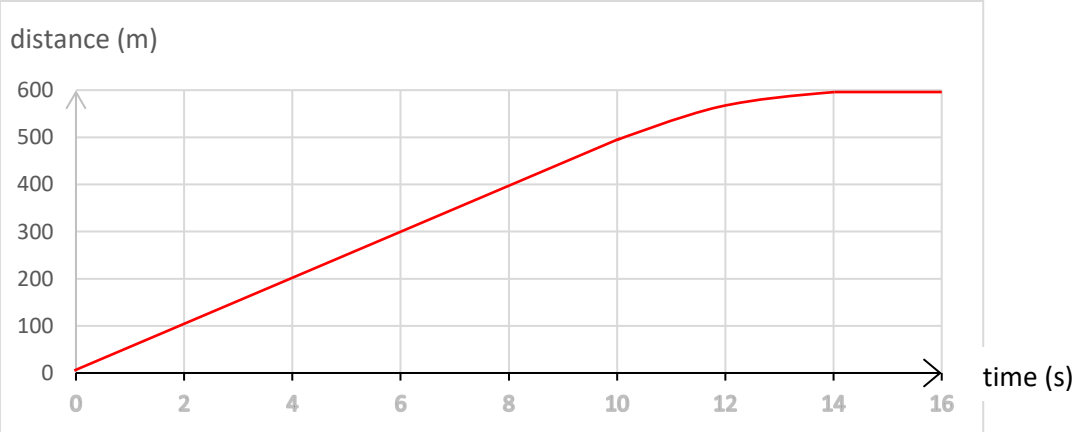
$\sum F = 510\times10^6$ N $- 3.14\times10^7$ N $= 4.79\times10^8$ N or 479MN (this is simpler if both F are in MN!)

c) So now workout the rockets acceleration. $a = \frac{\sum F}{m} = \frac{479x10^6\ N}{3.2x10^6\ kg}$ = 150 m/s^2

10) Draw a velocity-time graph for a train that travels at a constant 50 m/s for 10s then brakes to a stop in the next 4s



11) Draw a distance-time graph for that train journey



12) State how you can use a velocity-time graph to find distance travelled:
The area under the graph (for the relevant time section)

13) Use this method to find the distance travelled by the train between 10 and 14s. Show all working out.
0-10s rectangle so 50x10=500m
10-14s triangle so ½x4x50=100m
Total distance =500m+100m=600m

14) Write the equation to calculate acceleration in symbol and word form, include the units

$a\left(\frac{m}{s^2}\right) = \frac{v\left(\frac{m}{s}\right) - u\left(\frac{m}{s}\right)}{t(s)}$ so $a = \frac{final\ velcity - initial\ velocity}{time\ taken}$

Or $a = \frac{\Delta v}{\Delta t}$ $acceleration = \frac{change\ in\ velocity}{time\ for\ change}$

15) What would a negative value of acceleration tell you about an objects motion?
It's slowing down or decelerating

16) Explain using Newtons 1st and 2nd laws of motion why a falling object accelerates at first but ends up reaching a terminal velocity. Ensure you use the terms: weight, air resistance, resultant force, unbalanced force, balanced force.
At first the weight is greater than the air resistance so there is a downwards resultant force. This causes downwards acceleration and the sky divers speed increases.
As the speed increases the air resistance increases, which reduces the resultant force and hence acceleration.
Eventually the air resistance is equal and opposite to the weight.
At this point the forces are balanced and the acceleration =0 , terminal velocity is reached.

17) A football is kicked for a penalty, it leaves the boot at 17.2m/s (u)and crosses the goal line 1.24s (t) later and is travelling at 15.6 m/s (v). Calculate the acceleration of the ball, showing all working out.

$$a = \frac{v-u}{t} = \frac{15.6-17.2}{1.24} = -1.29 \text{ m/s}^2$$

18) State how to calculate momentum and give its unit.
momentum (kg m/s) = mass (kg) x velocity (m/s) or p=mv

19) State the principle of conservation of momentum:

The **total** momentum of a system (all objects involved) is conserved (i.e. is the same after an event such as a collision or explosion as before the event)

20) An 90kg astronaut is stationary in space – state her momentum.

Its zero as her velocity is zero! (multiply any number by zero gives zero)

21) She throws a 500g spanner away from her at 9m/s. Calculate its momentum and use this to find the speed she moves away at.
Need to convert g -> kg m=0.5kg
Spanners momentum p= 0.5kg x 9m/s = 4.5 kg m/s
So astronauts momentum = - 4.5kgm/s or 4.5 kg m/s in the opposite direction

So her $v = \frac{p}{m} = -\frac{-\frac{4.5kgm}{s}}{90kg}$ = - 0.05m/s

22) Explain why she must move in exactly the opposite direction to the spanner.

The total momentum of astronaut and spanner was zero and since total momentum is conserved her momentum must be equal and opposite to the spanner's momentum, so her direction of velocity is opposite to the spanners direction.

Energy

Answers:

1) Write down the equations to calculate:

   a) Kinetic energy $E_k = ½mv^2$ or kinetic energy = ½ x mass x velocity squared

   b) Gravitational potential energy E_{grav} or $g.p.e = mg\Delta h$ or gravitational potential energy = mass x gravitational field strength x change in height

   c) Power $P = \frac{E}{t}$ or $power = \frac{energy\ transferred}{time\ of\ transfer}$

   d) Efficiency $efficiency = \frac{useful\ energy\ out}{total\ energy\ in}$ or $efficiency = \frac{useful\ power\ out}{total\ power\ in}$

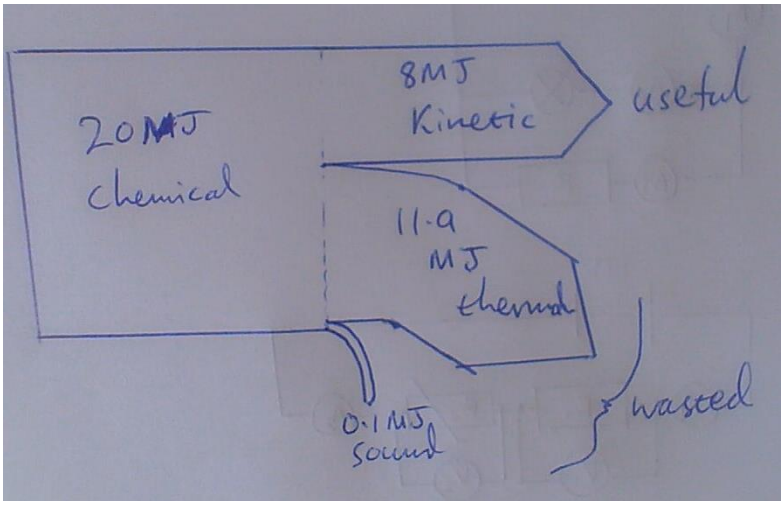
2) State what is the principle of conservation of energy:
   Energy cannot be created or destroyed so the total amount of energy after a transfer equals the total amount of energy before the transfer

3) Describe the energy transfers that take place in an electric motor that operates a lift.
   Electrical energy is transferred usefully as kinetic energy and wasted as thermal energy and sound (the wasted energy is dissipated to the surroundings)

4) A petrol motor that transfers 20MJ of chemical energy to produce 8MJ kinetic and 0.1MJ of sound. How much thermal energy is produced? (Must add up to 20MJ of kinetic sound and thermal so..)

   Kinetic energy = 20 – 8 – 0.1 = 11.9 MJ

5) Draw a labelled Sankey diagram for the petrol motor.



6) Calculate the motors efficiency. Show your working out, give your answer to 2 significant figures.

$$efficiency = \frac{useful\ energy\ out}{total\ energy\ in} = \frac{8MJ}{20MJ} = 0.4\ \ or\ 40\%$$

7) If a 4kW pump is 60% efficient what is its power output If a 4kW pump is 60% efficient what is its power output? $Useful\ power\ out = efficiency\ x\ total\ power\ in$

= 0.4 x 4kW = 1.6kW or 1600W

8) A crane lifts a pallet of bricks from a lorry 1.5m above the floor, up to a platform 9m above the floor. If the pallet mass is 2100kg what was its gain in g.p.e?

$$\boldsymbol{\Delta h = 9 - 1.5m = 7.5m}$$

$E_{grav} = mg\Delta h$ = 2100kg x 9.8N/kg x7.5m = 1.54x10^5 J or 154 kJ

9) The crane completed the lift in 18s, Calculate its power output.

$P = \frac{E}{t}$ = $\frac{1.54x10^5 J}{18s}$ =$8.58x10^3 W$ or $8.58kW$

10) The foreman wants to speed up work, state and explain what he could change in the crane to achieve this?

He should get a crane with a greater power output (or more cranes)
This will mean more energy is transferred every second
So the lifts will take less time.

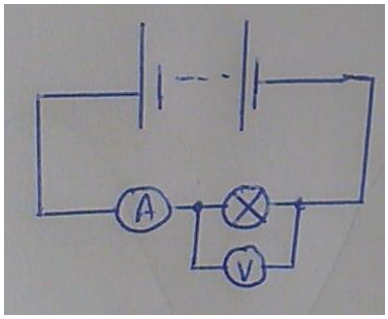
Electricity

Answers:

1) Complete the table

Quantity	Definition	symbol for	Unit of
Charge	a fundamental property of matter – can be positive or negative.	Q	C Coulomb
Current	the rate of flow of charge $I = \frac{\Delta Q}{\Delta t}$	I	A Amperes Amps
potential difference	The difference in electrical potential energy of 1 coulomb of charge between 2 points $V = \frac{E}{Q}$ *or* the work done by 1 coulomb of charge between 2 points in a circuit $V = \frac{W}{Q}$	V	V Volts
resistance	The ratio of potential difference (p.d.) across a component to the current through it. A measure of how hard it is for p.d. to push current through a component	R	Ω Ohms

2) Draw a circuit used to measure the current and potential difference (p.d. or voltage) of a bulb



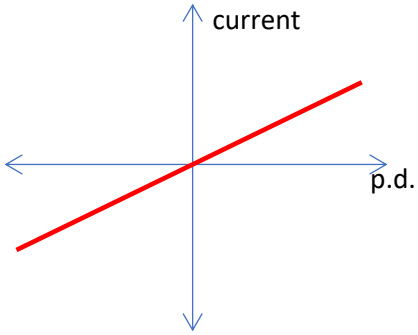
Must have at least 1 cell or a battery

The ammeter must be in series with the bulb (can be before or after it)

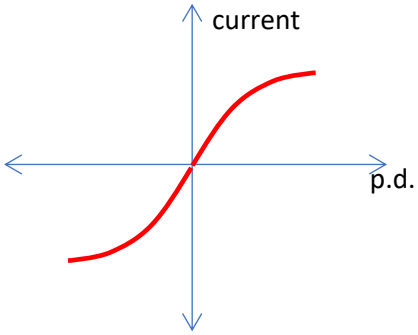
The voltmeter must be parallel to the bulb (i.e. across it)

3) Sketch the current – p.d. graphs for

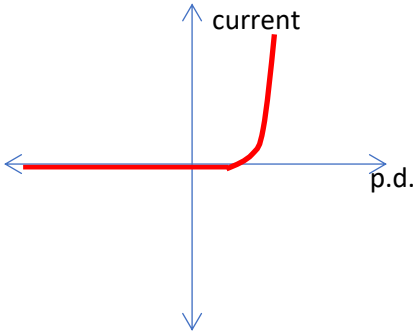
a) a fixed resistor



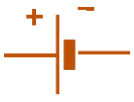
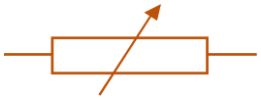
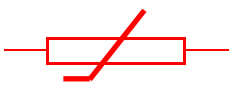
b) a bulb



c) a diode



4)

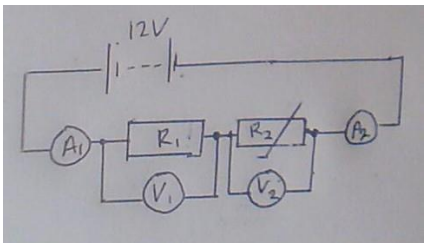
Component	Symbol	What it does
resistor		Transfers electrical energy to thermal & limits the flow of current
voltmeter		measures p.d.
ammeter		measures current
bulb/lamp		transfers electrical energy to thermal and light energy
cell		stores chemical energy and transfers it as electrical energy to charges as they pass through
variable resistor		its resistance can be changed manually (by hand)
thermistor		its resistance changes with temperature
diode		allows current through in the forward direction but stops it in the reverse direction – acts like an direction sensitive switch

4) What makes a circuit either a series circuit or a parallel circuit?

Series circuits only have 1 pathway round from the + to – of the battery/cell

Whereas parallel circuits have 2 or more pathways from + to – (branches)

5) a) Which type of circuit is this?
Series (meters don't affect circuits)



b) If V_1 reads 3.7V what does V_2 read? Series circuit – components split or share battery p.d. so 12V-3.7V = 8.3V

c) If R_1 is 600Ω calculate the reading of A_1.

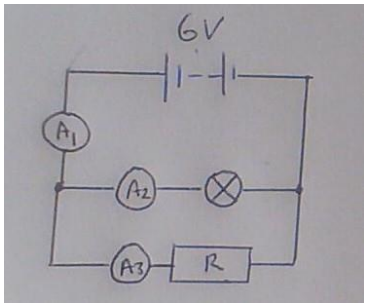
$I = \frac{V}{R} = \frac{3.7V}{600\Omega} = 6.17x10^{-3}A$ or 6.17mA

d) What is the reading of A_2? $6.17x10^{-3}A$ or 6.17mA
(i.e. Same as A_1. Current is the same at all points in a series circuit).

e) Find R_2 $R_2 = \frac{V_2}{I} = \frac{8.3V}{6.17x10^{-3}A} = 1.35x10^{3}\Omega$ or 1,350Ω or 1.35kΩ

f) Find the total resistance of the circuit. In series circuits R adds, so
R_{total} = 1,350Ω+600Ω = 1,950Ω or 1.95kΩ

6) a)Which type of circuit is this? Parallel



b) What is the p.d. across the bulb? 6V
(in parallel circuits the p.d. across each branch equals the battery p.d.)

c)If R=15Ω find A_3

$I_3 = \frac{V}{R} = \frac{6V}{15\Omega} = 0.4$ A

d) If A_1=1.1A, what is the current through the lamp?
$A_2 = A_1 - A_3$ = 1.1A-0.4A = 0.7A (current splits/rejoins at junctions)

7) Find the power of the bulb. $P = IV$ = 0.7A x 6V = 4.2 W

8) If the current flows for 3 minutes calculate the amount of charge that flows through the resistor.
need to convert minutes to seconds $t = 3x60 = 180s$ I = 0.4A through resistor (or answer in 7c)
$Q = It$ = 0.4A x 180s = 72 coulombs or 72 C

9) Explain what would happen to ammeter 1 reading if the resistor had a lower resistance.
A lower resistance allows more current to flow in that branch, the bulb branch current will stay the same so more current flows out of the battery i.e. ammeter 1 reading will increase.

Waves

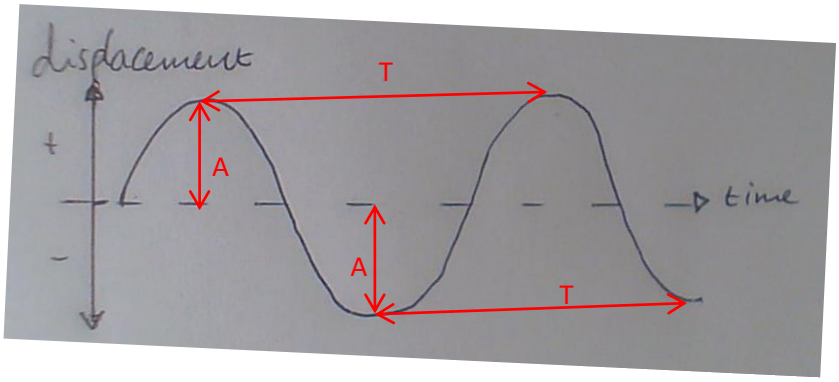
Answers :

1) Write a definition for

Term	Symbol	Unit	Definition
wave speed	v	m/s	the speed the wavefront travels through a given medium
oscillation			a repetitive movement (displacement) either side of an equilibrium position
wavelength	λ	m	distance between 2 consecutive crests or troughs of a wave (or any 2 consecutive points perorming the same motion at the same time!)
amplitude	A	m	the maximum displacement from the equilibrium position
frequency	f	Hz hertz	the number of oscillations in a second or the number of waves passing a point in a second
time period	T	s	the time to complete one complete oscillation or the time for one wave to pass a point

2) Describe the difference between transverse & longitudinal waves in terms of direction of vibration/oscillation and direction of wave travel.
Transverse – the oscillations are **perpendicular** (90°) to the direction of wave travel
Longitudinal – the oscillations are **parallel** to the direction of wave travel

3) Label time period and amplitude on this diagram: either of the 2 shown



4) How would it look if the frequency was higher? You could sketch it underneath…
Higher f gives shorter T so the waves will be closer together (A stays the same)

5) A tsunami travels across an ocean at 500km/h if its wavelength is 800m what is its frequency? (hint: think about the unit of wave speed convert it if needed)

Convert km/h → m/s $500km = 500x10^3m$ 1h=3600s so 500km/h= $\frac{500x10^3}{3600}$= 139m/s

$$f = \frac{v}{\lambda} = \frac{\frac{139m}{s}}{800m} = 0.174\ Hz$$

6) Name the sections of the electro-magnetic spectrum in order of longest wavelength to shortest. For each section give one use and one danger (if any).

Section of EM spectrum	Wavelengths	Use	Danger
Radio	10^{4}m to 10^{-2} m	communication by radio & TV radio-astronomy	no known danger
microwave	10^{-1}m to 10^{-3}m	mobile phones/RADAR/ heating food	high dose causes heating of cells
infra-red	10^{-3}m to $7x10^{-7}$m	grills/toaster/electric fires/	heat burns
visible	$4x10^{-7}$m to $7x10^{-7}$m	sight/cameras/lighting/ photosynthesis	cataracts, v strong intensity can damage retina
ultra-violet	$7x10^{-7}$ m to 10^{-9}m	security inks/tanning/sterilising water	sunburn & skin cancer
x-ray	10^{-9}m to 10^{-11}m	airport luggage security medical imaging	high dose kills cells, increase risk of cancer
gamma rays	10^{-10}m to 10^{-12}m	medical imaging/cancer treatment/sterilising equipment	high dose kills cells, increase risk of cancer

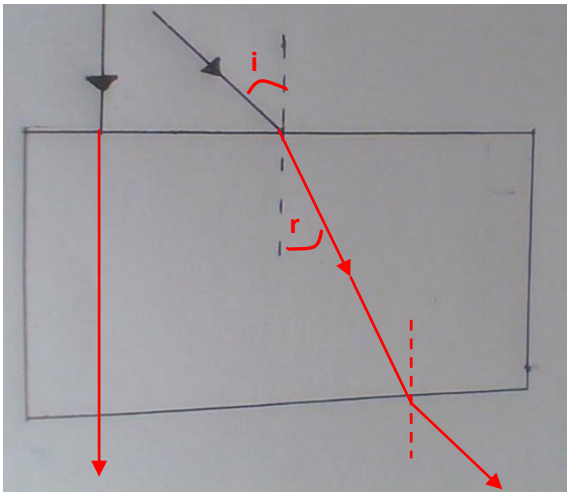
7) What is the law of reflection? The angle of reflection is equal to the angle of incidence r = i

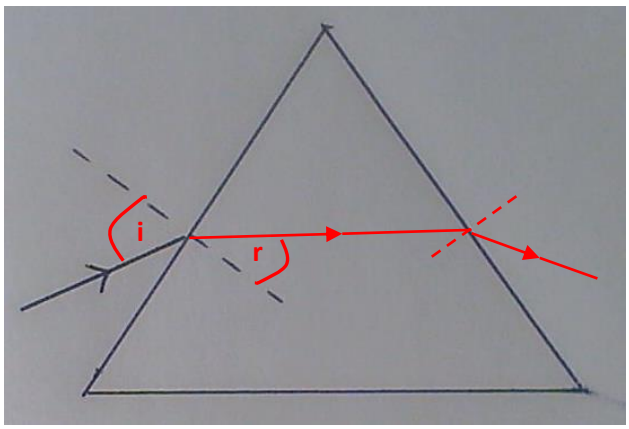
8) What is the name of the line that is perpendicular (90°) to a surface from which all angles are measured in ray diagrams? The normal (this is a mathematical term)

9) When light is incident on a surface what are the 3 things that could happen to it?
1 of 3 things: It can transmit through (& refract) or reflect or be absorbed

10) When white light passes through a red filter and is then shone onto a green t-shirt, the t-shirt looks black, explain why.
The red filter absorbs all colours of light except red ,so only red light is incident on the t-shirt.
Green objects absorb all colours of light except green which they reflect, so the t-shirt absorbs the red light and doesn't reflect any light making it appear black.

11) Complete the rays and label the angles of incidence i and refraction r.





12) If white light enters a prism explain why a spectrum of colours leaves it.

Each colour of light travels a different speed in glass (red the fastest, violet the slowest) so it refracts each colour by a different amount, red changes direction the least as it has the smallest change in wave speed, violet the most. Hence the colours get separated. This is called dispersion.

Practical Science

A	Accurate	A statement suggesting what may happen in the future.	1
B	Data	An experiment that gives the same results when a different person carries it out, or a different set of equipment or technique is used.	2
C	Precise	A measurement that is close to the true value.	3
D	Prediction	An experiment that gives the same results when the same experimenter uses the same method and equipment.	4
E	Range	Physical, chemical or biological quantities or characteristics.	5
F	Repeatable	A variable that is kept constant during an experiment.	6
G	Reproducible	A variable that is measured as the outcome of an experiment.	7
H	Resolution	This is the smallest change in the quantity being measured (input) of a measuring instrument that gives a perceptible change in the reading.	8
I	Uncertainty	The interval within the true value can be expected to lie.	9
J	Variable	The spread of data, showing the maximum and minimum values of the data.	10
K	Control variable	Measurements where repeated measurements show very little spread.	11
L	Dependent variable	Information, in any form, that has been collected.	12

A3 B12 C11 D1 E10 F4 G2 H8 I9 J5 K6 L7

Maths Skills

Re-write the following quantities:

1. 1502 metres in kilometres

2. 0.000 45 grams in micrograms

3. 0.000 45 metres in millimetres

4. 1055 kilometres in metres

5. 180 megaseconds in seconds

6. 2500 centimetres in millimetres

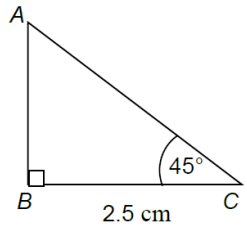
Which SI unit and prefix would you use for the following quantities?

1. The length of a finger
2. The temperature of boiling water
3. The time between two heart beats
4. The width of an atom
5. The mass of iron in a bowl of cereal

1) **c**m centimetres 2) no prefix 100°C 3) **m**s milliseconds 4) **n**m nanometers 5) **µ**g microgrammes

Trigonometry

1 (a) Work out the length of *AB*.



(Not drawn accurately)

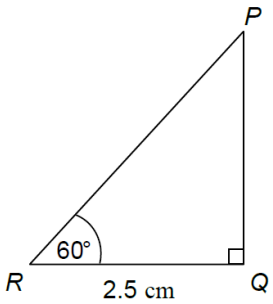
$$Tan(45°) = \frac{opposite}{adjacent}$$

$$Tan(45°) = \frac{AB}{2.5}$$

$$AB = 2.5\ x\ Tan(45°)$$

$$AB = 2.5\ cm$$

(b) Work out the length of *PR*.



(Not drawn accurately)

$$Cosine(60°) = \frac{adjacent}{hypothenuse}$$

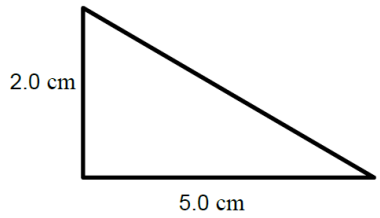
$$Cosine(60°) = \frac{RP}{2.5}$$

$$RP = 2.5\ x\ cosine(60°)$$

$$RP = 1.25\ cm$$

Pythagoras' Theorem

Work out the lengths of the unlabelled side

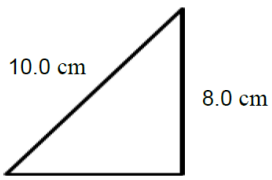


$$a^2 = b^2 + c^2$$

$$a^2 = 2^2 + 5^2$$

$$a^2 = 29$$

$$a = \sqrt{29} = 5.39\ cm$$



$$a^2 = b^2 + c^2$$

$$10^2 = b^2 + 8^2$$

$$b^2 = 100 - 64 = 36$$

$$b = \sqrt{36} = 6\ cm$$

Re-arranging equations

1. Rearrange $y = 2x + 3$ to make x the subject. $x = \frac{y-3}{2}$

2. Rearrange $C = 2\pi r$ to make r the subject. $r = \frac{C}{2\pi}$

3. Rearrange $E = \frac{1}{2}mv^2$ to make v the subject. $v = \sqrt{\left(\frac{2E}{m}\right)}$

4. Rearrange $s = ut + \frac{1}{2}at^2$ to make u the subject. $u = \frac{s-\frac{1}{2}at^2}{t}$ or $u = \frac{s}{t} - \frac{at}{2}$

5. Rearrange $s = ut + \frac{1}{2}at^2$ to make a the subject. $a = \frac{2(s-ut)}{t^2}$

7. Rearrange $T = 2\pi\sqrt{\frac{v}{r}}$ to make r the subject. $r = \frac{4\pi^2 v}{r}$

Challenge.....

8. Rearrange $v = \omega\sqrt{A^2 - x^2}$ to make x the subject.

$x = \sqrt{A^2 - \frac{v^2}{\omega^2}}$ phew & bravo if you got this right!

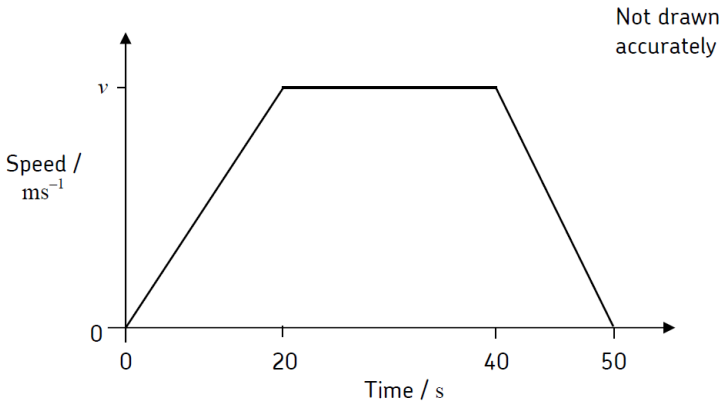
Extension work (optional but great preparation for the 1st topic)

1. The graph shows the speed of a car between two sets of traffic lights.

   It achieves a maximum speed of v metres per second.

   It travels for 50 seconds.

   The distance between the traffic lights is 625 metres.



   Calculate the value of v

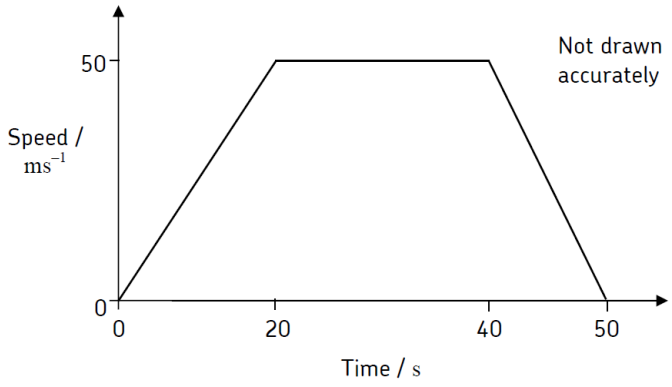
Distance = area under graph = 625m so …

$$625 = \frac{1}{2}20v + (40-20)v + \frac{1}{2}(50-40)v$$

$$625 = 10v + 20v + 5v$$

$$625 = 35v \qquad v = 17.9\text{m/s}$$

2. The graph shows the speed of a train between two stations.

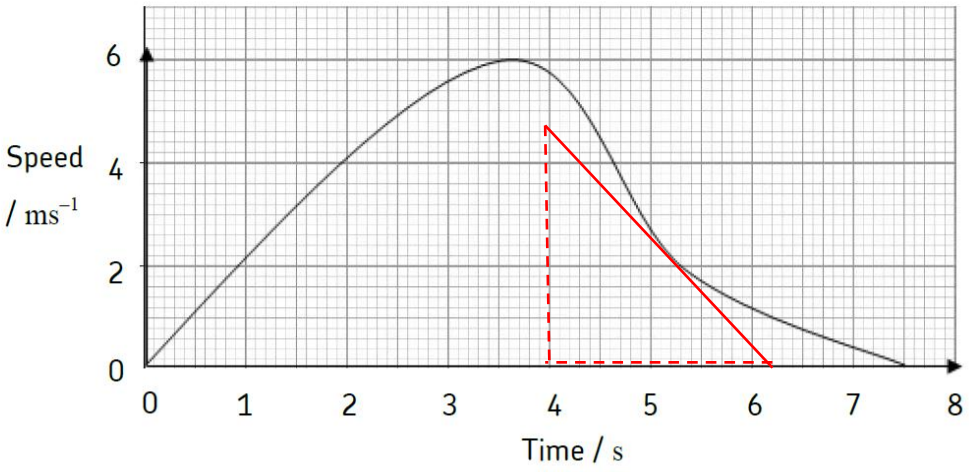


   Calculate the distance between the stations.

Area under graph = ½ 50x20+50x20+ ½ 50x10 =1750m

Cont….

3 The graph shows the speed-time graph of a car.



Use the graph to work out:

a. The maximum speed of the car.

b. The total distance travelled.

c. The average speed for the journey.

d) The acceleration at 5.3s

a) 6m/s (highest point)

b) Have to use counting squares technique….
there are approx. 10½ big squares under the graph
each is 1sx2m/s so represents 2m distance travelled
10½ x 2 = 21m but as this is approximating accept 20-22m

c) Average speed = $\frac{totald\ istance}{final\ time} = \frac{21m}{7.5s} = 2.8\ m/s$ (accept 2.7-2.9m/s)

d) Need to take the gradient at t=5.3s using a tangent technique as shown
Gradient = $\frac{0-4.6\ m/s}{6.2-4.0\ s}$ = - 2.1 m/s^2