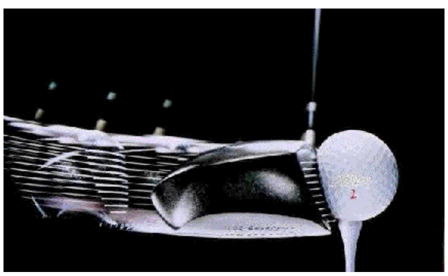
Knox Academy

Department of Physics

National 4/5
Kinematics and Dynamics

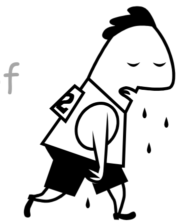


Section 1 Mechanics

Instructions

Work through the booklet. Titles are underlined and should always be copied into your notes. Text printed in black should also be copied into your notes. Text in grey should not be copied as it is for information but should be read in full. Diagrams should all be glued into your notes at the appropriate place. Remember to answer all questions in complete sentences so that your notes make sense. Homeworks should be completed, *at home*, when instructed and then handed in.

Average speed



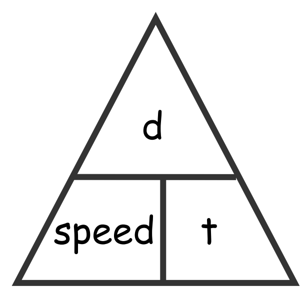
In this activity you will measure the average speed of a member of your group in different circumstances.

Event being measured	distance(m)	time(s)	average speed(m/s)
Walking	20		
Jogging, from rest	20		
Jogging, already underway	20		
sprint from rest	20		
sprint already underway	20		

Time how long it takes to travel the 20m.
Complete column 3 in the table for all five events.
Return to class and complete the final column in the table.

Use the following formula

$$\textbf{average speed} = \frac{\textbf{distance}}{\textbf{time}}$$



Write down the units for speed, distance and time.

Answer the following questions in your jotter

1. Are the speeds the same for all situations?

2. (a) Which has the greater speed, sprinting from rest or sprinting already underway?
   (b) Explain this result.

3. A car travels across Edinburgh from the Gyle Centre to Leith without exceeding the 30mph speed limit. Suggest an average speed for the journey. Explain your answer.

4. A driver travels on the A1 motorway between the flyover bridge at Tranent to the service station at Old Craighall without exceeding the 70mph speed limit. Suggest an average speed for the journey. Explain your answer.

Your teacher will now show you how to measure the average speed of a trolley using two light gates and a data logger.

Collect a 'light gates and average speed' diagram.
Write a short report on the demonstration you have seen.

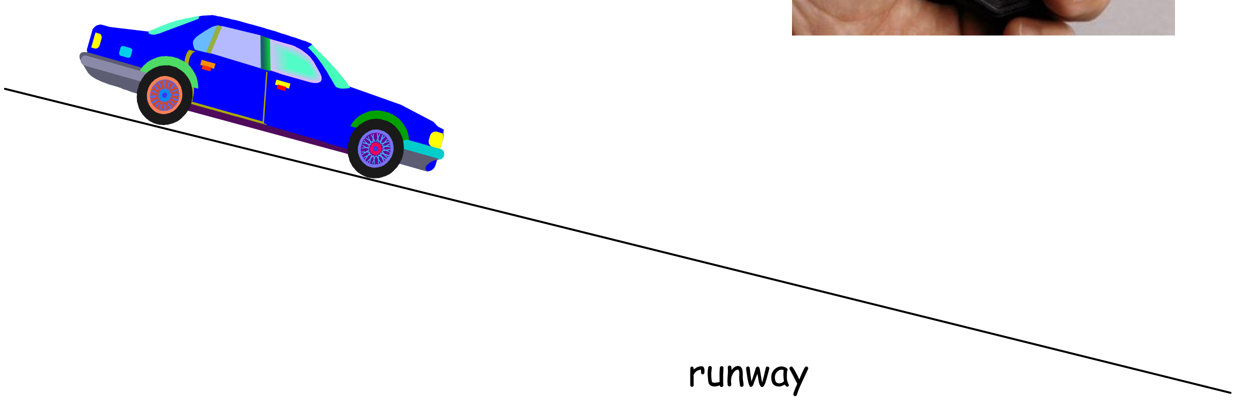
It should include:
a description of the steps taken to measure the average speed.
a list of the measurements made by the computer.

Instantaneous speed

Instantaneous speed is the speed of an object at a particular time. The speed at an instant in time!!

You are going to measure the instantaneous speed using two methods.

Method 1: Stopwatch

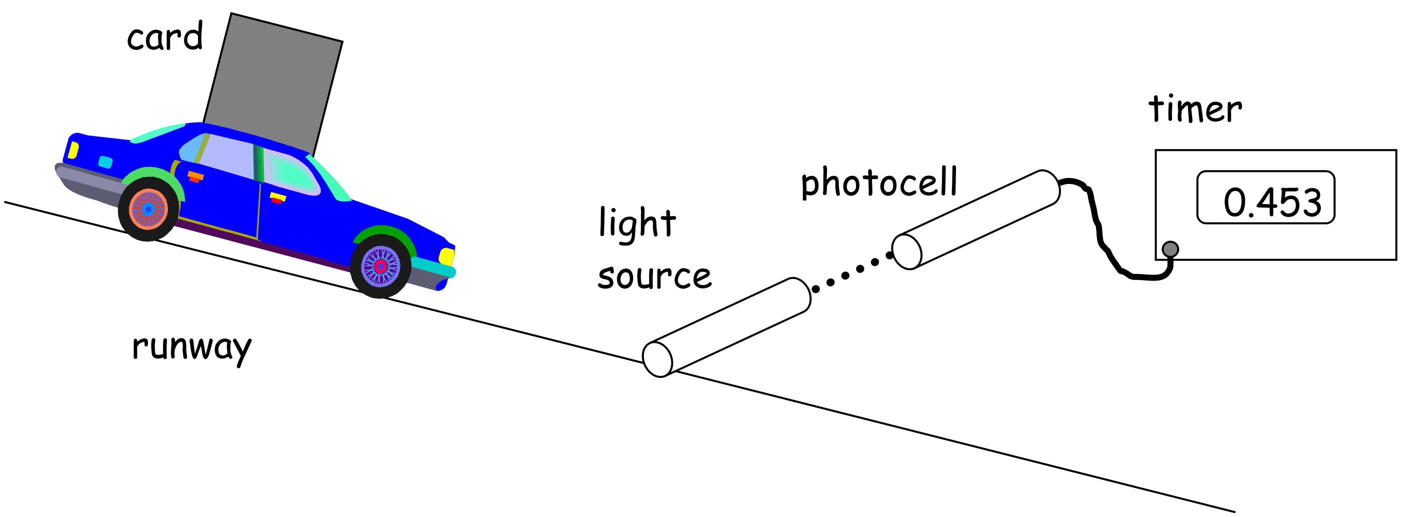


Mark a line on the runway.
Start the car from a fixed point on the slope.
Time how long it takes for the car to cross the line.
Measure the length of the car.
Calculate the speed of the car.
Repeat the experiment four times.
Present your results in an appropriate way.

Answer the following questions in sentences.

Would you expect the car to be travelling at the same speed each time it crossed the line? Explain your answer.
Did your calculations support this hypothesis?
Give a reason why your results were varied.

Method 2: light gate



Repeat the previous experiment using the light gate to time the card passing over the line.

Write a few sentences to explain any differences in the results of the two experiments.

Complete the questions 1 – 14 in the problems booklet.

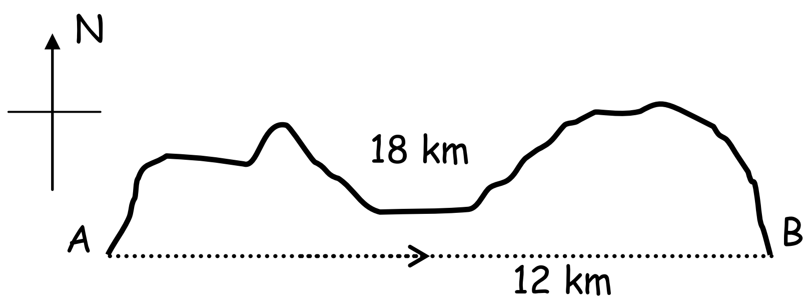
Now try Mechanics homework 1

Vectors and scalars

In physics there are two groups of measurable quantities. One group has size and direction, this group is known as vectors. The other group has only size, this group is known as scalars.

It is important that you know the common vector and scalar quantities.

Distance and displacement



Distance is how far you have travelled, the winding route from A to B.
Displacement is the straight line distance from A to B. Direction is important, it must go from A to B. In this case the direction would be due east.

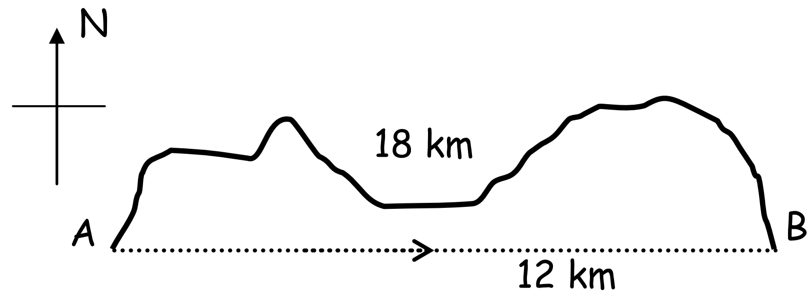
Speed and velocity

Speed is distance ÷ time
Velocity ($\overline{v}$) is displacement (s) ÷ time

The direction of the velocity will be the same as the direction of the displacement.

Example:

It takes a runner 2 hours to run from A to B along the winding route. Calculate their average speed and average velocity.



average speed = distance ÷ time

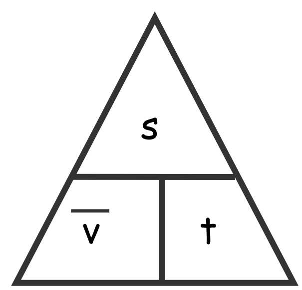
= 18 ÷ 2

= 9 km/h

average velocity = displacement ÷ time

= 12 ÷ 2

= 6 km/h due east



Variables that you are already familiar with are listed in the table below. You will add new variables as they appear in the course.

scalars	**vectors**
distance	displacement
speed	velocity
time	force
energy	
temperature	

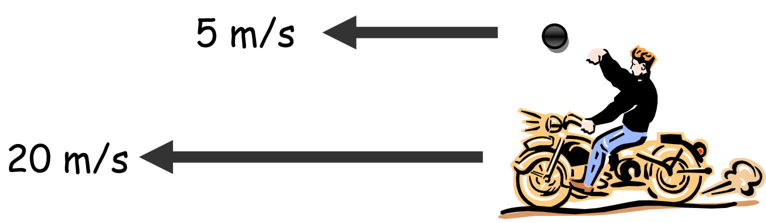
Addition of Vectors

When two or more scalars are added together, the result is simply a numerical sum.

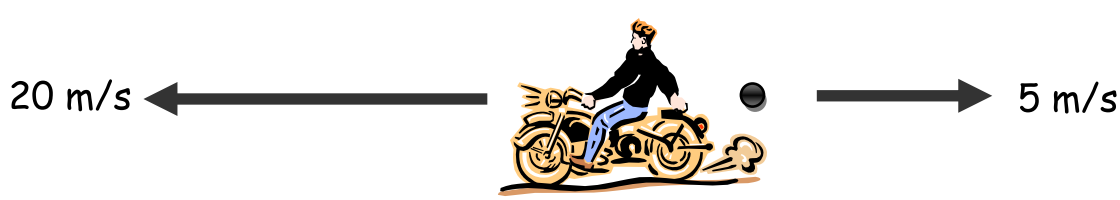
For example a mass of 3kg and a mass of 5 kg, when added, make a mass of 8kg.

When two or more vectors are added together, providing they act in the same direction, the addition is straightforward.

A motorcyclist is travelling to the left at 20 m/s. He throws a ball forwards at 5 m/s. What is the velocity of the ball?



If they are acting in opposite directions



The resultant of two or more vectors which act at angle to each other can be found either using a scale diagram, or by Pythagoras and trigonometry.

To find the resultant of a set of vectors using a scale diagram

1. Scale: remember if the question is in ms^{-1} then your scale should be a conversion from cm to ms^{-1}.
2. Direction: draw compass on page
3. 1^{st} vector: length and direction
4. 2^{nd} vector: tail of 2^{nd} starts at tip of 1^{st}
5. Resultant vector: tail of 1^{st} to tip of last
6. Answer must include magnitude (including units) and direction

Direction should be given as a three figure bearing from North e.g. (045) or (175) or (035)

Any other angle must be clearly marked on the scale diagram.

Example

A car travels 100 km South, then 140 km East. The time taken for the whole journey is 3 hours.

Using a scale diagram (and the six step process) find

(a) the car's total distance travelled
(b) its average speed
(c) its overall displacement
(d) its average velocity

Now attempt questions 15 - 22 from the problems booklet.

Now try Mechanics homework 2

Acceleration

If an object changes its speed it is accelerating. This could mean either speeding up or slowing down.

In order to measure acceleration (a), we need to know the **change** in speed (Δv) and the time it takes for the change to happen (t).

$a = \Delta v/t$

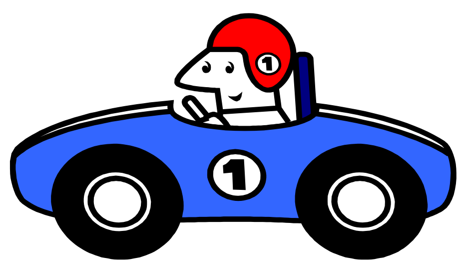
a = acceleration (m/s^2)
Δv = change in speed (m/s)
t = time for change (s)

Example 1:

A car starts from rest and reaches a speed of 20m/s. It takes 4 seconds to reach 20m/s. Calculate the acceleration of the car.

$a = ?$ $\Delta v = 20m/s$ $t = 4s$

$a = \Delta v/t$
$a = 20/4$
$a = \underline{\underline{5\ m/s^2}}$



Acceleration is $\underline{\underline{5\ m/s^2}}$

Example 2: (more difficult).

A cyclist is travelling at 12m/s. She applies the brakes which causes the bike to decelerate at 1.5m/s^2. The brakes are applied for 6 seconds. Calculate the final speed of the cyclist.

Step 1: find change in speed, Δv.

$$\Delta v = at$$
$$= 1.5 \times 6$$
$$= \underline{\underline{9\text{m/s}}}$$

Step 2: Decide, add or subtract?

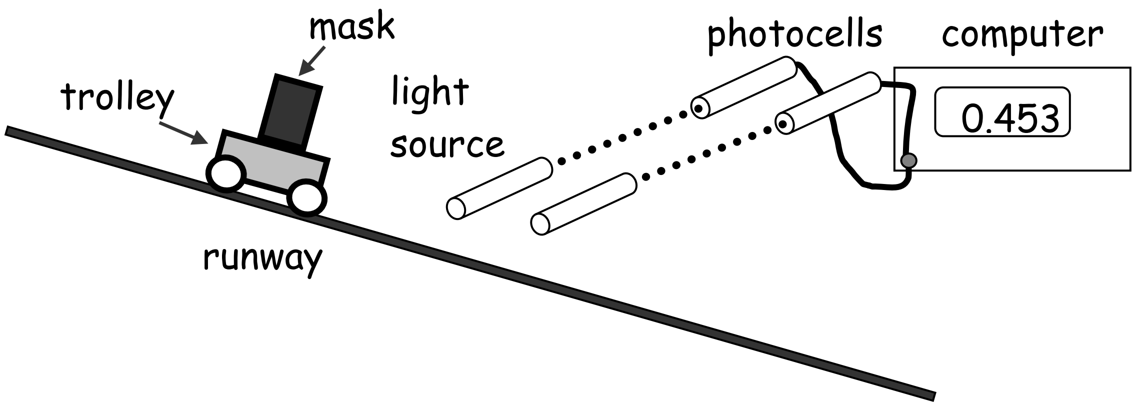
In this case the bike is slowing down, so the final speed must be less. We need to subtract the change from the starting speed.

final speed = 12 – 9 = <u>3m/s</u>

Attempt questions 23 – 35 from the problems booklet.

Now try Mechanics homework 3

Measuring Acceleration



Watch the demonstration of acceleration measurement by your teacher.
Collect an experiment diagram and stick it into your jotter.

When an object accelerates its ______ changes. In order to measure acceleration ____speeds must be measured. The first light gate measures the _____ speed, the second light gate measures the _____ speed. The change in speed is the final speed minus the ________ speed. The acceleration is the change in speed divided by the time to go between the two _________.

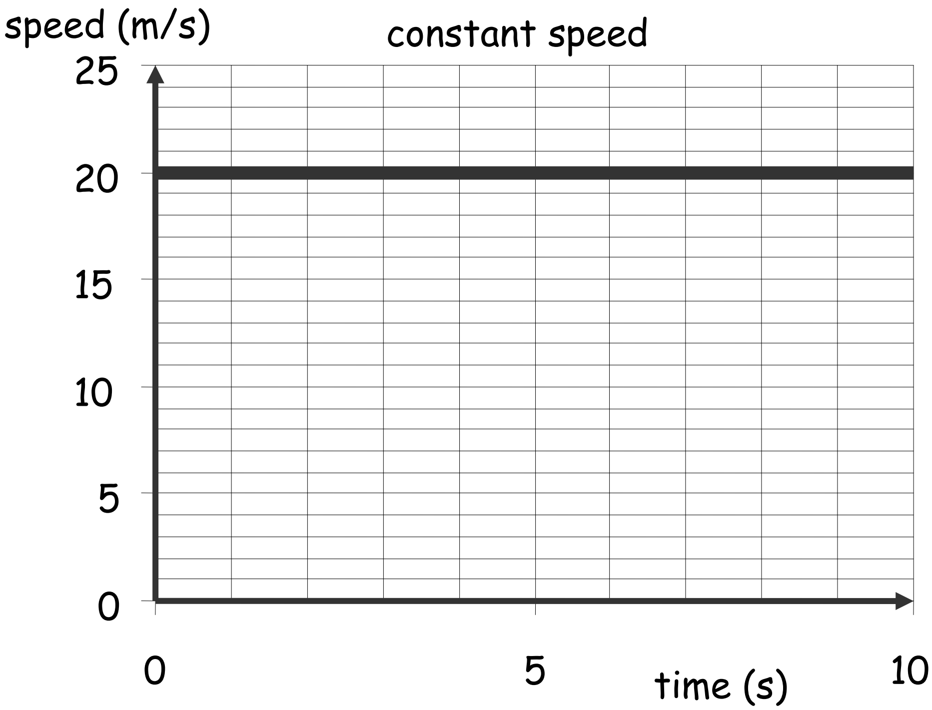
Set the experiment up at your bench.
You will conduct an investigation:

Choose a variable to change and measure the effect on the acceleration?

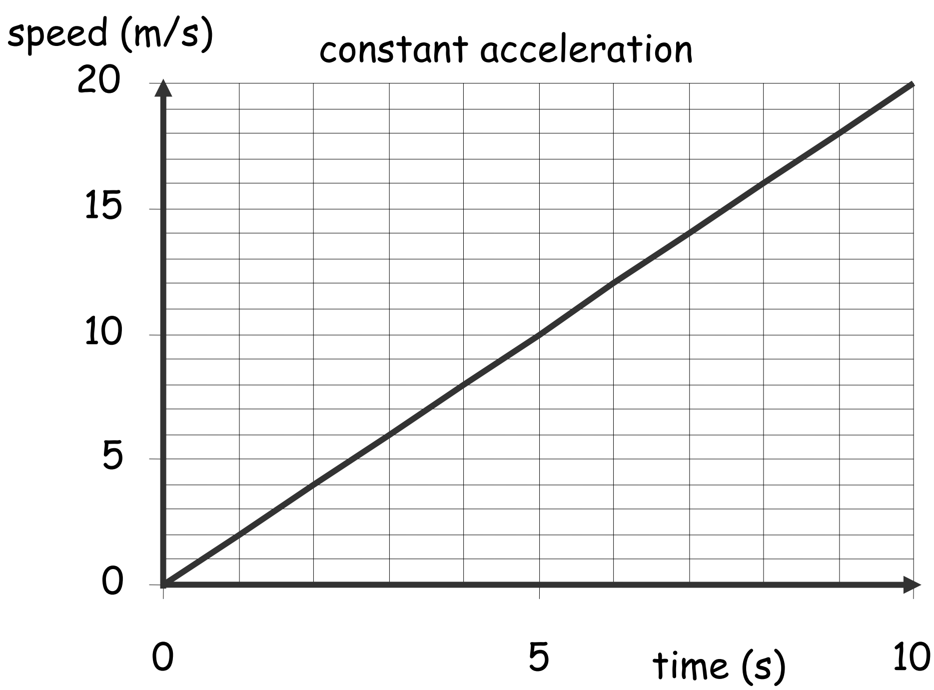
Present your results in a suitable way.

Speed Time Graphs

Collect a 'speed time graphs I' sheet. Complete the passage next to each graph. Stick the graphs into your jotter.



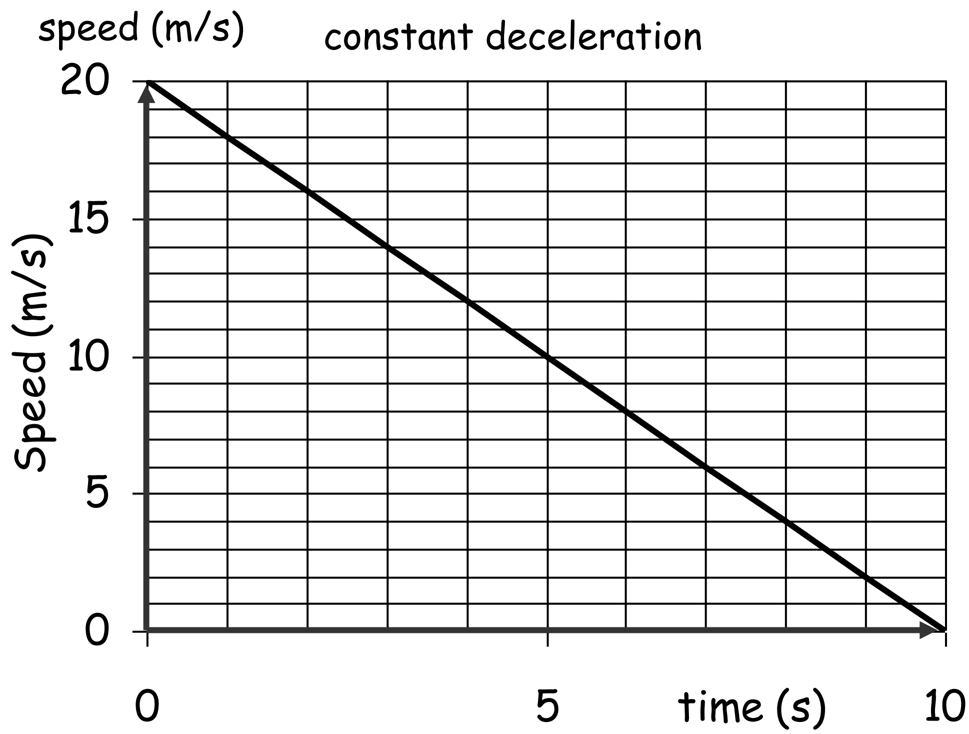
This graph shows an object travelling at a constant speed of ______.



This graph shows an object travelling at a constant acceleration of 2 m/s^2.

Its speed increases by ______ m/s every second.

constant deceleration



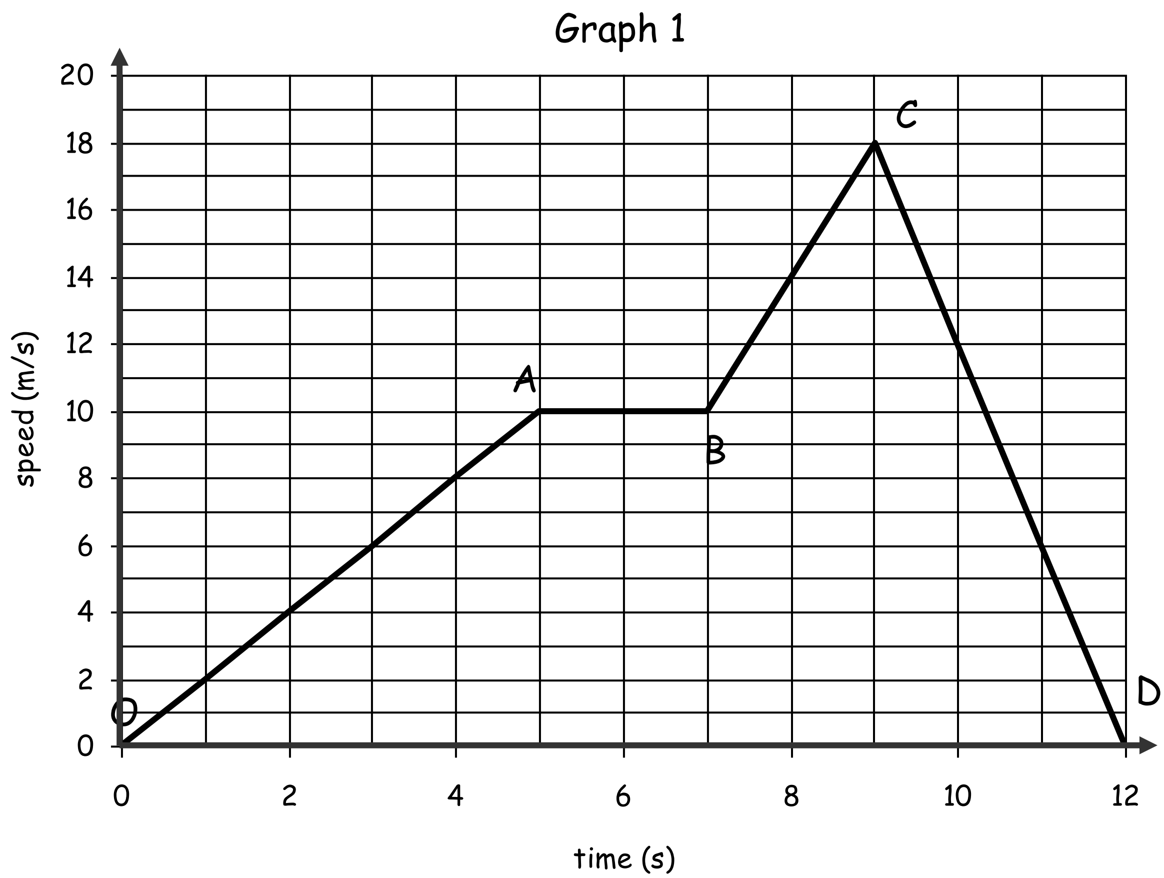
This graph shows an object travelling at a constant deceleration of 2 m/s^2.

Its speed decreases by _______ m/s every second.

Speed time graphs are useful to physicists because they can be used to:
describe the motion of the object
calculate the acceleration of the object
calculate the distance travelled by the object

You will investigate each of these areas in turn.

Collect 'speed time graphs II' sheet
Stick graph 1 into your jotter



Task 1. Describe **fully** the motion of the object that produced the graph above. The first part is done for you.

OA: Constant acceleration from 0 to 10 m/s in 5 seconds.

Task 2. Calculate the values of the acceleration for all sections of the graph. The first part is done for you.

OA: acceleration = $\Delta v/t$

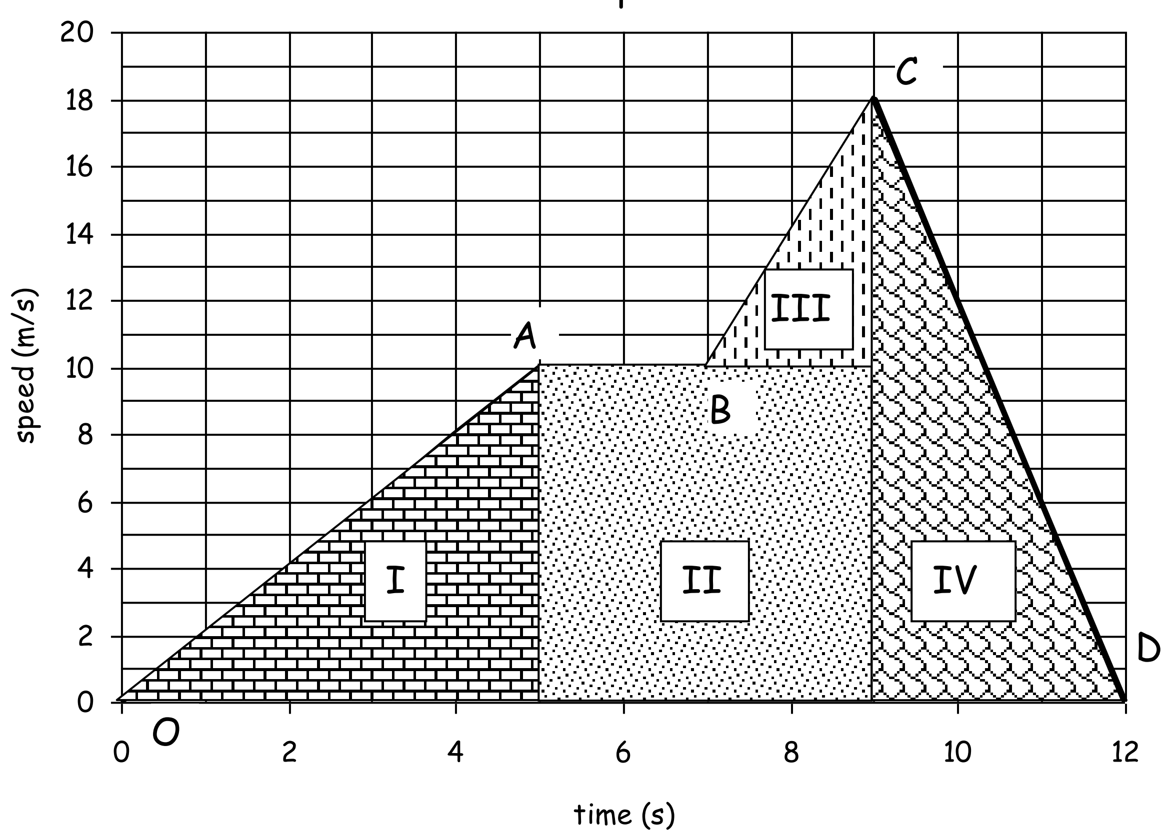
= $(10 - 0)/5$

= $\underline{\underline{2 m/s^2}}$

Task 3. Calculate the distance travelled by the object. The equation distance = speed x time **cannot** be used because the object changes its speed.

To calculate the distance the area under the graph must be used.

Graph 1



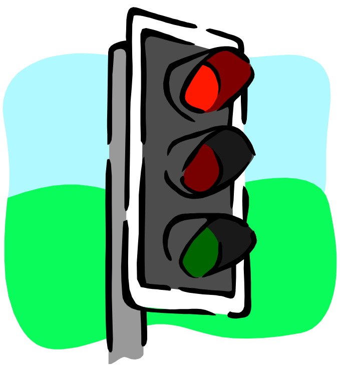
Area I :	Triangle area	= ½ x b x h	= ½ x 5 x 10	= 25m
Area II :	Rectangle area	= l x b	= 4 x 10	= 40m
Area III :	Triangle area	= ½ x b x h	= ½ x 2 x 8	= 8m
Area IV :	Triangle area	= ½ x b x h	= ½ x 3 x 18	= 27m
Total Area				= 100m
Distance travelled				= 100m

Repeat for the other speed time graph on the sheet.
Now attempt questions 36 – 40 from the problems booklet.

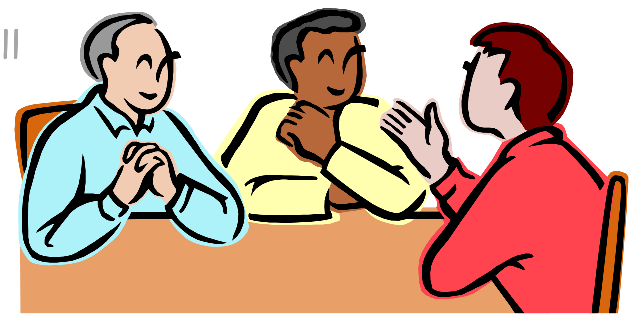
Kinematics Checklist

Collect a checklist sheet and traffic light it.

Work in groups to change any red or amber entries to green. If no one in the group can get green then see your teacher for assistance.

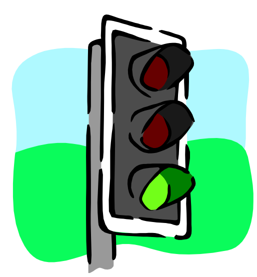


When you have successfully changed all your lights to green you should attempt Kinematics questions from the past papers booklet.



Try to use your notes as little as possible.

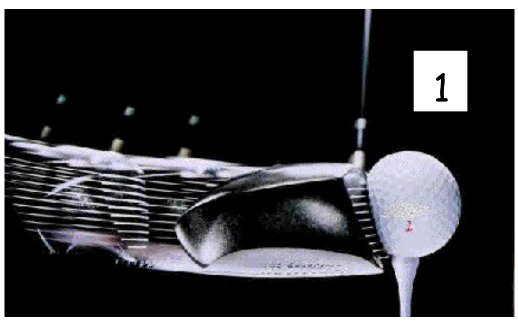
Mark your answers using the mark scheme. Any questions that you get wrong you need to find out why and write a short note to explain your mistake.



<u>**The Effect of Forces**</u>

You may remember from second year the set of experiments to investigate the effects of forces. The results of these experiments are summarised below.

1. Change of Shape:	A force can change the shape of an object
2. Change of Speed:	A force can change the speed of an object
3. Change of Direction:	A force can change the direction of a moving object



2

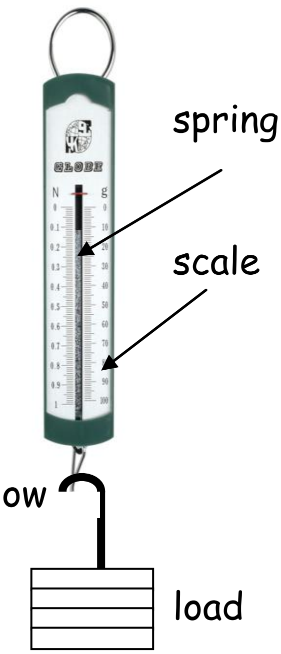
3

Measuring Forces

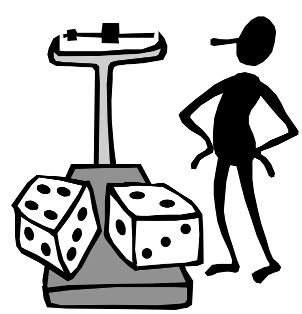
If we wish to measure forces we need a measuring device.
The device we use is called a newton [or spring] balance.

The diagram to the right shows a Newton balance.
The balance is a very simple device.
It contains a spring which stretches
as a force is applied. The bigger the force,
the bigger the stretch.

A load is applied to the balance and the pointer moves to allow a reading to be taken directly from the scale.



Use the Newton balances available to you and measure some forces around the lab. Present your results in an appropriate way.



Weight and mass

These are two terms which can confuse pupils. We do not use them correctly in a physics sense in everyday language. The correct definitions are given below. Learn them.

Mass: the quantity of matter in an object. [How much "stuff" it contains.]

Weight: the **force** acting on an object (mass) due to a gravitational pull.

You will now complete an experiment to investigate the relationship between mass and weight.

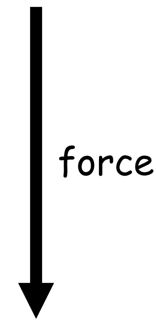
mass(kg)	weight(N)	weight/mass(N/kg)
0.2		
0.4		
0.6		
0.8		
1.0		

Collect a Newton balance and a set of 100g masses.

Hang the required mass on the Newton balance, read off the weight and enter it into the table. When you have completed this for all masses, calculate the values in the final column.

Q. Is there any pattern to the values in the final column?

All masses experience a force acting towards the centre of the Earth [down!!]. The force depends on the mass and the gravitational field strength. This force is called weight.

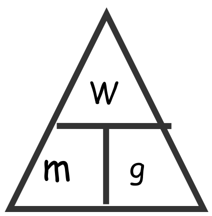


From the experiment that you have just completed you should have found that each kilogram of mass experiences a force of 10N.

The relationship between weight and mass can be written as an equation,

$W = m \times g$

W = weight, N
m = mass, kg
g = gravitational field strength, N/kg

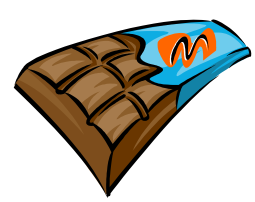


g = 10 N/kg on Earth but may be different on other planets.

Planet	value of g (N/kg)
Mars	4
Jupiter	25
Saturn	11

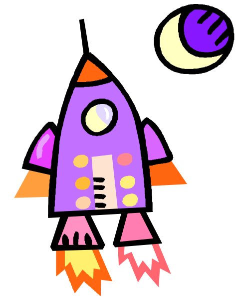
Example:

Calculate the weight of a 150g bar of chocolate.



W = ?   m = 150g = 0.15kg   g = 10 N/kg

W = mg
= 0.15 x 10
= <u>1.5N</u>



Example:
A space probe has a mass of 500kg.

a) Calculate the weight of the probe on Earth.
b) What would the mass of the probe be on Saturn?
c) Calculate the weight of the probe on Saturn.

(a) W = ? m = 500 kg g = 10 N/kg

W = mg
= 500 x 10
= 5 000 N

(b) Mass remains constant. Mass = 500 kg on Saturn.

(c) W = ? m = 500 kg g = 11 N/kg

W = mg
= 500 x 11
= 5 500 N

Attempt questions 41 – 48 from the problems booklet.

Now try Mechanics homework 4

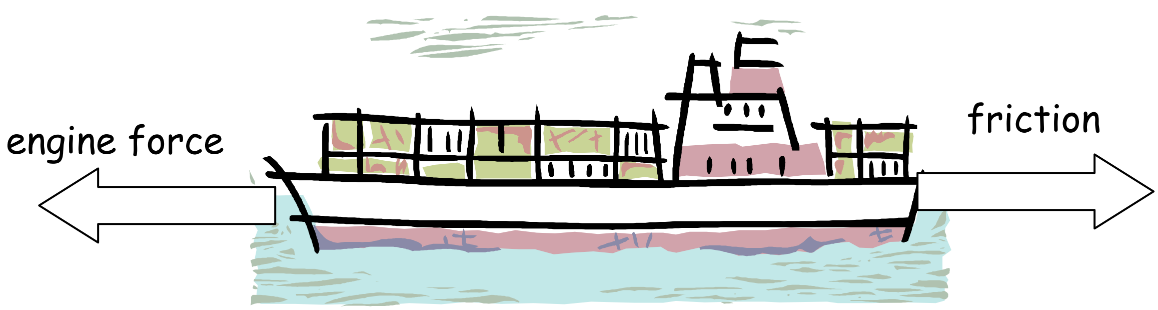
Friction

Friction is a force that opposes motion.
This can mean it causes an object to slow down or it may mean that it stops an object moving.

There are situations where we want to increase friction to slow things down. An example would be between the brakes and wheel on a bike.
There are situations where we want to increase friction to speed things up. An example would be running spikes.

There are situations where we want to decrease friction. An example would be between the skis and the snow for a skier, streamlining, or lubrication.

All forces, by definition, must be vectors. Forces are always applied in a particular direction.



Attempt questions 49 – 50 from the problems booklet.

Now try Mechanics homework 5

Newton I

Sir Isaac Newton was born on 4 Jan 1643 and died on 31 March 1727. He was a scientist and mathematician. He did work on movement and light.

In this course we are interested in his work on movement. He devised three laws of motion. We will investigate his first law in this activity.

Collect a Newton balance and hang a mass of 400g from it. Copy the table below

situation	reading on balance(N)
stationary	
moving up at constant speed	
moving down at constant speed	

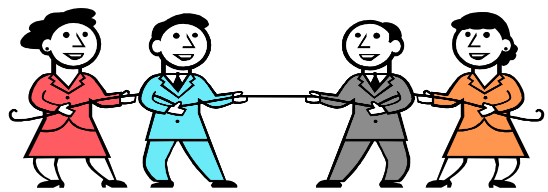
Weight of 400g mass =

Hold the balance steady (you are providing a force to hold the balance and masses up, you'll feel this in your muscles) and record the reading on the balance.
Raise the balance slowly at a constant speed, record the reading as the balance is moving.
Lower the balance slowly at a constant speed, record the reading as the balance is moving.

If an object is stationary or is moving at a constant speed the forces acting on it are balanced. Balanced forces are equal in size but opposite in direction. Balanced forces are equivalent to having no force acting at all.

Examples of balanced forces:

A draw in a tug of war

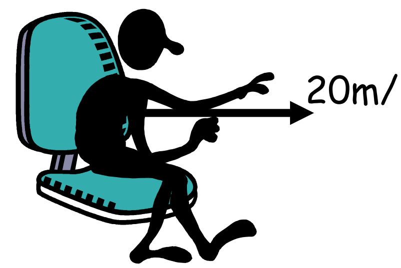


A parachutist falling at constant speed

Seat belts – why wear them?

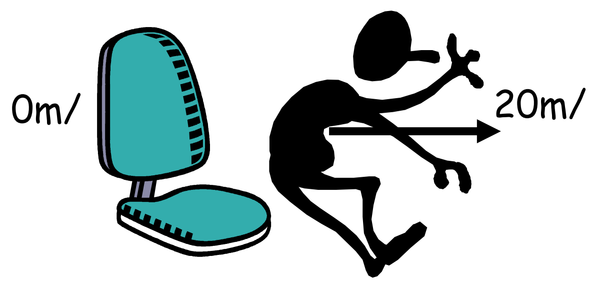
You might not think that there is a link between Isaac Newton and safety in a car but there is.

When you sit in a car travelling at 20m/s you are also travelling at 20m/s. Seems reasonable!



If the car suddenly stops, for example in a crash, its speed goes to zero. Everything attached to the car will also stop.

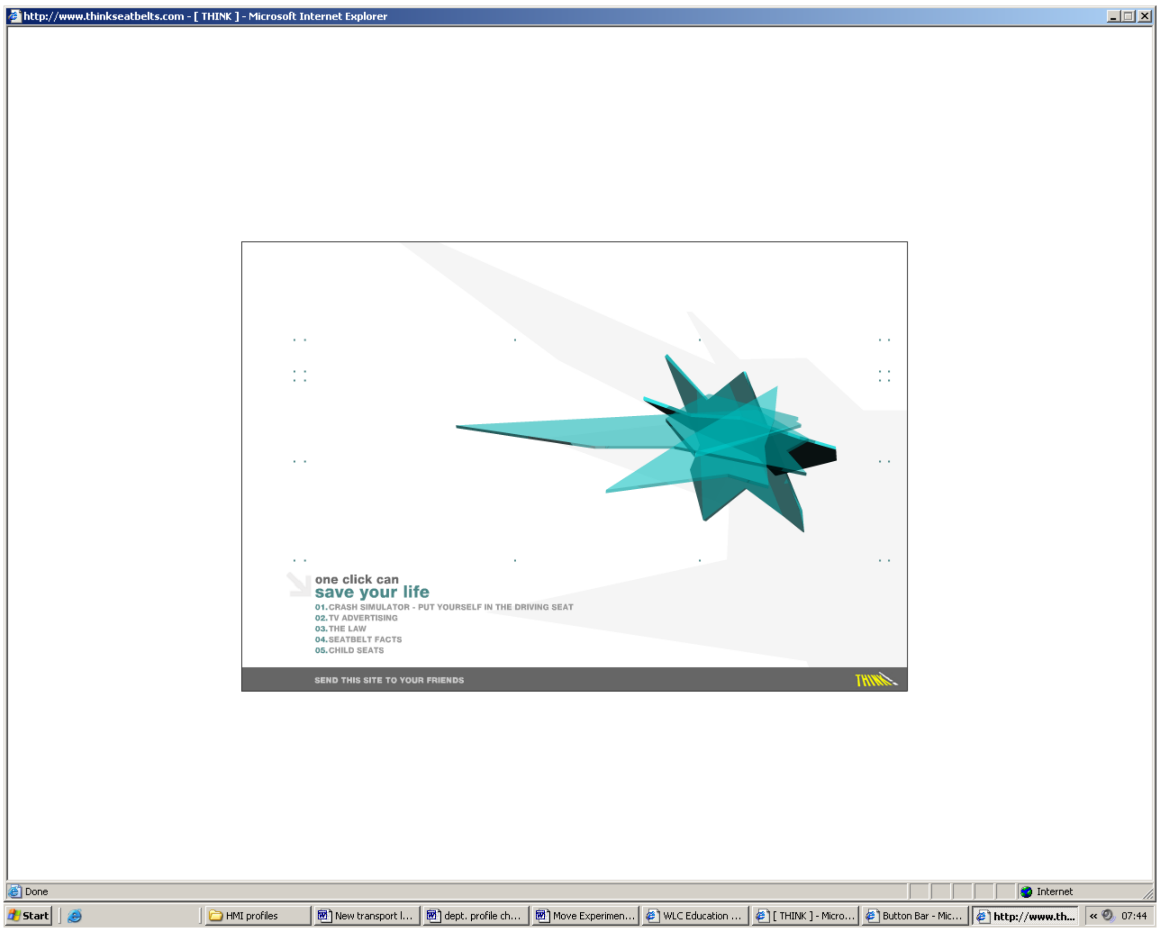
Anyone not wearing a seatbelt is only attached to the car by the seat of their trousers [or skirt]. This is a very small force, effectively zero, so the person continues to travel at 20m/s. They will stop normally, unfortunately, by hitting the dashboard or windscreen, ouch!!



The seat belt provides an unbalanced force that prevents the passenger travelling on at 20m/s.

Collect a laptop.

Log on and type in the URL below.
http://www.thinkseatbelts.com/launch.html



Select crash simulator
Choose a set of criteria for the crash – select **with** seat belts
Run simulation
Repeat with the same set of criteria for the crash – select **without** seat belts this time.

Why does a person not wearing a seatbelt continue to travel forwards at the speed of the vehicle when the vehicle comes to a sudden stop?
What is the purpose of the seatbelt in a vehicle?
What differences did you notice between your two crash simulations?

Terminal Velocity

The air resistance acting on a moving object increases as it gets faster.

Terminal velocity is reached when the air-resistance (acting upwards) has increased to the same size as the person's weight (acting downwards).

Forces in Outer Space and Motion

Large parts of outer space are a vacuum - There are no air (or other) particles present.

Therefore, when a spacecraft travels through outer space, there is no air friction acting on it. If its engine is switched off, no forces will be acting on it.

This means the spacecraft will travel at a constant speed in a straight line.

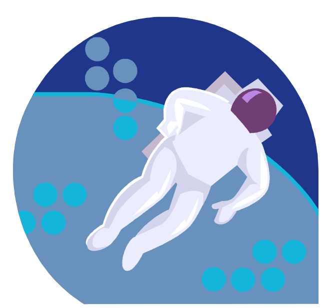
If the spacecraft engine is switched on, this will create an unbalanced force, so the spacecraft will accelerate in the direction of the unbalanced force.

A spacecraft is travelling through outer space. Its engine is switched off.

(a) Describe and explain the motion of the spacecraft:

(b) The spacecraft's engine is now switched on.

An astronaut is travelling at constant speed through outer space towards her space capsule.



(a) Describe the forces acting on her:

(b) The space capsule is accelerating towards the astronaut.
Describe the forces acting on it.

Now attempt questions 51 – 54 from the problems booklet.

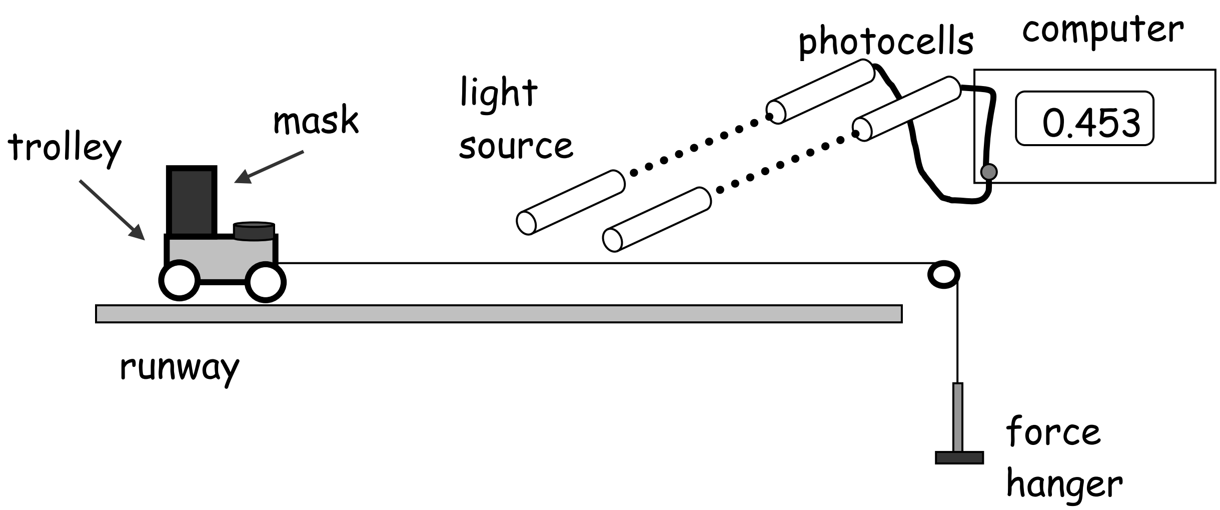
Newton II

In the previous activities we have seen that if there is no unbalanced force an object will:

Remain at rest

Move with constant speed in a straight line.

Now we are going to examine what happens when an unbalanced force acts on an object.



Collect a Force-Acceleration diagram. Stick it into your jotter.

Force applied	acceleration (m/s^2)			
	run 1	run 2	run 3	average
1				
2				
3				
4				
5				

Watch the demonstration, completing the table as the results are obtained.

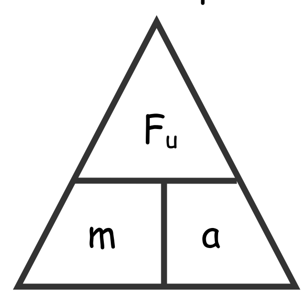
Use the data to draw a line graph of average acceleration against force applied.

Answer the following questions in sentences

What happens to the acceleration as the force applied increases?
Is there any pattern to the results? [Hint – check the shape of your graph]
Predict the value for the acceleration if the force applied was 6 units.

The acceleration is directly proportional to the force applied when this is the only force acting. This is shown by the straight line through the origin of the graph. We can write this relationship as an equation.

$F_u = m \times a$

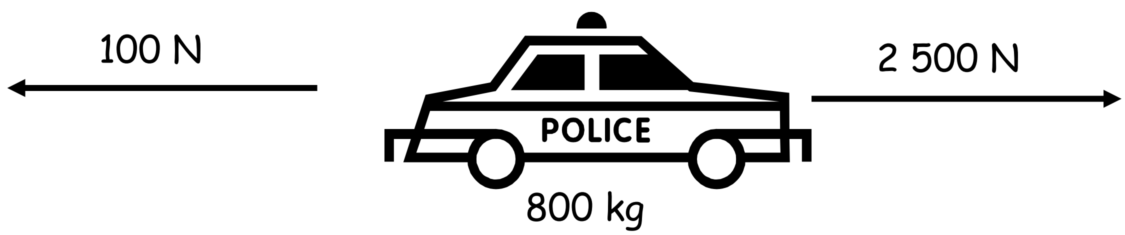


F_u	unbalanced force	newtons, (N)
m	mass	kilograms, (kg)
a	acceleration	metres per second squared, (m/s^2)

More than one force

In most situations there will be more than one force acting on an object. If we want to calculate the acceleration of the object we must first find the unbalanced force. The combination of forces is known as the resultant.

Example: The engine of the car provides a driving force of 2 500 newtons. The frictional force acting on the car is 100 newtons. The mass of the car is 800 kg. Calculate the acceleration of the car.



Step 1: Find unbalanced force.

F_u = 2 500 – 100
= 2 400N

Step 2: Calculate acceleration

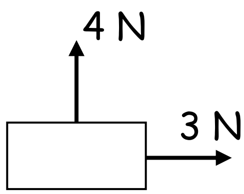
a = F_u/m
= 2 400/800
= $3\ m/s^2$

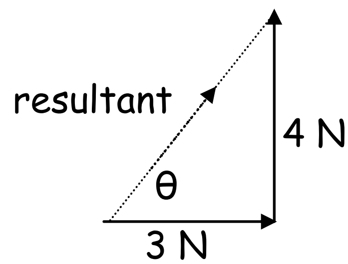
Now attempt questions 55 – 72 (but not 57) from the problems booklet.

More than one force – Advanced

Sometimes when more than one force acts on an object they are not in the same dimension [up – down, left – right]. This makes it more difficult to calculate the resultant force.

Example: Two forces act on a box as shown below. Calculate the size and direction of the resultant force.





Use a scale diagram or Pythagoras

Size: $r^2 = 3^2 + 4^2$

$= 9 + 16 = 25$

$r = \sqrt{25}$

$= \underline{\underline{5\ N}}$

Direction: Trigonometry $\tan\theta = \frac{\text{opposite}}{\text{adjacent}}$

$= \frac{4}{3}$

$= 1.33$

$\theta = \underline{\underline{53.1^\circ}}$

Answer: Resultant force is 5 N, 53.1° above the horizontal.

Any direction given must be relative to a fixed direction, an angle on its own is not enough. Only a 3 figure bearing is okay on its own.

Now attempt question 57 from the problems booklet.

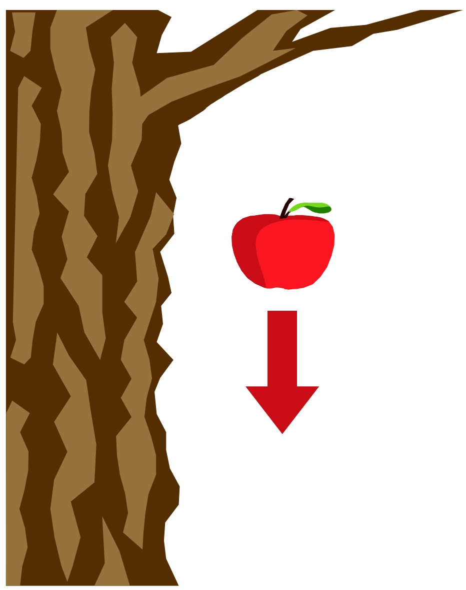
Acceleration due to gravity

On pages 21 – 22 you found that the gravitational field strength on Earth is 10 N/kg.

If an object is dropped on Earth, what is its initial acceleration?

$$a = \frac{F_u}{m} = \frac{mg}{m} = g$$

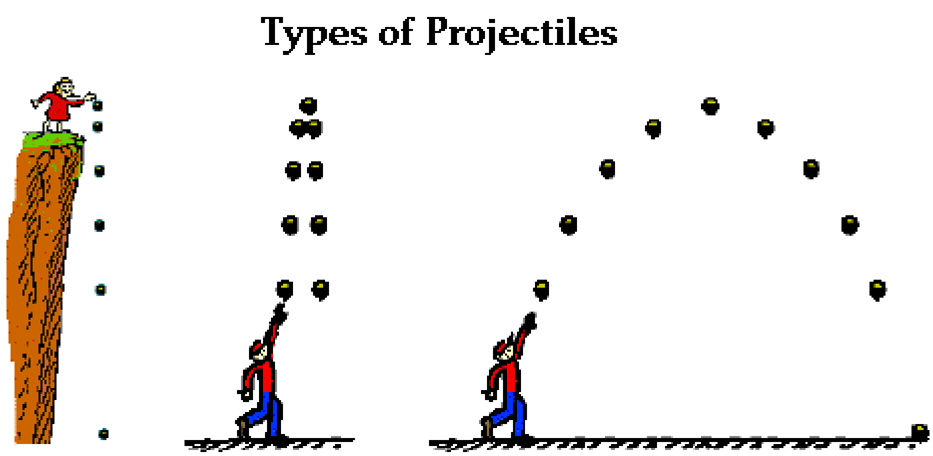
The acceleration of an object on any planet has the same magnitude as the gravitational field strength on that planet.



Now attempt question 73 from the problems booklet.

Projectiles

An object is thrown into the air. If air resistance is ignored, the only force acting on it is its weight. This object will be known as a projectile.



What causes the curved path of a projectile?

The projectile has two separate motions.

Horizontal, V_h: No air resistance so projectile moves with constant speed.

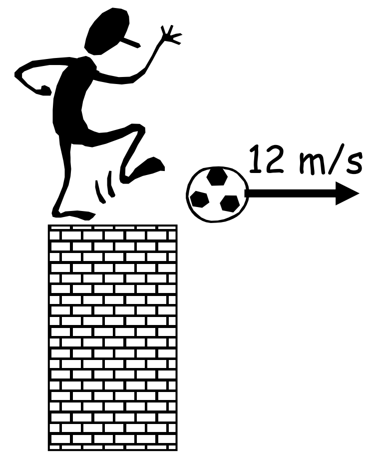
Vertical, V_v: Force acting is weight so projectile accelerates downwards at 10 m/s^2.

These motions can be thought of as being independent.

Projectiles calculations

A ball is kicked horizontally off the top of a wall. The initial speed of the ball is 12 m/s. The ball takes 0.9s to land.

Calculate the horizontal distance travelled by the ball before it lands [the range].
Calculate the vertical speed of the ball just before it lands.
Calculate the height of the wall.



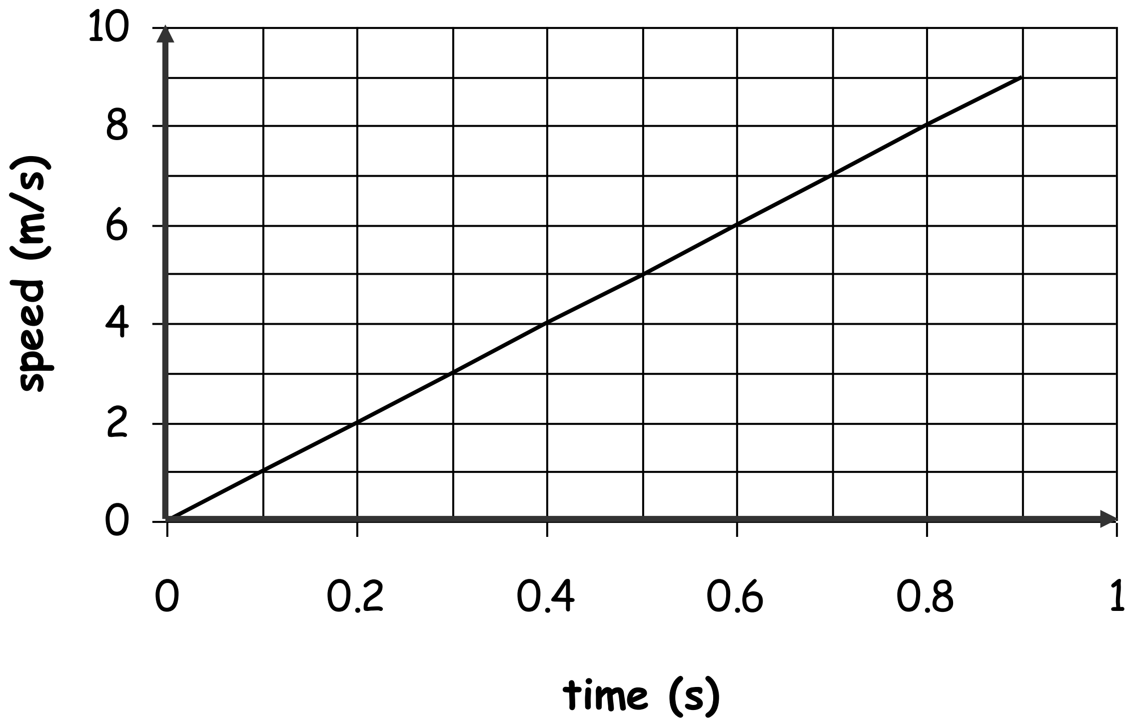
Since the horizontal speed of a projectile remains constant, the range can be calculated using;

range = $v_h \times t$
= 12×0.9
= 10.8 m

The ball accelerates downwards at 10 m/s^2. The speed can be calculated using:

speed = $u + (a \times t)$
= $0 + (10 \times 0.9)$
= 9 m/s

To calculate the height of the wall, a speed time graph of the vertical motion needs to be drawn.



The height of the wall will be the vertical distance travelled, which is the same as the area under the graph. [page 17]

area = $\frac{1}{2}$ x b x h

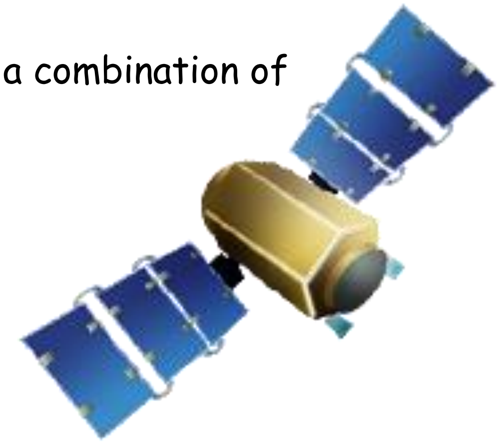
= $\frac{1}{2}$ x 0.9 x 12

= <u>5.4 m</u>

Now try Mechanics homework 6

Satellite Motion - An Extension of Projectile Motion

The motion of a satellite around the Earth is a combination of two separate motions:



Constant horizontal speed (which is not large enough for the satellite to move away from the Earth).

Constant downwards attraction towards the Earth's surface due to the attractive force of the Earth's **gravity.**

The combination of these two separate motions is a **curved path** which exactly matches the **curve** of the Earth.
As the satellite accelerates down towards the Earth, the Earth's surface **curves** away from it at the same rate – So the satellite does not get any closer to the Earth's surface. The satellite remains in **orbit** around the Earth.

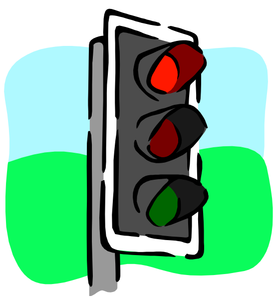
Now attempt questions 74 – 78 from the problems booklet.

Dynamics Checklist

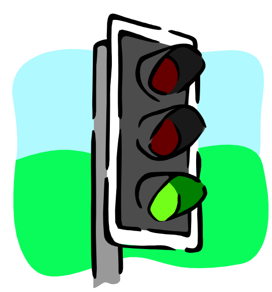
Collect a checklist sheet and traffic light it.

Work in groups to change any red or amber entries to green. If no one in the group can get green then see your teacher for assistance.

When you have successfully changed all your lights to green you should attempt Dynamics questions from the past papers booklet. Try to use your notes as little as possible.



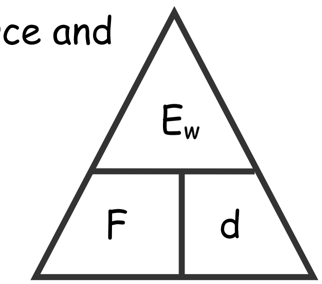
Mark your answers using the mark scheme. Any questions that you get wrong you need to find out why and write a short note to explain your mistake.



Work

Yes, it is a four letter word, but it isn't bad! Work is a measure of how much energy has been used or transferred.
If work is done lifting an object, work is done against the gravitational field.
If work is done moving an object across a surface, work is done against against friction.

The amount of work done depends on the size of the force and how far the object has moved.

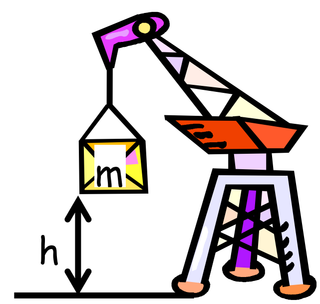


work done = force x distance

E_w = F x d

Force in newtons, distance in metres gives work done in joules.

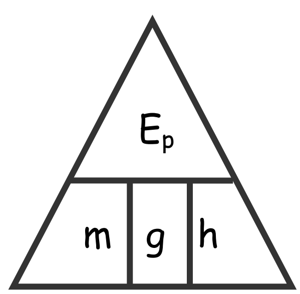
Special case – Gravitational potential energy.



When an object is lifted and work is done against the gravitational field the equation that is produced looks different to E_w = Fd but is in effect the same.

The force acting on the object will be its weight = mg. Since the distance is vertical we call this the height = h. The equation now becomes

E_w = Fd = mgh = E_P

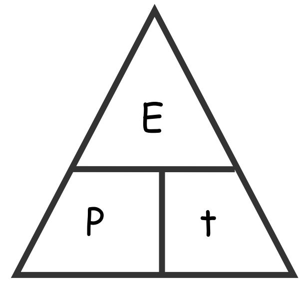


This is known as the gain in potential energy.

<u>Power</u>

Power is a measure of how quickly energy is converted. The more powerful an appliance, machine or person the greater the quantity of energy converted each second.

As always, we have a shorthand way of expressing this by using an equation.



Power = energy/time

$P = E/t$

Power	watt	(W)
Energy	joule	(J)
time	second	(s)

You will now conduct an experiment to find out your power when walking up a flight of stairs.
You should work in your group to decide how you are going to conduct the experiment.

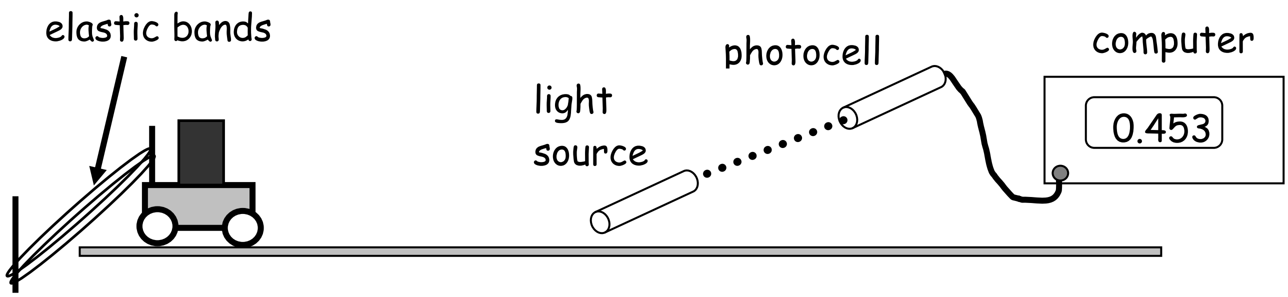
Consider:
What quantities you need to measure
What quantities you need to calculate
How you are going to do the experiment.

You should show your teacher your plan **<u>before</u>** you attempt the experiment.
Write up the experiment in an appropriate form.

Now attempt questions 88 - 102 from the problems booklet

Kinetic energy

Kinetic energy is the energy of movement.
The following experiment will examine the relationship between energy, speed and mass.



Collect an experiment diagram, stick it into your jotter.

Number of bands	speed (m/s)				average speed squared
	speed 1	speed 2	speed 3	average	
1					
2					
3					
4					

The elastic band is stretched by a fixed distance.
The trolley is propelled by the band and its speed is measured.
The experiment is repeated using an increasing number of bands.
Two bands will supply twice as much energy to the trolley.
Complete the table as the experiment is conducted.

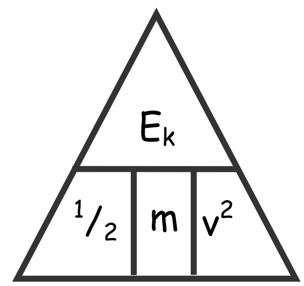
Draw a graph of the trolley speed squared against the number of bands.

Answer the following questions in sentences.

What happens to the energy supplied to the trolley as the number of bands is increased?
What happens to the speed of the trolley as the number of bands is increased?
Does the speed double when two bands are used instead of one?
What is the relationship between energy and speed?

We can write the equation to show the relationship between kinetic energy, speed and mass.

$$E_k = \frac{1}{2}mv^2$$



E_k	kinetic energy	joules	(J)
m	mass	kilograms	(kg)
v	speed	metres per second	(m/s)

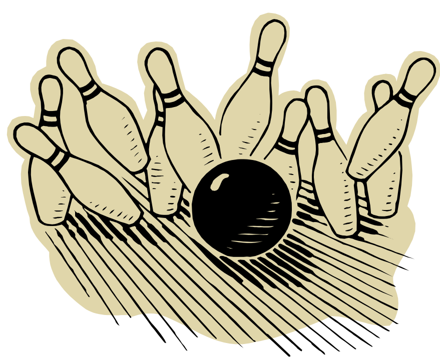
Examples:

A car of mass 500kg is traveling along a road at 20m/s.
Calculate the kinetic energy of the car.

$E_k = \frac{1}{2}mv^2$
$= \frac{1}{2}[500 \times (20^2)]$
$= \frac{1}{2}[500 \times 400]$
$= \underline{\underline{100\,000J}}$

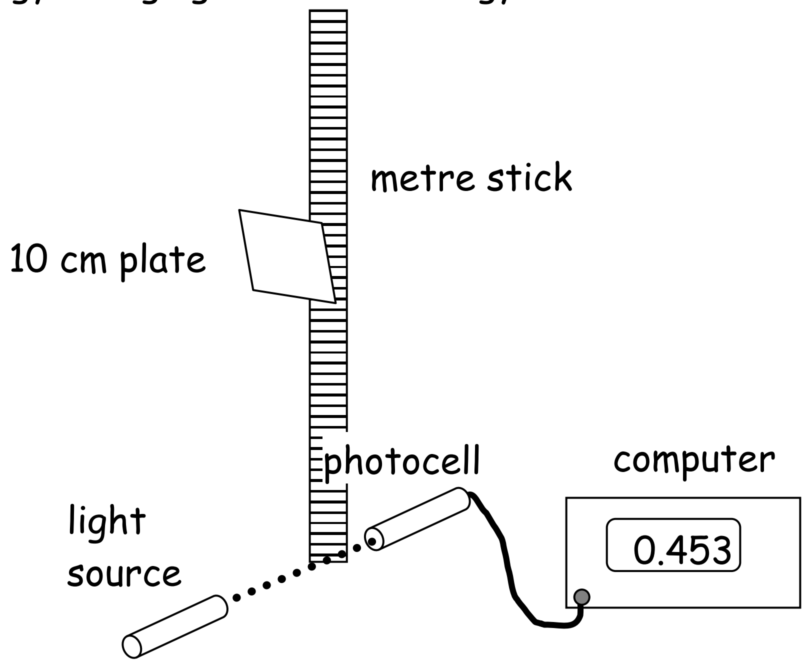
Calculate the speed of a 6kg bowling ball that has a kinetic energy of 27J.

$E_k = \frac{1}{2}mv^2$
$27 = \frac{1}{2}[6 \times (v^2)]$
$54 = 6v^2$
$v^2 = 9$
$v = \sqrt{9}$
$v = \underline{\underline{3m/s}}$



Conservation of Energy

Gravitational potential energy changing to kinetic energy.



In this experiment a plate is dropped from a known height through a light gate. The loss in gravitational potential energy will be calculated by measuring the height fallen. The kinetic energy gained will be calculated by measuring the speed of the plate as it passes through the light gate.

Collect an experiment diagram and stick it into your jotter.

height (m)	Gravitational potential energy (J)	speed (m/s)	kinetic energy (J)

Answer the following questions in sentences.

What happens to the value of the potential energy lost as the drop height is increased?
What happens to the value of the kinetic energy lost as the drop height is increased?
Compare columns two and four. What is the relationship between the potential energy lost and the kinetic energy gained?

Energy cannot be created or destroyed.
Energy can change from one form to another.
Sometimes the energy produced is not useful, we say that this energy has been lost to the system.
Normally this energy is lost as heat due to friction.

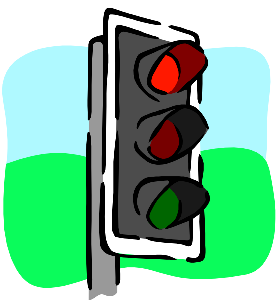
Now attempt questions 103 – 111 from the problems booklet

Now try Mechanics homework 7

Energy Checklist

Collect a checklist sheet and traffic light it.

Work in groups to change any red or amber entries to green. If no one in the group can get green then see your teacher for assistance.



When you have successfully changed all your lights to green you should attempt Energy and Power questions

from the past papers booklet. Try to use your notes as little as possible.

Mark your answers using the mark scheme. Any questions that you get wrong you need to find out why and write a short note to explain your mistake.