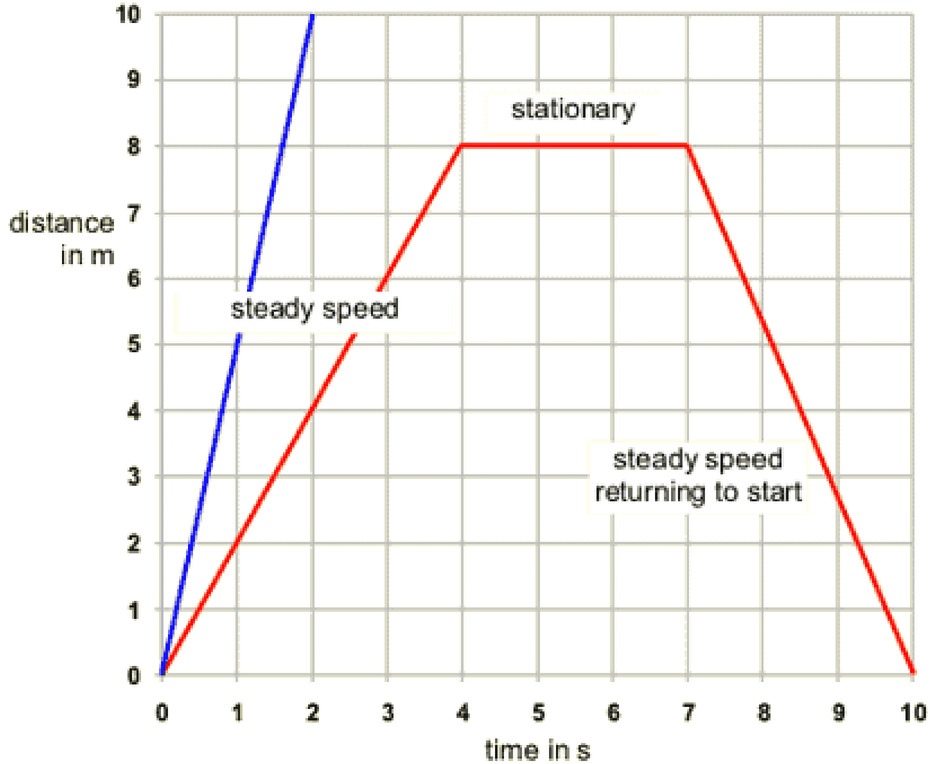
AQA Physics P2 Topic 1

Motion

Distance / Time graphs

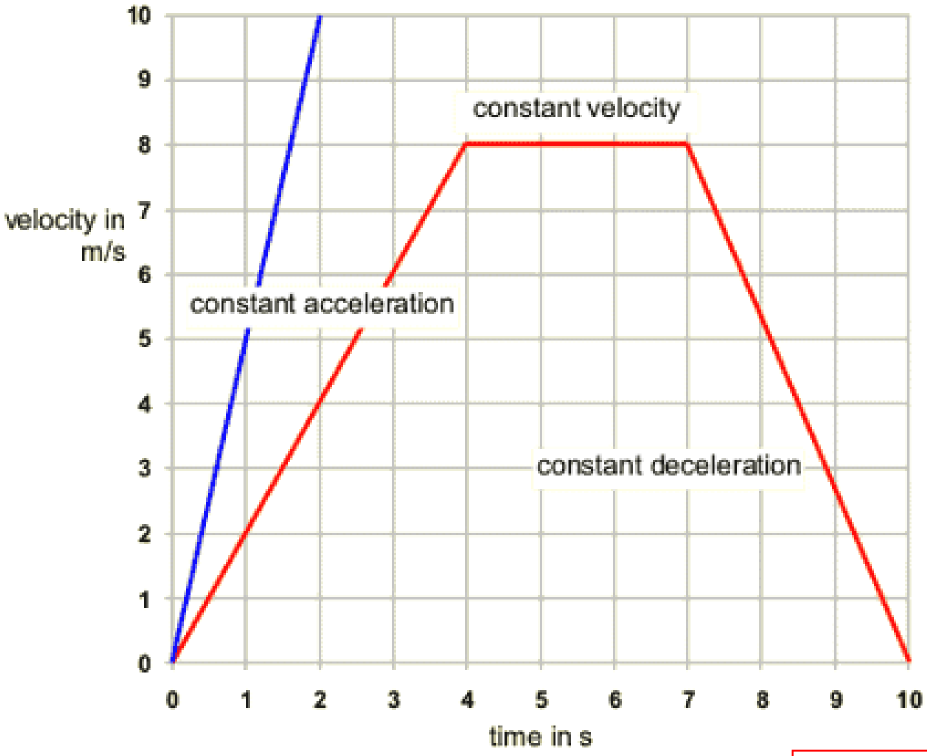


$$\text{speed} = \frac{\text{distance}}{\text{time}}$$

$$m/s = \frac{m}{s}$$

- Horizontal lines mean the object is stationary.
- Straight sloping lines mean the object is travelling at a constant speed.
- The steeper the slope, the faster the object is travelling.
- To work out the speed, you need to calculate the gradient.
- Gradient = change in distance (m) / change in time (s)

Velocity/Time Graph part 1



- Velocity is speed in a given direction
- Acceleration is the change in velocity per second when and object speeds up. The units are m/s^2
- Deceleration is the change in velocity per second when an object slows down.

$$acceleration, (m/s^2) = \frac{change\ in\ velocity\ (m/s)}{time\ take\ for\ the\ change\ to\ happen (s)}$$

$$acceleration, a = \frac{v - u}{t}$$

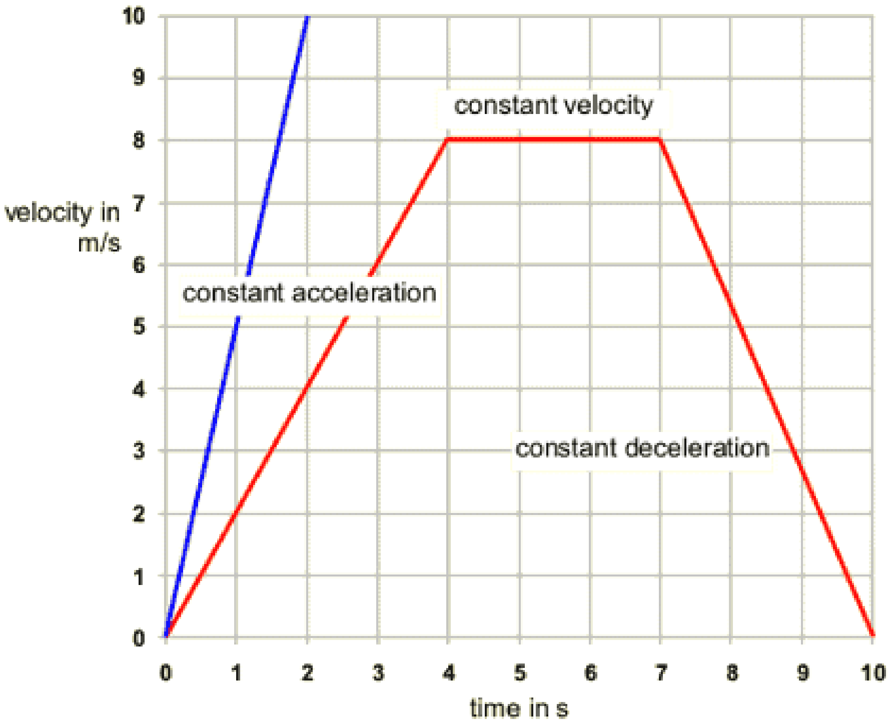
Where

v = the final velocity (m/s)

u = the initial velocity (m/s)

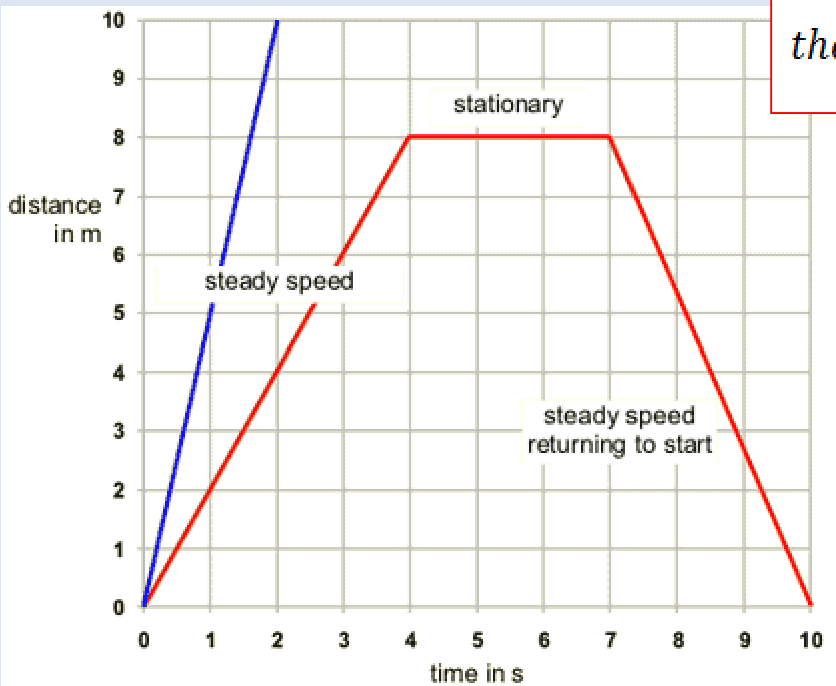
t = time taken (s)

Velocity/Time Graph part 2



- Horizontal lines mean the object is travelling at a constant velocity.
- Straight sloping lines mean the object is accelerating or decelerating.
- The steeper the slope, the faster the acceleration or deceleration.
- A curved line means the acceleration is changing.
- The area under the graph is the distance travelled.

Using Graphs



calculated from the gradient on a distance – time graph

$$\textit{the gradient of any line} = \frac{\textit{the height of the triangle}}{\textit{the base of the triangle}}$$

- The acceleration or deceleration of an object can be calculated from the gradient on a velocity – time graph

- The area underneath a velocity – time graph tells you the distance that an object has travelled

Vectors and Velocity

Quantities which have a direction and size are known as VECTOR QUANTITIES.

4 Examples

- Displacement – distance travelled in a particular direction.
- Velocity – speed in a particular direction.
- Force – always has a size and direction.
- Acceleration – it has size and direction

Speed (m/s) = distance (m) ÷ time (s)

Acceleration (m/s^2) = change in velocity (m/s) ÷ time (s)

AQA Physics P2 Topic 2

Forces

Forces between objects

- A force can change the shape of an object or change its state of rest (stop an object) or its motion (change its velocity)
- All forces are measured using the unit Newton (N)

•A force is a push or a pull.

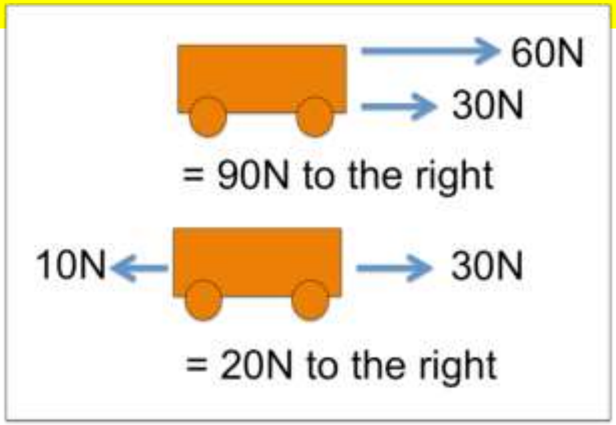
•When two bodies interact, the forces they exert on each other are equal in size and opposite in direction.

•For every action force there is an equal and opposite reaction force

Resultant forces

- Whenever two objects interact, the forces they exert on each other are equal and opposite

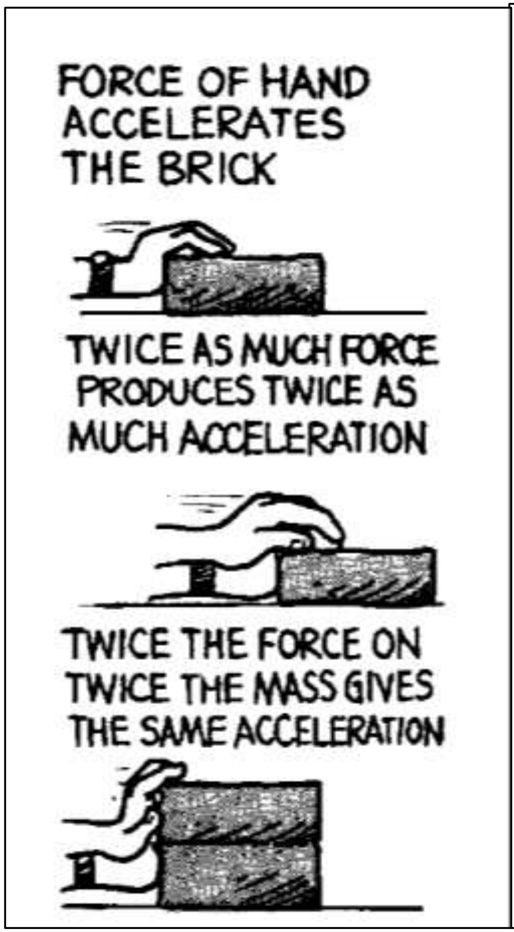
- A number of forces acting at a point may be replaced by a single force that has the same effect on the motion as the original forces all acting together. This single force is the resultant force

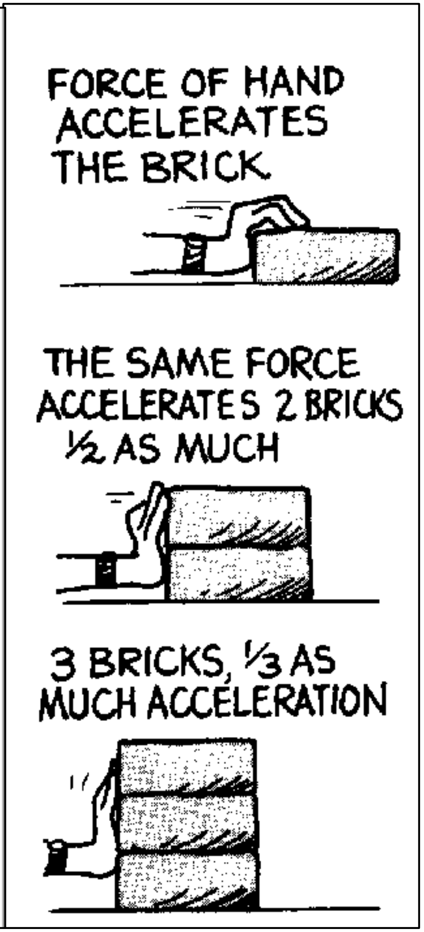


The resultant force acting on an object can cause a change in its state of rest or motion.

Force and acceleration

Force (N) = Mass (kg) x acceleration (m/s^2)





•The size of acceleration depends on:

- Size of the force
- Mass of the object
- The larger the resultant force on an object the greater its acceleration.
- The greater the mass of an object, the smaller its acceleration will be for a given force.

On the road

Stopping distance = thinking distance + breaking distance

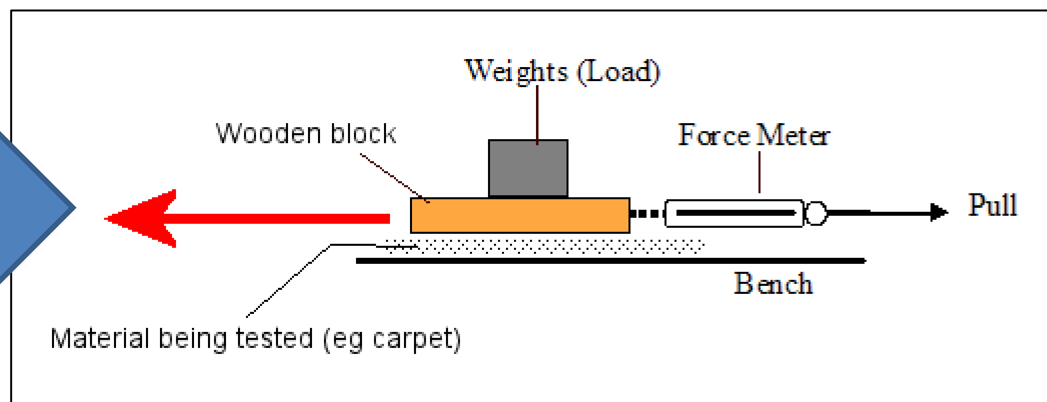
<u>Factors affecting thinking distance:</u>

1. Poor reaction times of the driver caused by
   1. Age of driver
   2. Drugs e.g. alcohol
   3. Tiredness
   4. Distractions
2. Visibility
3. Speed

<u>Factors affecting breaking distance:</u>

1. Mass of vehicle
2. Speed of vehicle
3. Poor maintenance
4. Poor weather conditions
5. State of the road
6. Amount of friction between the tyre and the road surface.

Investigating friction. How much force is needed to move weights on different surfaces?



Falling objects

Weight and mass are not the same thing

•The weight of an object is the force of gravity on it. Weight is measured in Newtons (N)

•The mass of an object is the quantity (amount) of matter in it. Mass is measured in Kilograms (Kg)

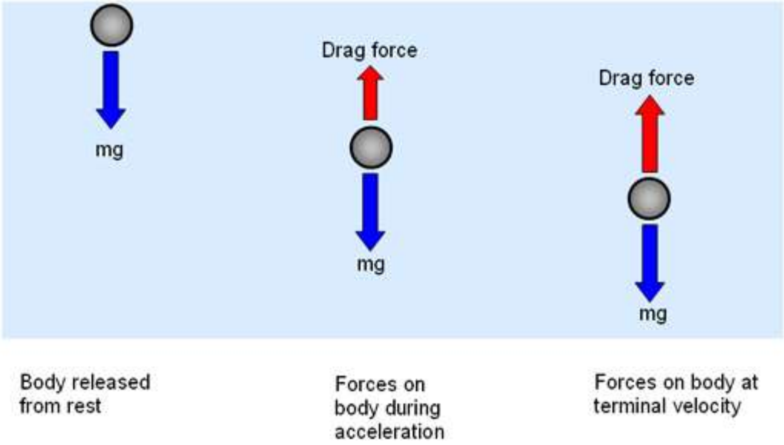
Weight (N) = Mass (kg) x gravity (N/kg)

In a vacuum

- All falling bodies accelerate at the same rate.

In the atmosphere

- Air resistance increases with increasing speed.
- Air resistance will increase until it is equal in size to the weight of a falling object.
- When the two forces are balanced, acceleration is zero and TERMINAL VELOCITY is achieved.
- An object acted on only by the Earths gravity accelerates at about 10 m/s^2



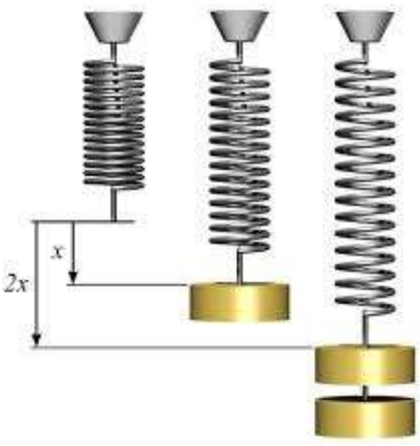
Stretching and squashing

A force applied to an elastic object such as a spring will result in the object stretching and storing elastic potential energy

Hooke's Law states:

The extension of a spring is directly proportional to the force applied, provided that its limit of proportionality is not exceeded.

Weight (N)	Length (mm)	Extension (mm)
0	120	0
1.0	152	32
2.0	190	70
3.0	250	105



The extension of a material is its current length minus it original length.

Force applied (N) = spring constant (N/m) x extension (m)

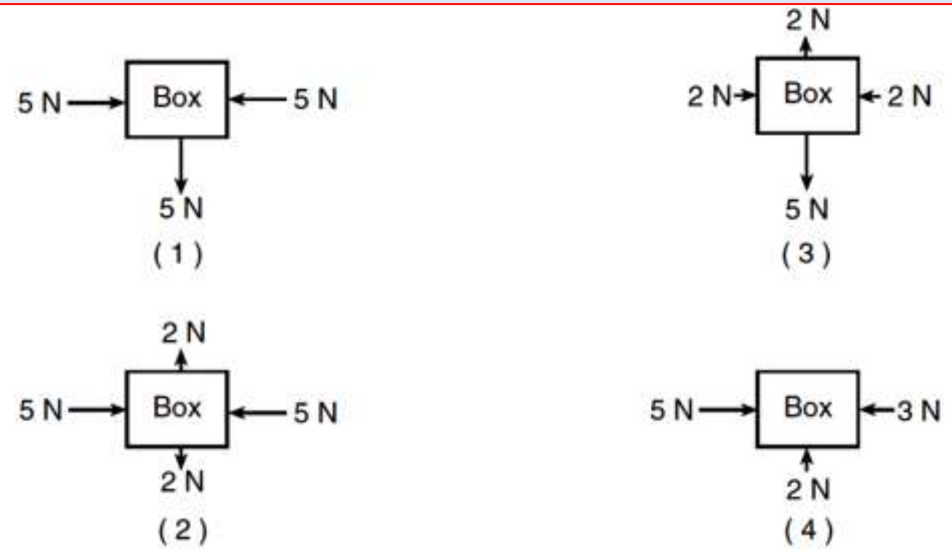
F = K x e

Forces

A force is a push or a pull.

When two bodies interact, the forces they exert on each other are equal in size and opposite in direction. These are known as REACTION FORCES.

You need to be able to interpret these diagrams and work out the resultant force in each direction.



If the resultant force is zero, it will remain at rest or continue to travel at a constant speed.

If the resultant force is not zero, it will accelerate in the direction of the resultant force.

AQA Physics P2 Topic 3

Work, energy and momentum

Energy and work

Key definitions

Energy transferred = work done

- Work – the amount of energy transferred. Measured in Joules (J)
- Power – The rate of doing work. Measured in Watts (W). 1 joule per second is 1 watt.

When a **force** causes an object to move a **distance, work** is done

Use this formula:

Work Done (J) = Force (N) x distance moved (m)

Or

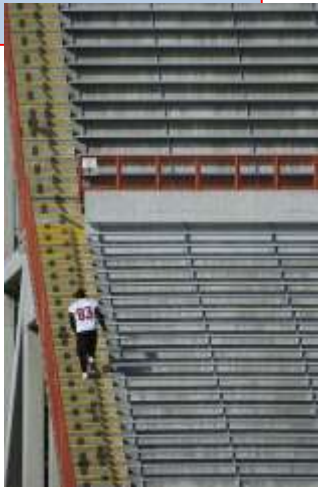
W = F x D

Example – if a 1kg mass (10N) is moved through a distance of 2 metres the work done is 20J.

Power (W) = Work Done (J) / Time taken (s)

Example – if a 24J of work is done over a 30 second period, the Power would be 24 ÷ 30 = 0.8W

Could you work out how much work you have done climbing a flight of stairs?



Electrical power and energy (extension)

A current in a wire is a flow of electrons. As the electrons move in a metal they collide with the ions in the lattice and transfer some energy to them.

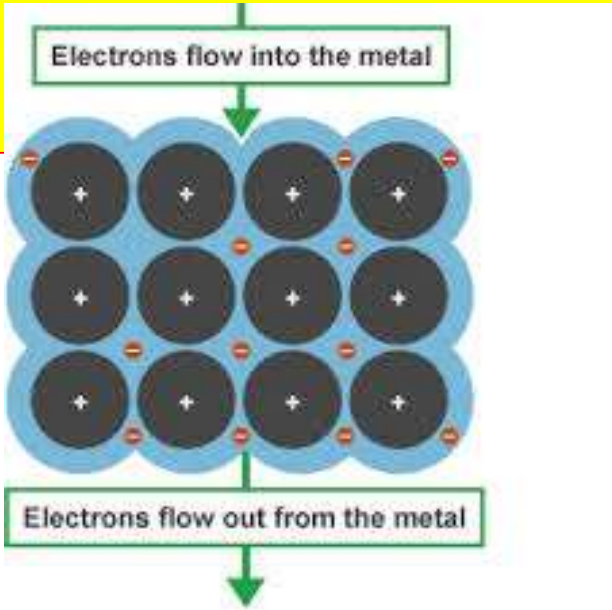
This is why a resistor heats up when a current flows through.

Electrical power (watt, **W**) = **current** (ampere, **A**) x **potential difference** (volt, **V**)

P = I x V

Energy transferred (joule, **J**) = **current** (ampere, **A**) x **potential difference** (volt, **V**) x **time** (second, **s**)

E = I x V x t



Distinguish between the advantages and disadvantages of the heating effect of an electric current

Advantages	Disadvantages
Useful Heating a kettle	Wasted energy
Useful in Fires	Cause burns

Gravitational potential energy (GPE)

Gravitational Potential Energy – The energy that an object has by virtue of its position in a gravitational field

When an object is **moved up,** its gravitational potential energy **increases.**

When an object is **moved down,** its gravitational potential energy **decreases**

Change in gradational potential energy (J) =weight (N) x change in height(m)

Change in gravitational potential energy = mass (kg) x gravitational field strength (N / kg) x change in height (m)

E = m x g x h

Kinetic energy

When an object speeds up or slows down. Its kinetic energy increases or decreases.

The forces which cause the change in speed do so by doing work.

The momentum of an object is produced by the object's mass and velocity.

The kinetic energy of an object depends on its mass and speed

Kinetic energy (J) = ½ x mass (kg) x speed² (m/s)²

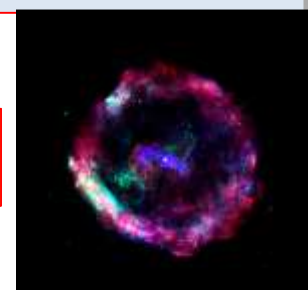
Elastic potential energy (the energy stored in an elastic object when work is done) can be transferred into kinetic energy.

Momentum

Momentum is a property of moving objects
In a closed system the total momentum before an event is equal to the total momentum after the event. This is called conservation of momentum.

p = momentum (Kg m/s)
m = mass (Kg)
v = velocity (m/s)

p = m x v



- Can you calculate the momentum of an athlete running at a velocity of 5 m/s with a mass of 75 Kg?
- If a train is 1200 Kg and is moving at a velocity of 5.0 m/s and collides with a stationary train with a mass of 1500 kg. The trains will move together after the collision.

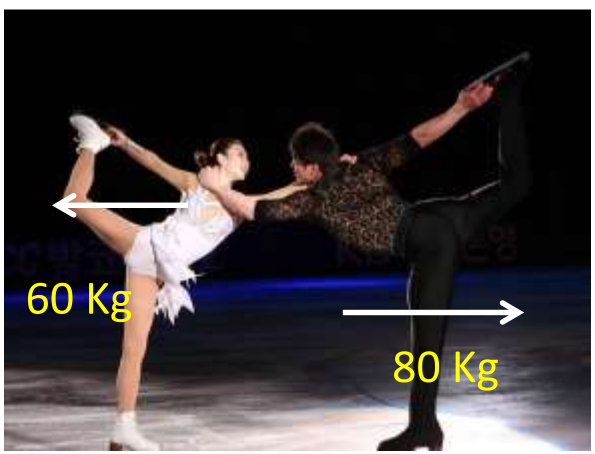
Can you calculate the momentum of both trains before the collision? And show the velocity of the wagons after the collisions?

Explosions

Explosions are good examples of momentum and conservation of momentum.

When two objects push each other apart they also move apart

- With different speeds if they have different masses
- With equal and opposite momentum so their total momentum is zero



If the ice skaters were to push each other away (explosion) from standing still

- Momentum A after explosion = mass A x velocity A
- Momentum of B after explosion = mass B x velocity B
- Total momentum before explosion = 0 as both skaters were standing still.

(mass A x velocity A) + (mass B x velocity B) = 0

Impact forces

When two objects collide the force of the impact depends on 3 factors:

- The mass of the objects
- The change in velocity
- The duration (time)of the impact.

The longer the impacts lasts the greater the impact force is reduced

When two vehicles collide

- They exert equal and opposite forces on each other
- Their total momentum is unchanged

Crumple zones are designed to lessen the effect of a collision. In a collision the forces change the momentum of the car

- In head on collisions the momentum of the car is reduced.
- In rear end collisions, momentum is increased.

Crumple zones increase the impact time.

Car Safety

When you are travelling in a car (or on a bike, skis, train etc.) you are travelling at the same speed as the car. If the car stops suddenly, your momentum continues to carry you forward. If you are stopped suddenly, by hitting the dashboard (or ground) you experience a large force, and therefore a large amount of damage.

Car safety features:

1. Seatbelts – stretch to increase the time taken to stop, thus reducing the rate of change of momentum and reducing injury
2. Air bags – inflate to increase the time taken to stop, thus reducing the rate of change of momentum and reducing injury
3. Crumple Zones – crumple and fold in a specific way to increase the time taken to stop, thus reducing the rate of change of momentum and reducing injury

Use this formula:

Force = change in momentum ÷ time

If you increase the time you reduce the force.

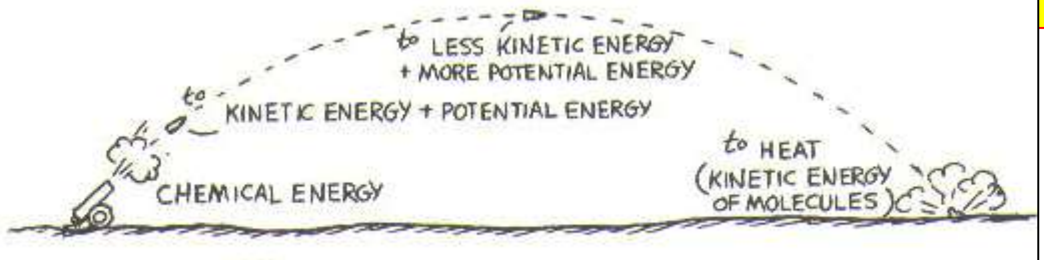
Potential and Kinetic Energy

Key Definitions

- Kinetic Energy – movement energy
- Gravitational Potential Energy – the energy something has due to its position relative to Earth – i.e. its height.

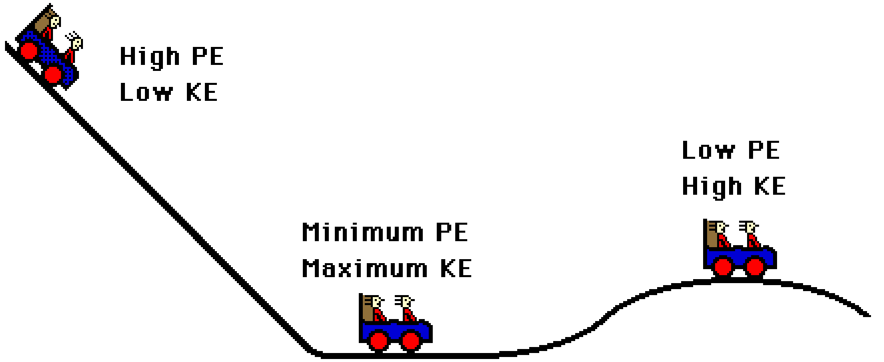
Conservation of Energy

When energy is transferred, the total amount always remains the same.



Energy Cannot Be Created or Destroyed

(It just changes forms)



As a coaster car loses height, it gains speed; PE is transformed into KE. As a coaster car gains height it loses speed; KE is transformed into PE. The sum of the KE and PE is a constant.

You need to be able to use these equations:

$GPE = mgh$

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