Chestnut Grove Academy

Physics

5. Forces

Foundation combined science

Revisiting Booklet

Name:

Forces and their interactions

A scaler is a physical quantity with _________________

Examples of scalers:

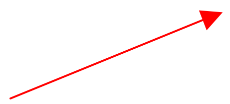
-
-
-
-
-

A vector is a physical quantity with ______________ and _________________

Examples of vectors:

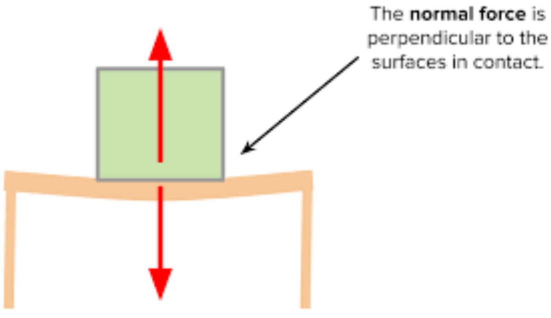
-
-
-
-
-
-

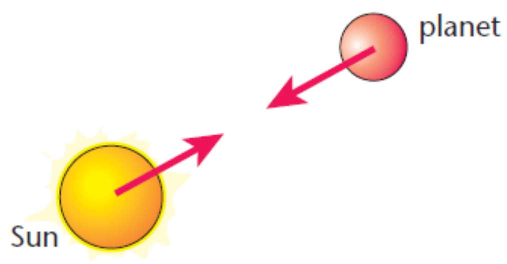
Vectors are represented by:



A force is a ______________ or ____________ that acts on an object due to the interaction with another object. All forces between objects are either:

contact forces	non-contact forces
Examples:	Examples:





Weight is the force acting on an object due to ________, so depends on the ________________________________, which varies it is a lot less on the moon (0.6N/Kg) compared to Earth (10N/Kg). Weight is measured from an objects ____________ _____

The weight of an object can be calculated using the equation:

Word equation: Symbol equation: Units:

(c) An object has a weight of 6.4 N.

Calculate the mass of the object.

Use the equation

mass = weight ÷ gravitational field strength (*g*)

gravitational field strength = 9.8 N / kg

____

____

Mass = __________________ kg

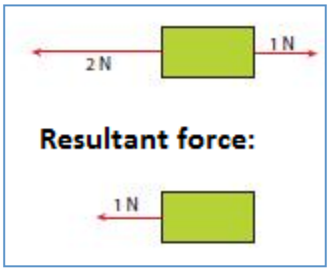
(1)

The weight of an object may be considered to act at a single point referred to as the object's 'centre of mass'.

The weight of an object and the mass of an object are ___________ _______________

What is the resultant force?

....



Forces are show by arrows. The longer the arrow, the greater the force.

Resultant force is the overall force; 2N -1N = 1N

How might a resultant force change an object?

....

If the resultant force acting on a stationary object is ___________ _____________

If the resultant force acting on a moving object is:

Zero, then

....

Not zero, then

....

(b) A fisherman pulls a boat towards land.

The forces acting on the boat are shown in **Diagram 1**.

The fisherman exerts a force of 300 N on the boat.
The sea exerts a resistive force of 250 N on the boat.

Diagram 1

(i) Describe the motion of the boat.

____

____

____

____

(2)

ipart 2)What is the resultant force?_____________________________________ (1)

Work done and energy transfer

Name the ten different types of energy:

What is work done?

....

Work done against the frictional forces acting on an object causes a rise in the

_________________ ____ of the object.

The work done by a force on an object can be calculated using the equation:

Word equation:

Symbol equation:

Units:

1 newton metre = 1 joule

What is the work done when Nazma moves an object 15cm by a force of 50N?

....

.... units ....

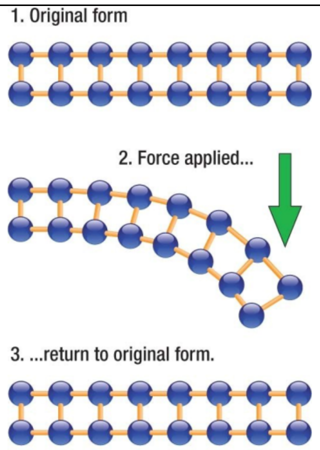
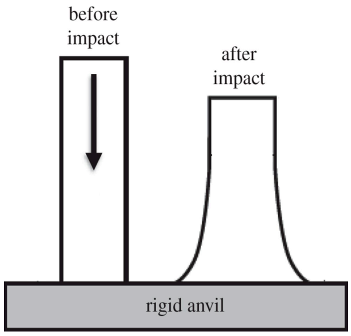
What is the energy transfer occurred?

....

Forces and elasticity

When a force such as ______ _____, _____ ______ or _______ ________ is applied on an object it may stretch, compress or bend. To change its shape in this way more than one force must be applied in different directions otherwise it would simply ____________________________________

____

Elastic deformation	Inelastic deformation
________________ ________________  	___________________________ 

Force of an extension can be calculated using the equation:

Word equation:

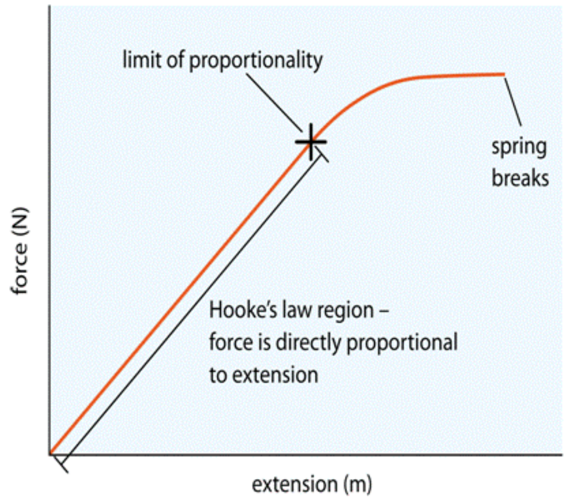
Symbol equation:

Units:

A 12N force is used to compress a spring with a spring constant of 96 N/kg. Calculate the compression of the spring.

....

.... units ....



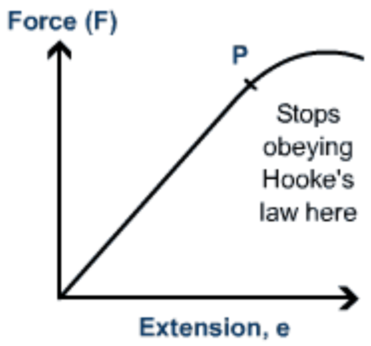
What does this graph show?

....

....

What type of energy is stored by a spring when it is stretched? ....

What does this graph show?



....

....

....

What therefore is the relationship between work done & elastic potential energy stored?

....

Calculate work done in stretching (or compressing) a spring (up to the limit of proportionality) using the equation:

Word equation:

Symbol equation:

Units:

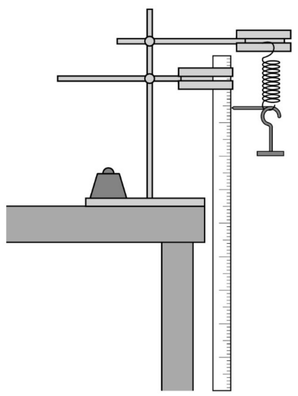
A spring has a constant of 1.2 N/m. Assuming that spring deforms elastically, calculate the total energy transferred to its elastic potential energy store when extended by 0.20m

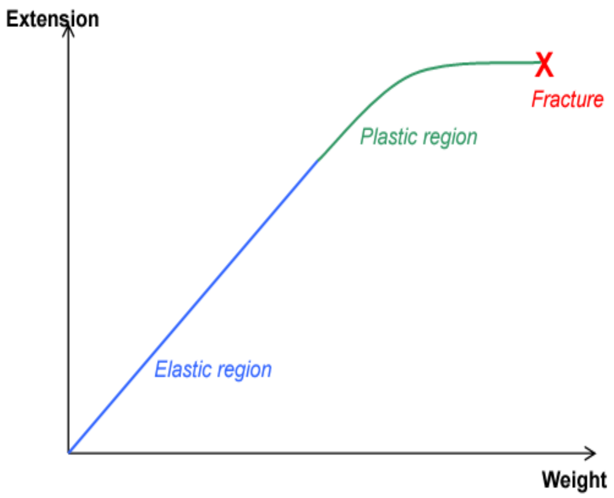
....

.... units ....

Required practical activity 18: investigate the relationship between force and extension for a spring

Method:





How can the spring constant be calculated?

Hooke's law

- As the force on the spring is increased the extension of the spring _______ ________
- The extension is _______ ________ to the force added (as the force is ______________, the extension is ____________) up until a certain point 'the elastic limit'
- When further force is applied to the spring it continues to extend but it does not extend in ______________. The spring will no longer _________________________

Forces and motion

Distance is ________ ______. Distance does not involve direction. Distance is a ______ ____ quantity.

Displacement is _______ ________ and __________ __________. Displacement is a __________ ________quantity.

Speed is ____________ _______. Speed is a ______ ______ quantity. Speed is constantly changing due to a number of factors, such as a person's speed of walking is influenced by ________, _________, ________ and _________________

Typical values of speed include:
walking~___________
running~___________
cycling~___________
Car~___________
Train ~___________
Plane ~___________

You need to know these values approximately.

It is not only moving objects that have varying speed. The speed of sound and the speed of the wind also vary. A typical value for the speed of sound in air is 330 m/s.

For an object moving at constant speed the distance travelled in a specific time can be calculated using the equation:

Word equation:

Symbol equation:

Units:

A cat is walking at the speed of 0.4m/s. Calculate how far the cat walks in 50 s and how long it takes to walk 32m. How does this speed compare to a human?

....

.... units ....

....

.... units ....

....

For an object moving at a varying speed you can calculate its average speed using the same equation: s=vt. You will need to add up the distance and time for each part to do this.

A lorry moves at a steady speed and travels 24m in 30s. The lorry than slows down and travels a further 45m in 70s before stopping, Calculate the average speed of the lorry for the whole time that it's moving

....

....

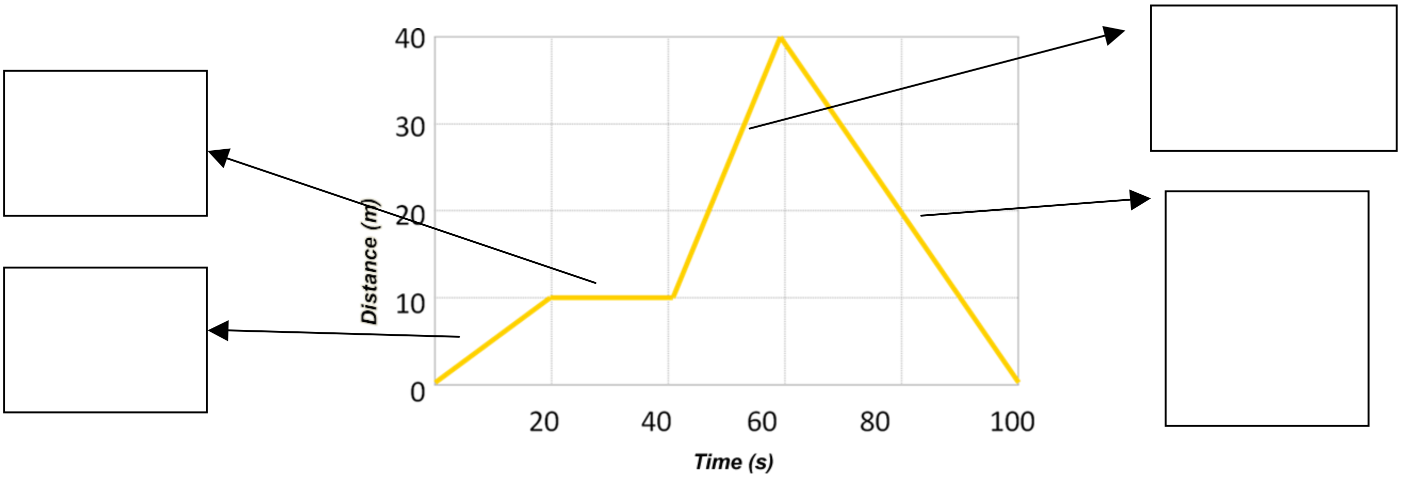
.... units ....

The velocity of an object is ____________ ___________.

Velocity is a _______ _____ quantity. E.g. 0.69m/s north.

If an object moves along a straight line, the distance travelled can be represented by a distance–time graph.

Annotate this distance-time graph of a Mohammed walking to work and back again.



The speed of an object can be calculated from the gradient of its distance–time graph.

Calculate the speed of Mohamed walking to work in its first 20 seconds:

....

.... units ....

Calculate the speed Mohamed walking home from work

....

.... units ....

Acceleration is when an object is ____________

Deceleration is when an object is ____________

The acceleration of an object can be calculated from the gradient of a velocity–time graph.

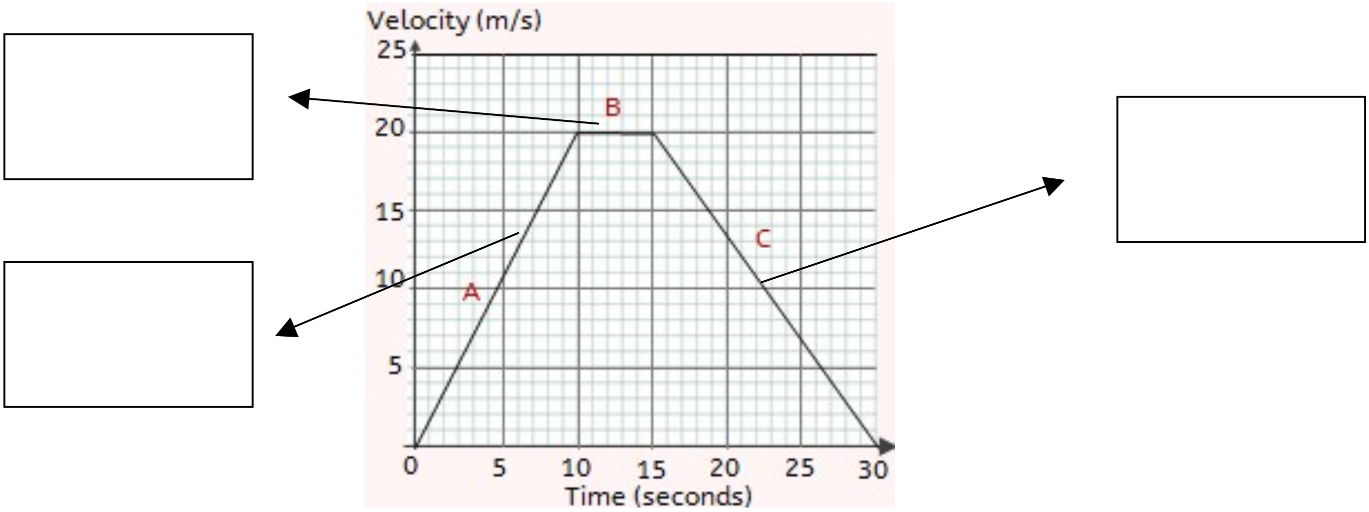
The average acceleration of an object can be calculated using the equation:

Word equation:

Symbol equation:

Units:

Annotate the velocity time graph:



Calculate the acceleration of William's bus during the first 10 second of his journey

....

.... units ....

Estimating accelerations can be worked out from objects typical speed and suggesting a typical time it would take to stop.

A car comes to a stop when it collides with a tree. Estimate the deceleration of the car.

....

.... units ....

Uniform acceleration is where __________________ _________

Near the Earth's surface any object falling freely under gravity has an acceleration of about 9.8 m/s^2.

An object falling through a fluid initially accelerates due to the force of gravity. Eventually the resultant force will be zero and the object will move at its ___________ ________.

The following equation applies to uniform acceleration:

Word equation: Symbol equation: Units:

A ball has been dropped from the top of a building. The velocity of the ball when it is 2.25 m from the ground is 6 m/s. Near the Earth's surface any object falling freely under gravity has an acceleration of about 9.8 m/s^2.
Calculate the velocity of the ball when it reaches the ground. You can assume there is no air resistance.

....

.... units ....

Forces, accelerations and Newton's Laws of motion

Newton's First Law:

If the resultant force acting on an object is zero and:

- The object is stationary, then the object remains _____________
- The object is moving, the object ____

The velocity (speed and/or direction) of an object will only change if _____________________

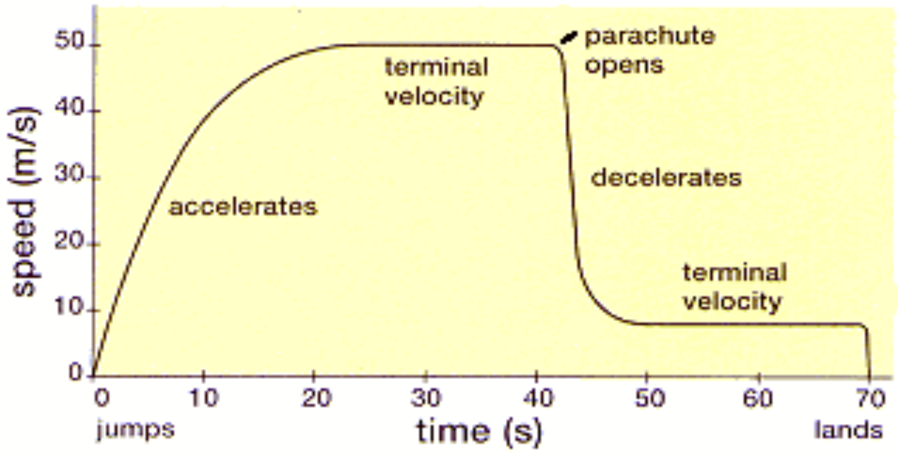
____

If a rocket is moving through space at a steady velocity, what can you say about the resultant force acting on the rocket?

....

....

Annotate the graph with the words below.



Balanced forces, unbalanced forces, steady speed, acceleration, deceleration

What two forces are balanced when an object reaches terminal velocity?

....

Newton's Second Law:

The acceleration of an object is ________________ to the resultant force acting on the object, and ________________________ to the mass of the object.

As an equation:

Word equation:

Symbol equation:

Units:

A car with a mass of 900kg accelerates from rest with an initial acceleration of 2.5 m/s^2. Calculate the resultant force required to produce this acceleration.

....

.... units ....

A car with a mass of 1250kg has an engine that provides a driving force of 5200N. At 70mph the drag force acting on the car is 5100N. Find its acceleration at 70 mph

....

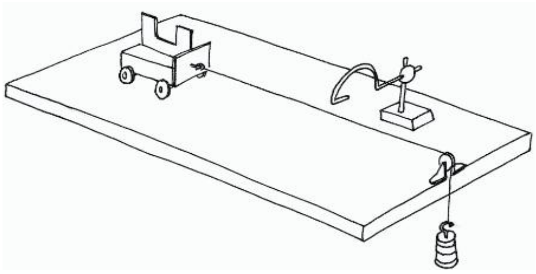
.... units ....

Estimate the resultant force on a car as it accelerates from rest to a typical speed in 10s

....

.... units ....

Required practical activity19: investigate the effect of varying the force on the acceleration of an object of constant mass, and the effect of varying the mass of an object on the acceleration produced by a constant force.



Method:

1.
2.
3.
4.
5.
6.
7.

Use the following equations to find acceleration:

s = v t

a = Δ v / t

Mass (kg)	Distance (m)	Time (s)	Speed (m/s)	Acceleration (m/s^2)
0.1	0.05	15		
0.2		13		
		11		

Conclusion:

....

....

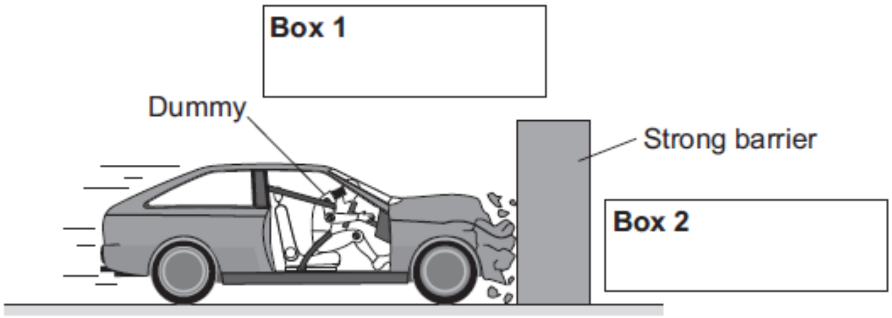
....

<u>Newton's Third Law:</u>

Whenever two objects interact, the forces they exert on each other are ____________________

An example of this is when a man pushes against a wall, there is a normal contact force acting back. This normal force is equal to the force the man is exerting on the wall.

The front crumple zone of a car is tested at a road traffic laboratory. This is done by using a remote control device to drive the car into a strong barrier. Electronic sensors are attached to a dummy inside the car.



(iii) Complete the following by drawing a ring around the correct line in the box.

The car exerts a force of 5000 N on the barrier. The barrier does not move. The force

	more than	
exerted by the barrier on the car will be	equal to	5000 N.
	less than	

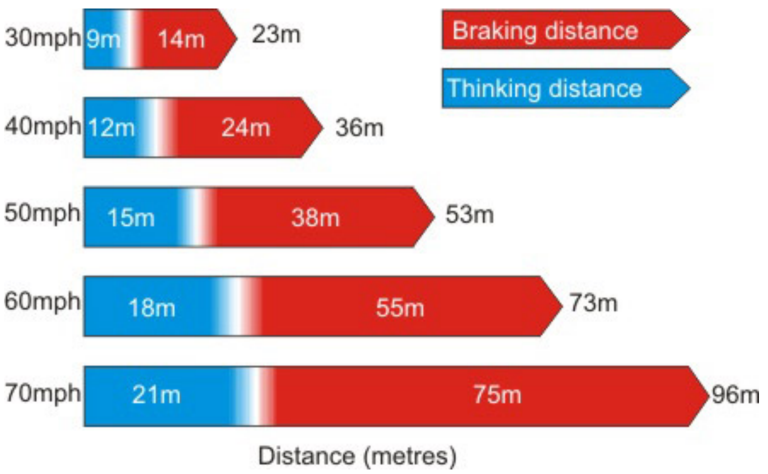
(1)

<u>Forces and braking</u>

What is the equation to work out stopping distance?

....

The greater the speed of the vehicle, the ______________ the stopping distance.



Factors affecting braking distance	Factors affecting thinking distance

Reaction times vary from person to person. Typical values range from 0.2 s to 0.9 s

.A typical way to measure reaction time is ___________________

When a force is applied to the brakes of a vehicle, ____________________ by the friction force between the brakes and the wheel reduces the __________________ of the vehicle and the temperature of the brakes _______________

The greater the speed of a vehicle the greater the braking force needed to stop the vehicle in a certain distance. The greater the braking force the greater the ________________ of the vehicle. Large decelerations may lead to ____