THE Ebbsfleet ACADEMY
Aspire, Excel

Subject: Physics
Year: KS3 – Year 7
Topic: P1 Forces and Motion

Lesson Sequence
1. Movement and Speed
2. Distance - Time Graphs
3. Forces Diagrams
4. Gravity and Weight
5. Gravity in Space
6. Density
7. Hooke's Law
8. Air and Water Resistance
9. Resultant Forces
10. Forces on an Object
11. Acceleration

Key Assessments

EA Exam 1

Core Texts

SMART Science Textbook

Key Words

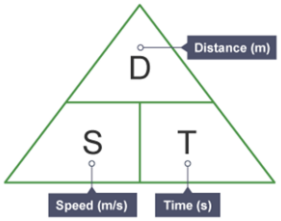
Accelerate	Speeding up or increasing speed. Units are m/s^2.	**Elastic Limit**	The amount of force needed to stretch a spring so far it will not return to its original shape.
Aerodynamic	Having a shape that reduces the drag from air moving past.	**Extension**	Increase in length (Stretched length - the original length = extension).
Decelerate	Slowing down, decreasing speed. Also known as negative acceleration. Units are m/s^2.	**Free Body Diagram (Force Diagram)**	A diagram to show all of the forces acting on an object.
Density	A measure of the 'concentration of mass' in an object, calculated by Mass ÷ Volume = Density. Units are g/cm^3.	**Friction**	A force caused when one surface rubs against another.
Distance - Time Graph	A graph showing a journey, it describes how the distance of an object has changed over time.	**Gradient**	A measure of the steepness of slope (on a graph).
Drag	The force of friction on an object when it moves through a liquid or a gas.	**Gravitational Field**	The region around an object where other objects feel the pull of its gravity.

Common SI Units

Value	Unit	Unit
Speed	Metres per Second	m/s
Force	Newtons	N
Weight	Newtons	N
Density	Kilograms per metres cubed	kg/m^3
Pressure	Pascals	Pa
Time	Seconds	s
Area	Metres squared	m^2
Distance	Centimetres Metres Kilometres	cm m km

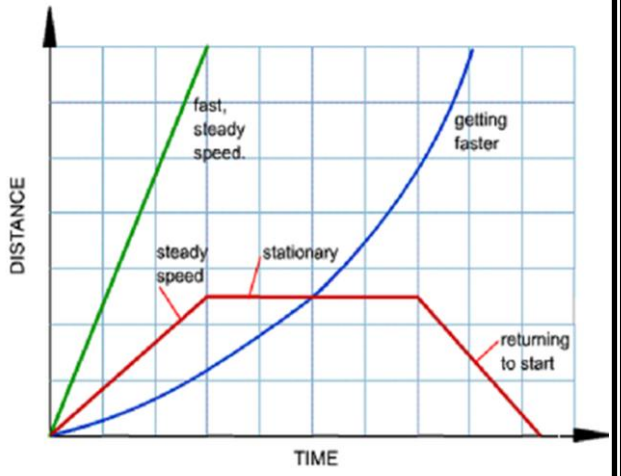
1 cm = 10 mm
100 cm = 1 m
1000m = 1 km

Calculating Speed

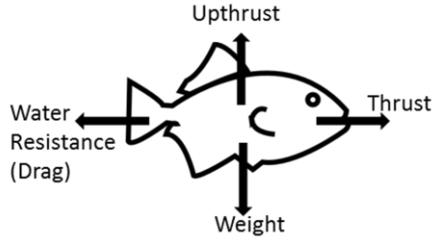


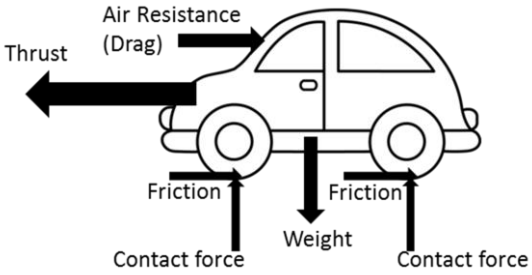
Speed (m/s)= Distance (m) ÷ Time (s)
Distance (m)= Speed x Time (s)
Time (s)= Distance (m) ÷ Speed (m/s)

Distance Time Graphs



Free Body Diagrams



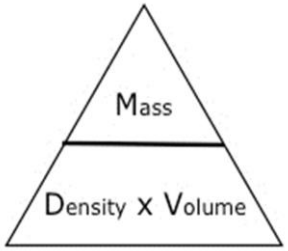


Remember:
- Force arrows must touch the object you are describing.
- Force arrows must be labelled.
- Force arrows must be proportional. E.g. An arrow for 10N will be twice as long as an arrow for 5 N.

Key Words

Gravity	Force between two objects caused by their masses.	**Resultant Force**	The sum of two forces acting on an object, calculated by Larger Force - Smaller Force (in opposite direction) = Resultant force).
Light Gate	Device that starts or stops a timer when an object passes, used to accurately measure speed or acceleration.	**Speed**	How fast an object is moving, measured in metres per second (m/s).
Lubricant	A substance that reduces friction.	**Streamlined**	A smoothly curved shape to reduce friction and help an object moved more quickly through a liquid or a gas.
Mass	Amount of matter in an object (measured in kg).	**Upthrust**	Upward force on a solid object when it is in a liquid or a gas.
Proportional	If two amounts are proportional, they change at the same rate so that the relationship between them does not change.	**Volume**	Amount of space taken up by an object, measured in m^3, cm^3 and litres.
Reactive / Contact Force	The force of a surface pushing back up against an object resting on it..	**Weight**	The pull of gravity on an object, a force measured in Newtons. Calculated by mass (kg) x Gravity (N/kg) = Weight (N)).

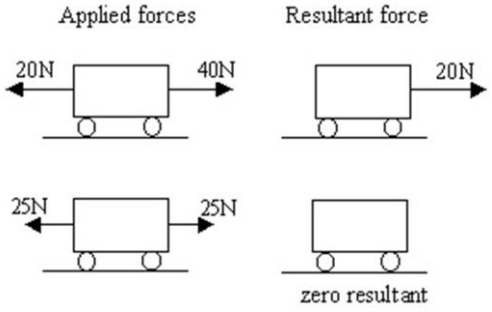
Density



Mass (g) = Density (g/cm^3) x Volume (cm^3)
Density (g/cm^3) = Mass (g) ÷ Volume (cm^3)
Volume (cm^3) = Mass (g) ÷ Density (g/cm^3)

- A measure of the concentration of mass in an object or in a specific volume.
- Objects with many particles in a small volume are dense e.g. metals.
- The denser an object the heavier an object will feel.
- Solids have high density, gases have low density.
- Measured in g/cm^3.

Resultant Force



- The sum of two forces acting on an object, calculated by [Larger Force - Smaller Force (in opposite direction) = Resultant force]
- Resultant forces above 0N must have a direction of movement.
- A resultant of 0N means an object is stationary or moving at constant speed.
- Objects with resultant forces above 0N are accelerating or decelerating.

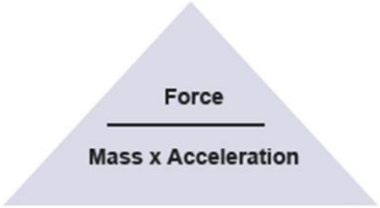
Hooke's Law: An equation that describes how the force needed to stretch or squash an object is proportional to the distance it is stretched or squashed.

F = K x

F = Force (N)
K = Spring Constant (N/m)
x = Distance or extension of spring (m)

- This equation until the elastic limit is exceeded. If a spring is stretched too much and it will not return to its original length when the load is removed then it has reached its elastic limit.
- Spring constants are a given value and are different for every object and material. It can only be calculated by doing an experiment to discover the objects elastic limit.

Calculating Acceleration



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

- Isaac Newton's second Law of Motion is F= ma.
- It describes that an object's mass is related to the amount of force needed to accelerate it.
- Remember to convert all units to kg for mass.

SI Unit Conversions

Prefix	Multiplying Factor	Symbol
nano-	10^{-9}	n
micro-	10^{-6}	μ
milli-	10^{-3}	m
centi-	10^{-2}	c
deci-	10^{-1}	d
kilo-	10^{3}	k
mega-	10^{6}	M
giga-	10^{9}	G