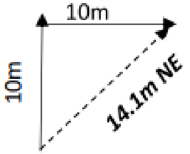
Keywords

Force	Make objects move or change shape. Measured in Newtons (N)
Vector	Quantities with both magnitude [size] and direction such as momentum
Scalar	Quantities with only magnitude
Speed	A scalar quantity – How something covers a set distance ***[speed = distance ÷ time]***
Velocity	A vector quantity – speed in a given direction
Acceleration	How quickly something speeds up. ***(change in speed ÷ time taken)* [m/s/s]**
Distance	A scalar quantity that measures how much ground an object covers when moved
Displacement	A vector quantity that measures how far out of place an object is from A to B
Weight	A **force** caused by gravity. Measured in **Newtons *[weight = mass x gravity]***
Mass	The amount of matter an object has. Measured in **g** or **kg**
Resultant Force	The overall, single force. This is zero if objects are stationary or at constant speed
Terminal Velocity	The maximum speed objects reach when falling. When weight = resistive forces
Joule	Force of 1 Newton displaces an object of 1 metre (1 Joule = 1 Newton-metre)
Hookes Law	Extension of an elastic object is directly proportional to the force ***[F = ke]***
Stopping Distance	The amount of time it takes to stop. Thinking distance + braking distance. (in m)

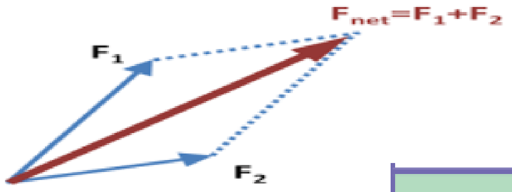
PF2 Knowledge organiser

Forces and Vectors



Measure displacement / resultant force with a ruler or by

$F = \sqrt{a^2 + b^2}$



Newtons Laws

First law	Resultant force is zero if stationary or travelling at constant speed. Objects will travel in a straight line unless a force acts on it. (**HT**- resisting that change)
Second Law	F=ma – acceleration is proportional to force & inversely proportional to mass
Third Law	When objects interact their forces are equal and opposite

Common Speeds

walking 1.5 m/s, running 3 m/s, cycling 6 m/s

Terminal Velocity

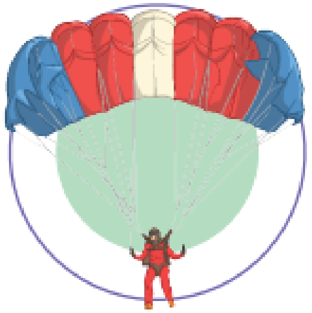
When an object begins moving, the force **accelerating** the object is much greater than the force resisting the movement. A resistant force might be **air resistance** or **friction**, for example.

As the **velocity** of the object increases, the force **resisting** the movement also increases. This causes the acceleration of the object to be reduced gradually until the forces become **equal** and are **balanced**. This doesn't cause the object to stop moving. As the object is already in motion, balanced forces mean it will continue to move at a **steady** speed. This steady speed is the maximum that the object can achieve and is called the **terminal velocity**.

The terminal velocity of an object depends on its shape and weight. The shape of the object determines the amount of resistant force which can act on it. For example, an object with a large surface area will have a greater amount of resistance acting on it.

Consider a skydiver and his parachute. When the skydiver first jumps from the aeroplane, he has a small area where the air resistance can act. He will fall until he reaches a terminal velocity of approximately 120mph.

After the skydiver releases his parachute, the shape and area has been changed and so the amount of air resistance acting is increased. This causes him to decelerate and his terminal velocity is reduced to about 15mph. This makes it a much safer speed to land on the ground.

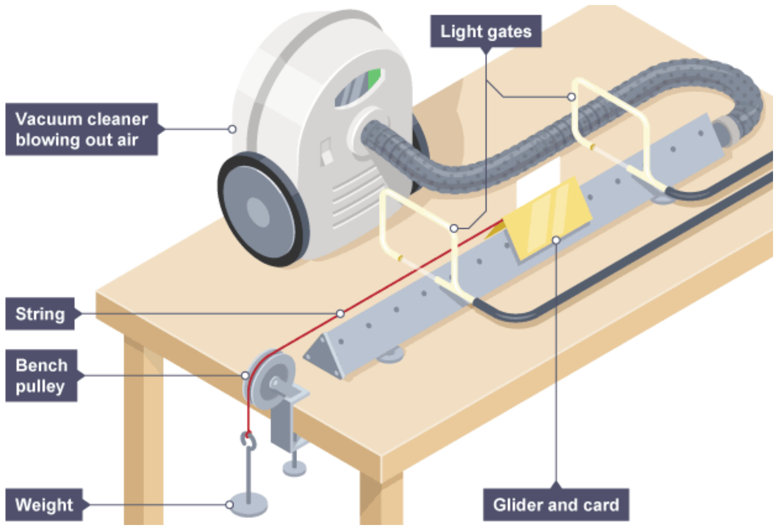


Acceleration require practical

To investigate the effect of varying the force on the acceleration of an object.

Method

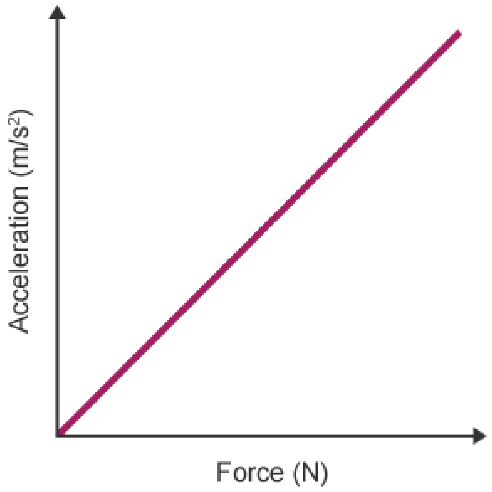
1.Position an air track on a bench with a bench pulley at one end and two light gates above the track. Cut an interrupt card to a known length (such as 10 cm) and attach it to an air track glider.
2.Connect the glider to a hanging mass by a string the length of the air track passing over the bench pulley. Make sure the air track is level and that the card will pass through both gates before the mass strikes the floor.
3.Set the data logging software to calculate acceleration.
4.Add 5 × 20 g slotted masses (0.98 N of force) to the end of the string.
5.Release the glider, then record the weight and acceleration.
6.Repeat steps 4 and 5 two more times, and calculate a mean value for the acceleration.
7.Repeat steps 4 to 6, removing one of the slotted masses each time (giving forces of 0.78 N, 0.59 N, 0.39 N and 0.20 N.



Results

It is important to record results in a suitable table, like the one below, which shows a set of example results:

Force (N)	Run 1 acceleration $(m/s)^2$	Run 2 acceleration $(m/s)^2$	Run 3 acceleration $(m/s)^2$	Mean acceleration $(m/s)^2$
0.98	0.22	0.27	0.37	0.29
0.78	0.20	0.29	0.21	0.23
0.59	0.26	0.11	0.17	0.18
0.39	0.21	0.10	0.05	0.12
0.20	0.04	0.06	0.11	0.07



Evaluation

Acceleration is directly proportional to the force exerted on the object.

Equations	
Energy Transfer (work)	Work (J or N/m) = Force (N) x Distance (m)
Weight	Weight (N) = mass (kg) x g
Hookes law	Force (N) = spring constant (N/m) x extension (m)
Elastic Potential Energy	Elastic potential energy = ½ x spring constant x $(\text{extension})^2$
Speed	Speed (m/s) = distance (m) ÷ time (s) [v = s ÷ t]
Newtons 2nd Law	Resultant Force (N) = mass (kg) x acceleration (m/s^2)
Acceleration	Acceleration (m/s/s or m/s^2) = change in velocity ÷ time taken
Uniform Acceleration	$V^2 - U^2 = 2as$ $V^2 = U^2 + 2as$ $V = u + at$ $S = ut + \frac{1}{2}at^2$

U = initial velocity V = final velocity t = time
a = acceleration s = displacement
u, v, a, s = vector quantities t = scalar quantity

Contact Forces	Non-Contact Forces	Scalar Quantity	Vector Quantity
Friction	Gravitational Forces	Mass	Force
Air Resistance	Electrostatic Forces	Speed	Acceleration
Tension	Magnetic Forces	Distance	Displacement
Reaction Forces	Nuclear Forces	Time	Velocity

PF2 Knowledge organiser