SCIENCE

Year 9: Pressure and moments

1) What is a Force?

- Forces are **pushes** and **pulls** that occur when two objects interact.
- Forces can cause five things to happen when applied to an object, they are:

Speed things up	Kicking a football
Slow things down	An open parachute
Change direction	Hitting a moving ball with a bat
Rotate	Using a spanner
Change shape	Stretching an elastic band

- The **size** of a force is measured in **Newtons** which have the unit of
- We measure using a Newton meter (force meter)

- When forces act on objects they "do work" which will cause an energy transfer.

For example: when friction acts on an object it will cause an energy transfer to occur. The

2) Examples of forces and whether they are contact or non-contact forces.

Contact	**Example**	**Non-contact**	**Example**
Friction	A car tyre on a road	Gravitational forces	A person and the Earth.
Air resistance	An open parachute	Electrostatic forces	Rubbing a balloon on your head and sticking it to a wall
Upthrust	A boat floating on water	Magnetic forces	Using a compass to find the North pole
Thrust	A jet engine on an aeroplane		

Keyword	**Meaning**	**Keyword**	**Meaning**
Pressure	The amount of force exerted on an area measured in Pa or **N/m^2**	**Resultant force**	The overall force acting on an object
Friction	A force between two surfaces that are sliding, or trying to slide across each other	**Lever**	A basic machineswhich help you do a job more easily for example spanners, scissors, crowbar
Air resistance	A force that air exerts against a moving object	**Contact forces**	Forces that only happen when two objects are touching each other
Upthrust	A force that any object in a fluid feels. It acts against the object's weight (upwards)	**Non-contact forces**	Forces that can act at a distance, i.e. objects don't need to touch
Thrust	A force normally provided by an engine of a plane, rocket or car.	**Electrostatic**	The attractive or repulsive forces between charged objects
Gravitational forces	A force that attracts objects with mass towards each other	**Moment**	A turning force caused by a force acting at a distance from a pivot measured in **N m** or **N cm**

3) How we show forces?

- The **size** and **direction** of forces are represented using **arrows**.

E.g. A cyclist is peddling with a forward (to the right) force of 20N. There is a force of friction (to the left) of 5N

E.g A skydiver has a weight of 700N (acting downward). The air she is passing through is creating 700N of air resistance (acting upwards)

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4) Balanced and unbalanced forces

When forces act on objects it is useful to know the **resultant force** on the object.

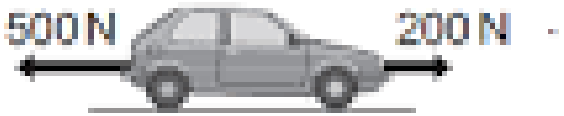
The resultant force on an object is the overall force acting.

Example: In box four the resultant force on the cyclist was 20=5 = 15N in the forward direction, and the resultant force on the skydiver was 700-700=0N.

When the resultant force on an object is zero the object will continue travelling at a constant speed (for the skydiver example this is called **terminal velocity**) or it will remain stationary.

When there is a resultant force the object will either accelerate or decelerate (speed up or slow down). For example the cyclist in box four will accelerate forwards.

In this example the car will decelerate because the resultant force is 500=200= 300 N backwards.



5) Pressure in solids

When an object is in contact with a sold surface a pressure is exerted. To calculate the size of this pressure you use the following formula.

$$\text{Pressure} = \text{Force} \div \text{Area}$$
$$\text{(Pa)} \qquad \text{(N)} \qquad \text{(m}^2\text{)}$$

Example: Calculate the pressure exerted by a snowboarder on the snow if they weigh 600 N and their snowboard has an area of 0.25 m^2.

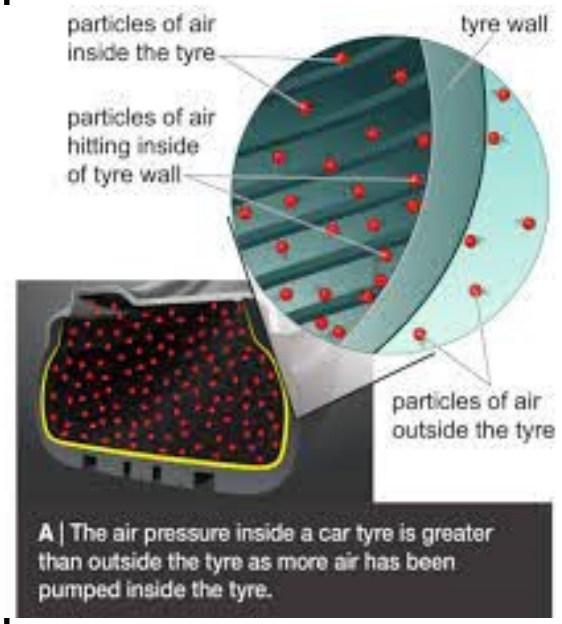
Pressure =?
Force = 600 N
Area = 0.025

Pressure = Force / Area

Pressure = 600 / 0.25 = 2400 Pa

6) Pressure in gases

- Particles in a gas move rapidly and randomly in all directions
- This means that they will collide with the walls of their container (for example a car tyre).
- During each one of these collisions a tiny force is exerted on the wall of the container (tyre).
- There are so many of these tiny collisions occurring at one time that they act as a constant force so in the case of a car tyre it stays inflated.

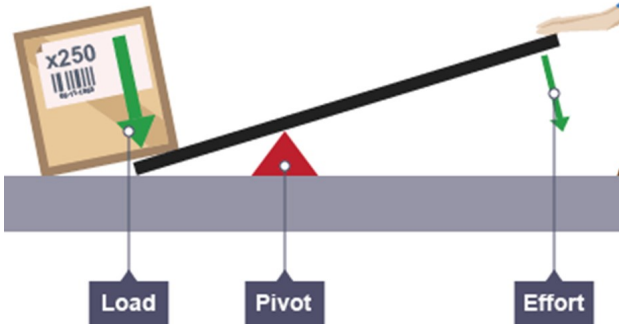


A | The air pressure inside a car tyre is greater than outside the tyre as more air has been pumped inside the tyre.

7) Levers

A levers are basic machines which help you do a job more easily. In this case lift heavy loads.

In this example the human exerts an effort far from a pivot which creates a large turning moment. As the load is near the pivot on the other side that turning moment creates a large lifting force on **the box.**



8) Moments

Moments are turning forces the size of which are calculated using the following formula:

$$\text{Moment} = \text{force} \times \text{distance from pivot}$$
$$\text{(Nm)} \qquad \text{(N)} \qquad \text{(m)}$$

Example. A student turns a nut with a spanner with a force of 40 N. The nut is 0.2m from the student's hand. What moment does the student exert?

Force=4N Distance=0.2 m Moment = Force x Distance from pivot Moment=4 x 0.2 = 0.8 Nm