

Knowledge organiser – 1.3 & 1.4 Contact forces and pressure

FRICION AND DRAG

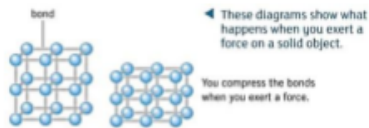
- Friction grips objects. You need to exert a force to make something move.
- If an object is moving through a fluid, the force slowing it down is called a drag force. When a moving object is in contact with air or liquid particles, it has to push them out of the way.
- Streamlining and lubricating (with oil or grease) will reduce drag and friction.

SQUASHING AND STRETCHING

- Forces can cause deformation of objects. They can also cause compression or tension.

How can the floor push you up?

When you stand on the floor, your weight pushes the solid particles closer together. The bonds are slightly compressed and push back and support you. This is called the reaction force.

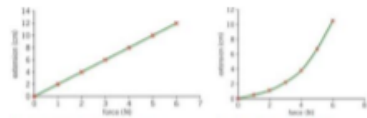


◀ These diagrams show what happens when you exert a force on a solid object.

You compress the bonds when you exert a force.

What happens when you stretch a spring?

- If you double the force on the spring, the extension will double (Hooke's Law).
- At some point, when you remove the force it will not go back to its original length (elastic limit).
- Not everything behaves like a spring when you stretch it.

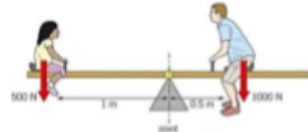


▲ This graph shows how the extension of a spring changes as you pull it.

▲ This graph shows the relationship between force and extension for polythene. It is not linear.

TURNING FORCES

- A turning force acts a certain distance from a pivot.
- The turning effect of a force is called a moment.
- $\text{moment (Nm)} = \text{force (N)} \times \text{perpendicular distance from the pivot (m)}$
- **Law of moments:** total clockwise moment = total anticlockwise moment
- You can work out if a see-saw is going to be balanced by calculating the clockwise and anticlockwise moments.



Calculating moments:

Clockwise = $1000\text{ N} \times 0.5\text{ m} = 500\text{ Nm}$

Anticlockwise = $500\text{ N} \times 1\text{ m} = 500\text{ Nm}$

The moments are equal; see-saw balances.

- All the weight of an object seems to act through a point called the centre of mass (or centre of mass). If the centre of gravity is directly above the pivot, there is no turning force.

FLUID PRESSURE

- Gases and liquids contain atoms or molecules that collide with the surface to produce fluid pressure.
- $\text{fluid pressure (N/m}^2\text{)} = \frac{\text{force (N)}}{\text{area (m}^2\text{)}}$
- You increase gas pressure if you squash or heat a gas. The same amount of gas in a smaller volume results in more collisions between air molecules and container walls, so the pressure is higher.

ATMOSPHERIC PRESSURE

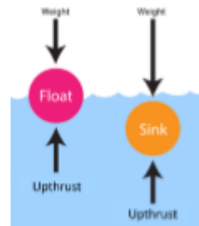
- You do not feel the pressure on your body exerted by air as it is cancelled out by the pressure of gases and liquids in your body pushing out.
- Atmospheric pressure near the ground is higher than pressure higher up. This is why mountaineers often take oxygen tanks when they climb.

STRESS: A measure of how much force is applied over a certain area.

- $\text{stress (N/m}^2\text{)} = \frac{\text{force (N)}}{\text{area (m}^2\text{)}}$
- If a force is applied over a smaller surface area (high heels/ studs on football boots) you produce a bigger stress.
- Stresses can break the surface of a material, which produces a scratch.

LIQUID PRESSURE

- Liquids are incompressible; particles are very close and there is very little space between them.
- The pressure in liquids acts in all directions.
- The pressure increases as you go deeper because the weight of the water above you gets bigger.
- Upthrust acts on any object that is floating or submerged in a liquid.
- Two factors that affect the upthrust on a floating object; area and pressure.
- **Why does a rubber duck float?** There are lots more water molecules hitting the bottom of the rubber duck than there are air molecules hitting the top. The water pressure is higher than the air pressure. This produces upthrust that keeps the duck afloat if the area is big enough. The duck floats when upthrust is the same as the weight of the duck.



KEYWORD	DEFINITION
Air resistance	The force on an object moving through air that causes it to slow down, also known as drag.
Atmospheric pressure	The pressure caused by the weight of the air above a surface/ on your body.
Centre of gravity	The point in an object where the force of gravity seems to act.
Centre of mass	The point in an object where all the mass of an object seems to act.
Compression	Force squashing or pushing together.
Contact forces	A force that acts when an object is in contact with a surface, air or water.
Deformation	Changing shape due to a force.
Elastic limit	The point beyond which a spring will not return to its original length when the force is removed.
Equilibrium	State of an object when opposing forces are balanced.
Extension	The difference between the original length of an object and the length when you apply force.
Fluid	A substance with no fixed shape (gas/liquid).
Friction	Force opposing motion which is caused by the interaction of surfaces moving over one another.
Gas pressure	The force exerted by air particles when they collide with a surface.
Hooke's Law	If you double the force on an object, the extension will double.
Law of moments	An object is in equilibrium if the clockwise moments equals the anticlockwise moments.
Linear relationship	When two variables are graphed and show a straight line which goes through the origin (proportional).
Liquid pressure	The pressure produced by collisions of particles in a liquid.
Lubrication	A substance that reduced friction between surfaces when they rub together.
Moment	A measure of the ability of a force to rotate an object about a pivot. Measured in newton metres (Nm).
Pivot	The point about which a lever or see-saw balances or rotates.
Pressure	The ratio of force to surface area, in N/m^2 , and how it causes stresses in solids.
Reaction	The support force provided by a solid surface like the floor.
Resultant force	Single force which can replace all the forces acting on an object and have the same effect.
Streamlined	Shaped to reduce resistance to motion from air or water.
Stress	The effect of a force applied to a solid.
Tension	Force extending or pulling apart.
Upthrust	The upward force that a liquid or gas exerts on a body floating in it produced by the collisions of particles in the liquid or gas.
Water resistance	The force on an object moving through water that causes it to slow down (also known as drag).

