P2 Chapter 3: Motion and pressure

Knowledge organiser

Speed

Speed is how far something moves in a certain time.

$$\text{speed (m/s)} = \frac{\text{distance travelled (m)}}{\text{time taken (s)}}$$

- Speed is measured in **metres per second (m/s)**.
- Convert distances to metres and times to seconds to calculate the answer.

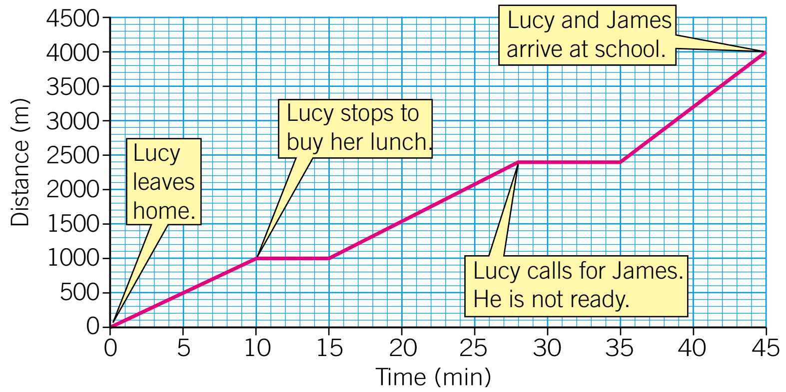
Relative motion

- Compares how fast one object is moving to another.
- If two objects are moving at the same speed in the same direction then their relative speed is zero.

Motion graphs

Distance–time graph

These graphs show the distance something travels over a certain time.



To calculate the average speed from a distance–time graph you find the distance covered, and divide it by the time taken.

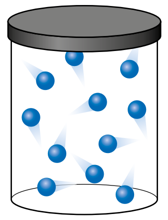
Pressure in solids

- Pressure is the force exerted on a surface because of weight, and is measured in **newtons per metre squared** or **Pascal (Pa)**. Where 1 N/m^2 = 1 Pa.
- For small areas you can use centimetres instead.
- Pressure explains why studded boots help you grip grass, or why snowshoes help you walk in snow.

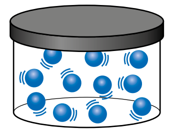
$$\text{pressure (N/m}^2) = \frac{\text{force (N)}}{\text{area (m}^2)}$$

Pressure in gases

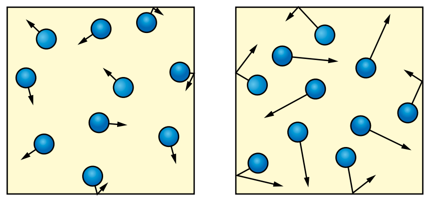
Collisions between gas particles and their container produce **gas pressure**.



If you **compress** (squash) a gas into a smaller volume there will be more collisions, and so a higher pressure.



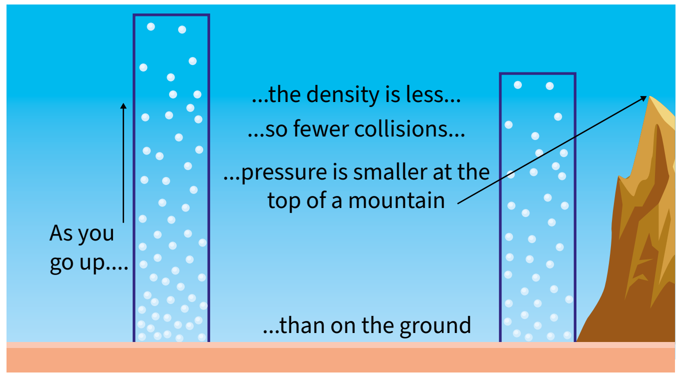
Before heating



If you heat a gas, the particles will have more energy. This means they will move more quickly and collide with the container more often, so the pressure will be greater.

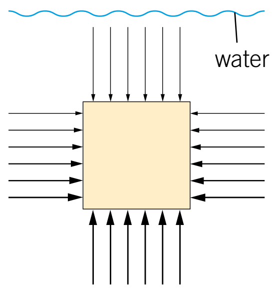
Atmospheric pressure is the pressure acting on us from the air around us.

- The higher above sea level the lower the atmosphere pressure.
- This is because the air is less dense the higher you go above sea level, so there are fewer collisions between air particles.



Pressure in liquids

- Solids and liquids are **incompressible**, because all the particles are touching already. This means they pass pressure on.
- The pressure at the bottom of a liquid is bigger than at the top, because the weight of the water pushing down increases with depth.



Objects float because of **upthrust**. Liquid pressure produces this upthrust. In the example, the object floats because the upthrust acting on the bottom of it is stronger than the forces acting on the top.

Turning forces

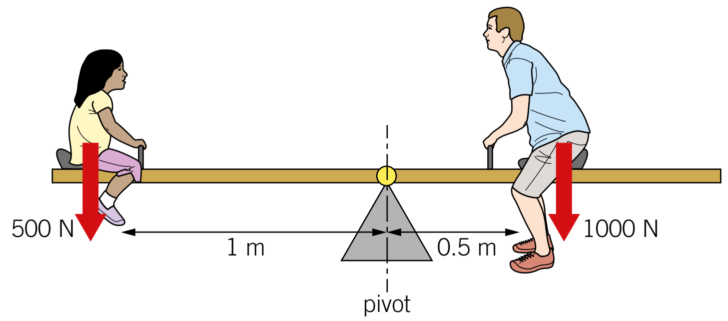
- **Moments** are the turning effect of a force.
- The unit for the moment is **newton metres (Nm)**.

moment (Nm) = force (N) × perpendicular distance from the pivot (m)

- To calculate the moment you multiply the force applied by the distance from the **pivot**.
- The bigger the force, or the further the distance, the bigger the moment.

The law of moments

When the forces are balanced, all the clockwise moments added together must equal all of the anticlockwise moments added together.



clockwise moment = force × distance on the right
= 1000 N × 0.5 m
= 500 Nm

anticlockwise moment = force × distance on the left
= 500 N × 1 m
= 500N m

The moments in the example above are the same. This is how see-saws balance. All the weight of an object seems to act through a point called the **centre of gravity** (or **centre of mass**). If the centre of gravity is above the pivot there is no turning force.

Key words

Make sure you can write definitions for these key terms.

atmospheric pressure · centre of gravity · centre of mass · compress · distance–time graph · gas pressure · incompressible · law of moments · liquid pressure · moment · motion · newton metres · newtons per metre square · pressure · pivot · speed