P1.7 Pressure

Pressure and how it varies with force and area

Pressure tells us how much force is applied on a certain area.

Formula: $p = \frac{F}{A}$ where p = pressure (in pascals, Pa), F = force (in newtons, N), and A = area (in square metres, m^2). 1 Pa = 1 N/m^2

Key ideas

If you increase the force, pressure increases. If you increase the area, pressure decreases. Pressure increases with greater force or smaller area.

Everyday examples

- High-heeled shoes vs flat shoes – High heels have a small area at the heel, so the same force (your weight) produces a much larger pressure. That is why high heels can damage wooden floors.

- Snowshoes vs normal shoes – Snowshoes spread your weight over a large area, reducing pressure, so you don't sink into the snow.

- Knife edge – A sharp knife has a very small surface area at the edge. For the same force, this creates a high pressure and makes cutting easier.

Example Calculations

$$p = \frac{F}{A}$$

Standing on one foot. A person weighs 600 N. Area of one foot = 0.03 m^2.

P = F/A = 600 / 0.03 = 20,000 Pa. Standing on one foot doubles the pressure compared to standing on two.

Drawing pin. Force pushing the pin = 20 N. Area of pin tip = 0.001 m^2.

P = F/A = 20 / 0.001 = 20,000 Pa. Small area makes pressure very large, so the pin goes into wood easily.

Box on the floor. A box weighs 200 N. Base area of box = 0.5 m^2.

P = F/A = 200 / 0.5 = 400 Pa. If the box is turned on its side with an area of 0.2 m^2, pressure increases to P = 200/0.2 = 1000 Pa.