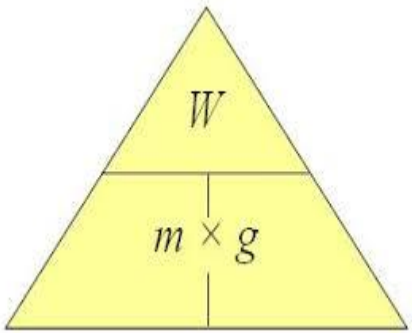
# Physics topic 5a: Forces

| 1. Forces keywords | |
|---|---|
| Force | Something that makes a change happen |
| Magnitude | The size of a measurement |
| Scalar | Things that have magnitude but not direct |
| Vector | Things that have a magnitude and a direction. Forces are always vectors |
| Contact force | Can only act when two things touch |
| Non-contact force | Can act on things not touching |
| Balanced (forces) | When forces are equal and opposite each other also called **equilibrium** |
| Unbalanced (forces) | When opposing forces are not equal to each other |
| Resultant (force) | The overall force once all the forces are considered |
| Force arrows | Show direction and size of a force |
| Newton | The unit of force |
| Newton meter | A spring calibrated so it has a scale to measure force |
| Centre of mass | A point in the middle of an object where all its mass acts |
| Elastic | A material that returns to its original shape after being deformed |
| Plastic | A material that does NOT return to its original shape after being deformed |
| Equilibrium | Forces in a system are balanced. |

| 2. Types of force | | | |
|---|---|---|---|
| **Force** | **Between** | **Contact or non-contact** | **Example** |
| Friction | Two moving surfaces | Contact | Brakes |
| Upthrust | An object and water | Contact | Boat |
| Reaction | Two stationary objects | Contact | Book on shelf |
| Air resistance | A moving object and air | Contact | Plane |
| Gravity | Two masses | Non-contact | You and the earth |
| Tension | Two ends of an elastic material | Contact | Spring |
| Magnetic | Magnets and magnetic materials | Non-contact | Magnet picking up a nail |
| Electrostatic | 2 charged particles | Non-contact | Proton attracting an electron |

| 3. Calculating weight | | |
|---|---|---|
| **Symbol** | **Name** | **Calculated by..** |
| W | Weight (N) | = Mass x Gravity |
| m | Mass (kg) | = Weight ÷ Gravity |
| g | Gravitational field strength | = Weight ÷ mass |
| On Earth g = 10 N/kg | | |



## 4. Calculating work

| Symbol | Name | Calculated by.. |
|---|---|---|
| W | Work (J) | = Force x Distance |
| F | Force (N) | = Work ÷ Distance |
| s | Distance (m) | = Work ÷ Force |

$$W = Fs$$

## 5. Hooke's law

| Symbol | Name | Calculated by.. |
|---|---|---|
| F | Force (N) | = Spring constant x Extension |
| k | Spring constant (N/m) | = Force ÷ Extension |
| e | Extension (m) | = Force ÷ Spring constant |

$$F = ke$$

## 6. Energy stored in a spring

| Symbol | Name | Calculated by.. |
|---|---|---|
| Ep | Elastic potential energy stored (J) | $Ep = \frac{1}{2}ke^2$ |
| $\frac{1}{2}$ | Half (0.5) | N/A |
| k | Spring constant (N/m) | $k = \frac{2\,Ep}{e^2}$ |
| e | Extension (m) | $e = \sqrt{\frac{2\,Ep}{k}}$ |

$$Ep = \frac{1}{2}ke^2$$

To calculate extension:

1. Measure the original length of the object
2. Measure the stretched length of the object
3. Extension = stretched length – original length

## 7. Moments:

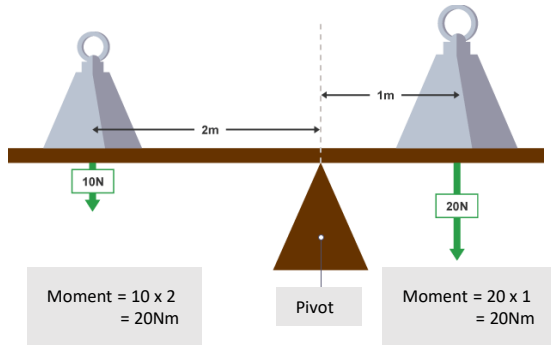
1.To calculate a moment you need to know:

- How much force is being applied (Newtons, N)
- The distance from the pivot that the force is being applied (Meters, m)

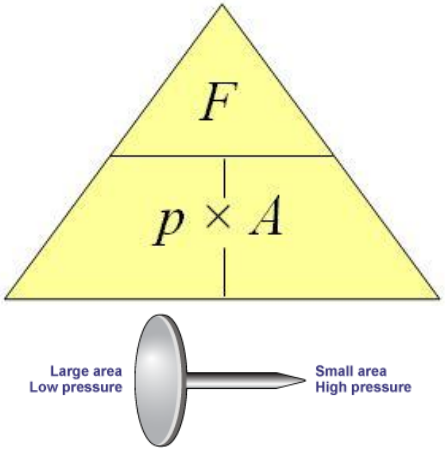
Moment = force x distance

2.The unit for moment is newton metre (Nm)

3.A small force over a large distance can generate the same moment as a large force over a small distance.



| 8. Calculating pressure | | |
|---|---|---|
| **Symbol** | **Name** | **Calculated by..** |
| F | Force (N) | = pressure x area |
| p | Pressure (Pa = n/m$^2$) | = force ÷ area |
| A | Area (m$^2$) | = force ÷ pressure |




| 9. Calculating pressure in column of liquid (HT ONLY) | | |
|---|---|---|
| **Symbol** | **Name** | **Calculated by..** |
| g | Gravitational field strength (10 N/Kg) | $g = \frac{p}{h\rho}$ |
| p | Pressure (Pa = N/m$^2$) | $p = h\rho g$ |
| h | Height (m) | $h = \frac{p}{g\rho}$ |
| ρ | Density (kg/m$^3$) | $\rho = \frac{p}{gh}$ |
| $p = h\rho g$ | | |