Forces in Balance:

Vectors & Scalars:

- Scalar quantities have **magnitude** (size) but no direction. Examples include distance, speed, time, mass, energy and power

- Vector quantities have magnitude and direction. Examples include displacement, velocity, force, weight and momentum

- Vectors may be represented by a diagram. An arrow is drawn in the direction of the vector and with length in proportion to the magnitude of the vector

Forces between objects:

- A force is a push or pull that acts on an object due to its interaction with another object. Forces are measured in newtons (N)

- A force can change the shape of an object, start or stop it moving, or change its direction

- If two objects must touch eachother to interct, it is called a contact force. Example: friction and air resistance

Newton's third law of motion:

- States that when two objects interact with eachohter, they exert equal and opposite forces on eachother
- These force pairs are sometimes called 'action and reaction' forces.
- The two forces are always of the same type (e.g.: both frictional forces) and each force always acts on different object from its partner.
- For example, if a car hits a barrier, it exerts a force on the barrier. The barrier exerts a force on the car that is equal in size and in the opposite direction

Resultant forces:

- Most objects have more than one force acting on them. The resultant force on an object is the single force that has the same effect as all the forces acting on the object

- When the resultant force on an object is not zero, the forces acting on the object are not balanced. The movement of the object depends on the size and direction of the resultant force

If two forces act on an object along the same line of motion, the resultant force will be:

- The difference between the forces (if they act in opposite directions) and the direction of the larger force

- The sum of the forces (if they act in the same direction) and in the same direction as both forces

Newton's first law of motion:

States that if the forces acting on an object are balanced, the resultant force on the object is zero and:

- If the object is at rest, it will stay at rest
- If the object is moving, it will carry on moving at the same speed and in the same direction

Moments

- The turning effect of a force is called its moment
- The size of the moment is given by the equation:

$$M = F\,d$$

This is when:

- moment (M) is measured in newton-metres (Nm)
- force (F) is measured in newtons (N)
- distance (d) is measured in metres (m)

Moments

You can increase the size of the moment by:

- Increasing the magnitude of the force
- Increasing the perpendicular distance from the line of the force to the pivot

Levers

- A lever can be used to increase the size of a force acting on an object or to make the object turn more easily

- When you use a lever, the force you apply to the lever is further away from the pivot, and smaller in size, than the fprce that the lever applies on the object. The lever is then called a force multiplier

Gears

- Gears are like levers because they can multiply the effect of a turning force:

- A lower gear gives low speed and a high turning effect

- A high gear gives high speed and a low turning effect

Centre of mass:

- Although any object is made up of many particles, its mass can be thought of as being concentrated at one single point. This point is called the centre of mass

- Any object that s freely suspended will come to rest with its centre of mass directly below the point of suspension. The object is then in equilibrium

- For a flat object that is symmetrical, its centre of mass lies along the axis of symmetry

- The wider the base of an object and the lower its centre of mass, the more stable it is

Principle of moments:

- If an object is in equilibrium it is balanced, not turning.
- We can take the moments about any point and will find that the total clockwise moment and the total anticlockwise moment about that point are equal.

Total clockwise moment = total anticlockwise moment (of the same point)