Physics Section 3.2: Using Physics to Make Things Work

Centre of Mass and Pendulums

- That the centre of mass of an object is the point at which all of its mass can be thought to be concentrated.
- That if you freely suspend an object from a pivot, it will eventually come to rest with its centre of mass vertically below the pivot.
- How to find the centre of mass of any flat object.
- That the centre of mass of a symmetrical object is where the object's axes of symmetry cross.
- How to use the formula shown below to calculate the time period and frequency of a simple pendulum.

$$T = \frac{1}{f}$$

- That the time period of a pendulum depends on its length.
- That some simple fairground and playground rides are pendulums.

Moments and Turning Effects

- That the turning effect of a force is known as the moment of the force.
- How to calculate the moment of a force around a pivot using the formula M = F × d, where M is the moment of the force, F is the size of the force and d is the perpendicular distance from the line of action of the force to the pivot.
- That levers can act as force multipliers by increasing the perpendicular distance from the pivot to the line of action of the force.

Balanced Moments and Stability

- That an object won't turn if the clockwise moments acting about any pivot on the object equal the anticlockwise moments.
- H How to find a missing force or distance in a situation where balanced moments are acting on an object, by setting the anticlockwise moments equal to the clockwise moments and rearranging.
- That if an object has a wide base and low centre of mass it is more stable than a similar object with a narrower base and/or a higher centre of mass.
- H That if the line of action of an object's weight lies outside of the object's base, there will be a resultant moment that will cause the object to topple.
- H How the line of action of an object's weight plays a role in the design of certain objects, such as vehicles and balancing toys.

Hydraulics

- That it's almost impossible to compress a liquid.
- That a force is transmitted to all points in a liquid, regardless of where the force is applied.
- That if a pressure is applied to any point in a liquid, the pressure will be transmitted through the liquid equally in all directions.
- How to calculate the pressure caused by a force applied to a given area using the formula:

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

- That liquids can be used as force multipliers in hydraulic systems by using pistons with different cross-sectional areas.

Circular Motion

- That for an object moving in a circle, the object is constantly accelerating towards the centre of the circle it's moving in.
- That the acceleration of an object moving in a circle is due to the object's direction changing, not its speed.
- That a centripetal force provides the acceleration in circular motion, and it always acts towards the centre of the circle.
- How to identify what's providing the centripetal force in a given situation where an object is moving in a circle.
- That the faster an object is moving, the bigger the centripetal force needed to keep it moving in a circle.
- That the larger the mass of an object, the bigger the centripetal force needed to keep it moving in a circle.
- That the smaller the radius of the circle an object's moving in, the bigger the centripetal force needed to keep it moving in a circle.