Energy | Revision Booklet

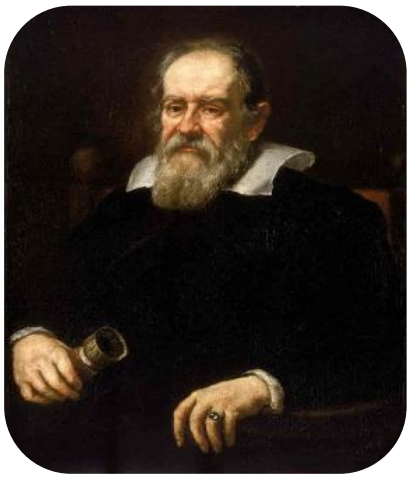
Work

What is work?

- Work is done when a force moves an object

What is the S.I. unit of work?

- Joules (J)



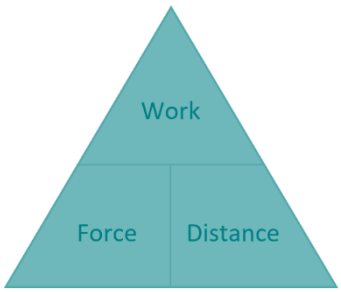
Who is James Joule?

- English physicist
- Discovered the fact that various forms of energy (mechanical, electrical and thermal) are the same and be can be changed from one into another

Formula

How do we calculate work?

formula: work (J) =
force (N) x distance (m)



Work Calculations

Example 1

How much work is done when a man pushes a lawnmower a distance of 20m with a force of 50N.

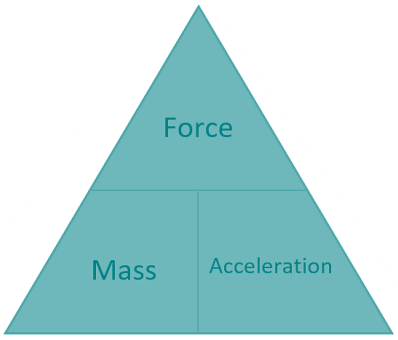
Solution

Work (J) = force (N) x distance (m)

Work (J) = 50N x 20m

Work (J) = 1000J

Formula



Example 2

A child goes down the slide that is 3m high. If her mass is 40 kg, calculate how much work is done? (acceleration of gravity = 9.8m/s^2).

Solution

Force (N) = mass (kg) x acceleration (m/s^2)

Force (N) = 40kg x 9.8m/s^2

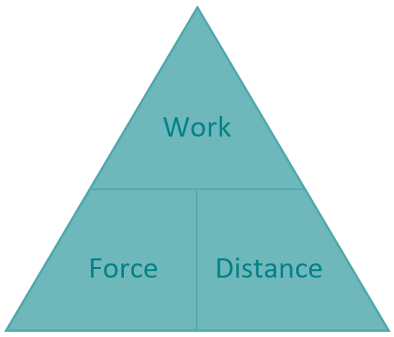
Force (N) = 392N

Work (J) = force (N) x distance (m)

Work (J) = 392N x 3m

Work (J) = 1,176J

Formula



Energy

What is energy?

→ The ability to do work

What is the S.I. unit of velocity?

→ Joules (J)

Explanation

The energy something has depends on whether it is **ABLE** to do work rather than if it **DOES** work. For example, having money is like energy, but spending money is like doing work. Having a car is like energy, but driving a car is like doing work. What matters for energy is how much something **COULD** do, not how much work it does. Energy can exist in many forms.

Types of Energy

1. Kinetic
2. Thermal
3. Light
4. Sound
5. Electrical
6. Chemical
7. Nuclear
8. Potential
   - → Gravitational
   - → Elastic

Kinetic Energy

- The energy of a moving object
- It depends on the mass and the speed of the object

Thermal Energy

Heat is energy that causes the temperature to rise when it is added.

Solids, liquids and gases **expand** (get bigger) when heated and gases **contract** (get smaller) when cooled.

- **Telegraph wires** and **power lines** hang lower in the summer than in the winter
- **Train tracks, bridges** and **concrete roads** must be built with expansion joints

Light Energy

Light from the sun provides energy for ...

- **Plants** to grow and make food
- Us to **heat water** in our homes (solar panels)

Sound Energy

Caused by **vibrations** that pass through the air to your ear

Electrical Energy

Caused by **moving electrons**

The faster the electrons move, the more energy they carry

As the electron are moving, they are a form of kinetic energy

Examples:

- Lightning
- Batteries
- Eels

Chemical Energy

Stored in the **bonds between atoms**

Nuclear Energy

Released when the nucleus of atom splits **(fission)** or when the nuclei of atoms join **(fusion)**

Potential Energy

The energy due to something's position or condition

→ **Gravitational Energy**

stored when something is raised at a height

→ **Elastic Energy**

stored in objects that can be stretched or squashed

Principle of Conservation of Energy

Energy cannot be created or destroyed; it can only be changed from one form to another.

Energy conversion taking place in a …

→ **Coal fire** – chemical energy → thermal energy / light energy
→ **Falling apple** – potential energy → kinetic energy
→ **T.V.** – electrical energy → sound energy / light energy
→ **Car** – chemical energy → electrical energy / kinetic energy

Dissipation

The loss of energy to less useful forms

Examples:

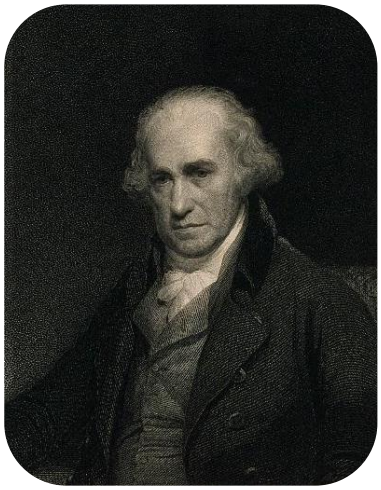
- Radio producing thermal energy in addition to sound energy
- Dryer producing sound energy in addition to heat energy

Power

What is power?

- Power tells us how much energy is being changed from one form to another in each second

Who is James Watt?



- English physicist, mathematician and philosopher
- Studied at Cambridge where he earned a professorship
- Introduced the three laws of motion
- Introduced the idea of gravity

What is the S.I. unit of work?

- Watt (W)

How do we calculate power?

- formula: power

$$\text{(W)} = \frac{work\ done\ (J)}{time\ (s)}$$

Power Calculations

Example 1

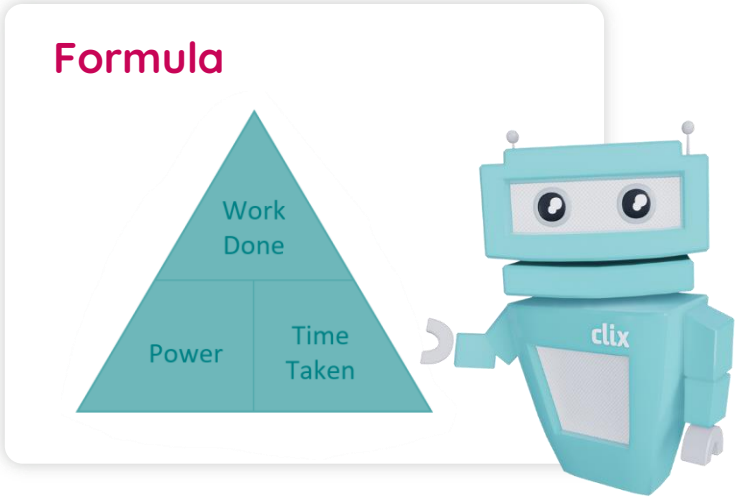
A cyclist takes 20s to cycle along a road. If she needs to do 500J of work to manage this, what is the average power developed?

Solution

Power (W) = $\frac{Work\ Done\ (J)}{Time\ Taken\ (s)}$

Power (W) = $\frac{500J}{20s}$

Power (W) = 25W



Example 2

An elevator lifts a weight 2000N through a height of 10m in 5s. What is the power of the elevator?

Solution

Work (J) = Force (N) x Distance (m)

Work (J) = 2000N x 10m

Work (J) = 20,000J

Power (W) = $\frac{Work\ Done\ (J)}{Time\ Taken\ (s)}$

Power (W) = $\frac{20{,}000J}{5s}$

Power (W) = 4,000W

Example 3

A boy of mass 60kg walks vertically up a 5m ladder in 3s. Calculate the power of the boy. (acceleration of gravity = 9.8m/s^2).

Solution

Weight (N) = Mass (kg) x Acceleration (m/s^2)

Weight (N) = 60kg x 9.8m/s^2

Weight (N) = 588N

Work (J) = Force (N) x Distance (m)

Work (J) = 588N x 5m

Work (J) = 2,940J

$$\text{Power (W)} = \frac{Work\ Done\ (J)}{Time\ Taken\ (s)}$$

$$\text{Power (W)} = \frac{2{,}940J}{3s}$$

Power (W) = 980W