Types of Energy

I hope you're feeling lively, because this section is all about energy...

There are **Different forms** of **Energy**

Objects can have different types of energy — the following types of energy can be stored by objects.

1) Kinetic ..... anything moving has kinetic energy.
2) Internal ..... any object — the hotter it is, the more internal energy it has (see p.51).
3) Chemical ..... anything that can release energy in a chemical reaction, e.g. food, fuel.
4) Gravitational Potential ..... anything that will fall (or would if it wasn't supported) has gravitational potential energy.
5) Elastic (or strain) ..... anything stretched, like springs and rubber bands.
6) Nuclear ..... atomic nuclei have nuclear energy that is released in nuclear reactions.

Energy can be **Transferred** in **Different Ways**

1) Energy can be transferred between objects and transferred from one type of energy to another.
2) Energy can be transferred in four main ways:

Mechanical working — an object moving or changing shape due to a force acting on it, e.g. pushing, pulling, stretching or squashing.

Electrical working — by an electric current flowing (see page 103).

By waves — energy transferred by waves (like light, see page 87, or sound), e.g. energy from the Sun reaching Earth as light.

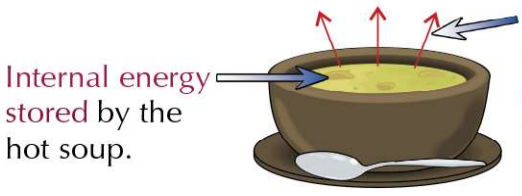
By heating (see p.62) — energy transferred from a hotter object to a colder object, e.g. heating a pan of water on a hob.

3) Some types of energy cannot be stored, they are energy transfers (i.e. these types of energy are always moving from one place to another). These types of energy are:

1) Electrical energy — this is the type of energy carried by an electric current in a circuit.
2) Sound energy — this is the type of energy carried by sound waves.
3) Light energy — this is the type of energy carried by light waves.
4) Thermal (heat) energy — this is the type of energy transferred between objects by heating.

Thermal Energy and **Internal Energy** are **Different** Things

1) Don't get thermal energy confused with internal energy.
2) Internal energy is the type of energy a hot object has stored in it. Thermal energy is the energy transferred by heating, e.g. from a hot object to its surroundings.



REVISION TIP

No matter what type it is, it's all energy...

There are a lot of types of energy to remember. Cover this page and keep scribbling down the energy types and whether they're an energy store or an energy transfer until you know them all. Then you can move on to calculating the kinetic or gravitational potential energy an object has...

Kinetic and Gravitational Potential Energy

Time to focus on two of the most common energy types — kinetic energy and gravitational potential energy.

Movement Means an Object has Kinetic Energy

1) Anything that is moving has kinetic energy.
2) The kinetic energy of an object depends on the object's mass and speed. The greater its mass and the faster it's going, the more kinetic energy it has.
3) There's a formula for the amount of kinetic energy an object has:

Energy is measured in joules (J).

$$\text{kinetic energy} = \tfrac{1}{2}mv^2$$

Joules (J) — kinetic energy — $(\text{Speed})^2$ $(\text{m/s})^2$; Mass (kg)

$\frac{1}{2}mv^2$ means $\frac{1}{2} \times m \times v^2$.

Supplement

EXAMPLE: **A car with a mass of 2500 kg is travelling at 20 m/s. Calculate its kinetic energy.**

$\text{kinetic energy} = \frac{1}{2}mv^2 = \frac{1}{2} \times 2500 \times 20^2 = 500\,000$ J

Supplement

Raised Objects Have Gravitational Potential Energy

1) Lifting an object in a gravitational field (p.5) causes gravitational potential energy to be transferred to the object. The higher the object is from the ground, the more gravitational potential energy it has.
2) The gravitational potential energy of an object depends on the object's mass, its height and the strength of the gravitational field the object is in.
3) You can use this equation to find the change in an object's gravitational potential energy when its height above the ground changes.

Supplement

The 'Δ' symbol means 'change in'. It's the Greek letter delta.

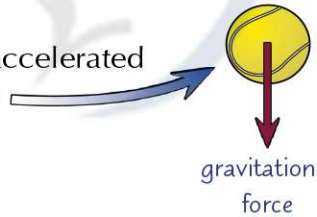
$$\text{change in gravitational potential energy} = mg\Delta h$$

Joules (J) — Mass (kg) — Change in height (m) — Gravitational field strength (N/kg); $g = 10$ N/kg on Earth

Supplement

Falling Objects Transfer Energy

1) When something, e.g. a ball, is dropped from a height, it's accelerated by gravity. The gravitational force causes an energy transfer.



Gravity is doing mechanical work on the ball, see p.26.

2) As it falls, some of the object's gravitational potential energy is transferred to kinetic energy.
3) If there is no air resistance, then:

Gravitational potential energy lost = Kinetic energy gained

This is an example of the conservation of energy principle (p.28) in action.

4) In real life, air resistance (p.12) acts on almost all falling objects. It causes some of the object's gravitational potential energy and kinetic energy to be transferred to other energy types, e.g. the internal energy of the object, or transferred as thermal energy to the surroundings.

REVISION TIP

You need to learn the equations for KE and GPE...

It might help to think of the delta symbol as being a hill. Climbing up a hill would increase your gravitational potential energy, so the equation with a Δ gives you gravitational potential energy.

Conservation of Energy and Energy Transfers

More! More! Tell me more about energy transfers please! OK, since you insist:

There is a **Principle of Conservation of Energy**

There are plenty of different types of energy, but energy always obeys the principle below:

KEY TERM

The Principle of Conservation of Energy states that energy can be stored, transferred from one type to another, or dissipated — but it can never be created or destroyed.

Dissipated is a way of saying that the energy is spread out and lost to the surroundings.

In other words, when an energy transfer takes place, the same amount of energy comes out as was put in.

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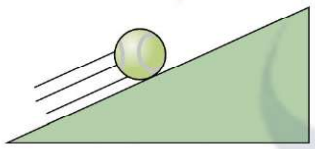
However, not all of the energy will be transferred usefully. Whenever something happens that causes energy to be transferred, some energy tends to be wasted. This often involves energy being transferred to the internal energy of the objects and dissipated as thermal energy to the surroundings.

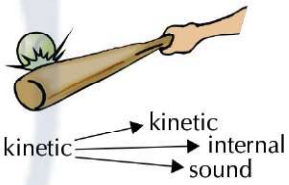
You Need to be Able to **Describe Energy Transfers**

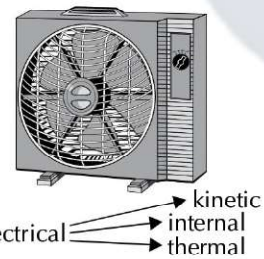
Here are some examples of energy transfers in every day situations:



A BALL ROLLING UP A SLOPE:
The ball's kinetic energy is transferred mechanically to gravitational potential energy by the force of gravity. Some energy is also transferred mechanically to the internal energy of the ball and the slope (due to friction). The total gravitational potential and internal energy gained by the ball and slope equals the kinetic energy lost by the ball.

A BAT HITTING A BALL:
Some of the bat's kinetic energy is transferred mechanically to the kinetic energy of the ball. The rest of the energy is wasted. Some of the bat's kinetic energy is transferred mechanically to the internal energy of the bat and the ball. The remaining energy is carried away by sound waves as sound energy.

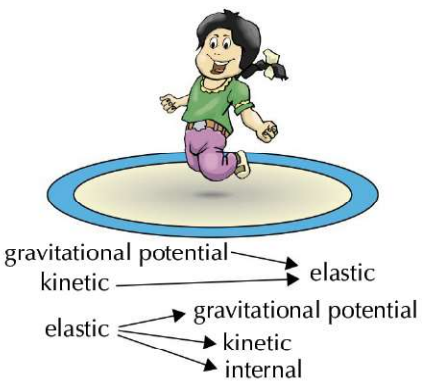




AN ELECTRIC FAN:
Electrical energy from the mains supply is transferred by the electric current into kinetic energy of the fan's blades. Some energy is also wasted, as it is transferred to the internal energy of the motor and electrical circuit in the fan, as well as to the surroundings by heating as thermal energy.

Supplement

A CHILD BOUNCING ON A TRAMPOLINE:
As the child falls towards the trampoline, she has kinetic and gravitational potential energy (p.27). As the child lands on the trampoline, the trampoline material stretches down and decreases her speed until she stops. Kinetic and gravitational potential energy is transferred mechanically from the child to the trampoline as elastic energy. As the child bounces back up, that elastic energy is then transferred mechanically to child as kinetic and gravitational potential energy. Some energy is also mechanically transferred to the trampoline as internal energy.



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