Energy Stores

Energy stores are different ways of storing energy. Simple really...

Energy is Transferred Between Energy Stores

Energy can be transferred between and held in different energy stores. There are eight you need to know:

1) KINETIC..... — anything moving has energy in its kinetic energy store (see below).
2) THERMAL..... — any object — the hotter it is, the more energy it has in this store.
3) CHEMICAL..... — anything that can release energy by a chemical reaction, e.g. food, fuels.
4) GRAVITATIONAL POTENTIAL... — anything in a gravitational field (i.e. anything that can fall) (see below).
5) ELASTIC POTENTIAL..... — anything stretched, like springs, rubber bands, etc. (p.206).
6) ELECTROSTATIC..... — e.g. two charges that attract or repel each other.
7) MAGNETIC..... — e.g. two magnets that attract or repel each other.
8) NUCLEAR..... — atomic nuclei release energy from this store in nuclear reactions.

A Moving Object has Energy in its Kinetic Energy Store

1) When an object is moving, it has energy in its kinetic energy store.
2) Energy is transferred to this store if an object speeds up and away from this store if it slows down.
3) How much energy is in this store depends on both the object's mass and its speed.
4) The greater its mass and the faster it's going, the more energy it has in its kinetic energy store.
5) For example, a high-speed train will have a lot more energy in its kinetic energy store than you running.
6) You can find the energy in a kinetic energy store using:

$$\text{kinetic energy (J)} = 0.5 \times \text{mass (kg)} \times (\text{speed (m/s)})^2$$

or

$$KE = \tfrac{1}{2} \times m \times v^2$$

7) If you double the mass, the energy in the kinetic energy store doubles.
If you double the speed, though, the energy in the kinetic energy store quadruples (increases by a factor of 4) — it's because of the '(speed)^2' in the formula.

EXAMPLE: A car of mass 1450 kg is travelling at 28 m/s. Calculate the energy in its kinetic energy store, giving your answer to 2 s.f.

kinetic energy = 0.5 × mass × (speed)^2
= 0.5 × 1450 × 28^2 = 568 400 = 570 000 J (to 2 s.f.)

Watch out for the (speed)^2 — that's where people tend to make mistakes and lose marks.

An Object at a Height has Energy in its Gravitational Potential Energy Store

1) When an object is at any height above the Earth's surface, it will have energy in its gravitational potential energy store.
2) You can calculate the change in energy in the gravitational potential energy store using the equation:

$$\Delta GPE = m \times g \times \Delta h$$

Change in gravitational potential energy (J) — Change in vertical height (m)
Mass (kg) — Gravitational field strength (N/kg)

Δ just means 'change in'.

There's potential for a joke here somewhere...

Hopefully this page wasn't too hard — just don't forget that squared sign when you're working and remember that the energy in an object's kinetic energy store only changes if its speed is changing. Now have a crack at this...

Q1 A 2 kg object is dropped from a height of 10 m. Calculate the speed of the object after it has fallen 5 m, assuming there is no air resistance. g = 10 N/kg. [5 marks]

Energy Stores

Warm-Up

Match each of the following energy stores to the object which mainly has energy in that store.

Kinetic energy store	**A nucleus about to undergo a nuclear reaction**
Magnetic energy store	**A stretched rubber band**
Electrostatic energy store	**A hot potato**
Chemical energy store	**A person on top of a mountain**
Elastic potential energy store	**A toy car rolling along the ground**
Nuclear energy store	**Two magnets attracted to each other**
Thermal energy store	**Petrol in a car**
Gravitational potential energy store	**Two electric charges repelling each other**

1 A 0.1 kg toy contains a compressed spring. When the spring is released, the toy flies 0.5 m upwards from ground level.

Calculate the change in energy stored in the toy's gravitational potential energy store when it reaches its highest point. The gravitational field strength of Earth is 10 N/kg. Use the equation:

$$\text{change in gravitational potential energy} = \text{mass} \times \text{gravitational field strength} \times \text{change in vertical height}$$

Energy = ... J

[Total 2 marks]

2 A 0.50 kg rock is dropped from a cliff edge. It falls 42 m before entering the sea.

a) State the equation that links the energy in an object's kinetic energy store, its mass and its speed.

.....

[1]

b) Calculate the speed of the rock when it hits the water.
You can assume there is no air resistance and that all of the energy transferred from the rock's gravitational potential energy store is transferred to its kinetic energy store.
Gravitational field strength = 10 N/kg.

Speed = ... m/s

[5]

[Total 6 marks]