PiXL KnowIT!

GCSE Physics

AQA Topic – Energy

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Overview
Energy

Energy changes and energy stores

- Energy stores and systems
- Changes in energy
- Energy changes in systems
- Power

Conservation and dissipation of energy

- Energy transfers in a system
- Efficiency

Energy resources

- Renewable and non renewable energy resources
- Environmental impact of energy resources
- Patterns and trends in the use of energy resources

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Energy changes and energy stores
Part 1

- Energy stores and systems
- Changes in energy

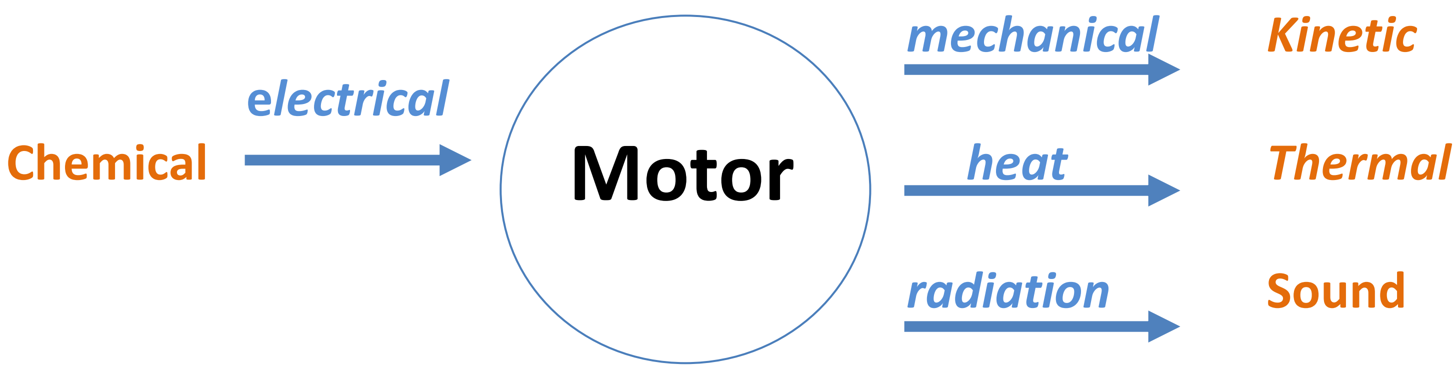
Energy stores and systems

An energy system is a group of objects that have the ability to do work.

Remember: energy can not be created or destroyed so when work is done, energy from one store is carried along a pathway to another energy store.

Consider the energy flow diagram for an electric shaver.

The battery has a store of chemical energy.
The current flows through an electrical pathway to the motor.
Energy from the motor follows a mechanical pathway to a kinetic store of the moving blades, a heat pathway to a thermal store and a radiation pathway to a sound store.



Energy stores and systems

Energy stores	Examples
Chemical	In food, fuel and electric batteries
Kinetic	In moving objects
Gravitational potential	In objects raised above a planets surface
Elastic potential	In a stretched, compressed or twisted object
Internal (thermal)	In any heated object
Magnetic	In any object with a magnetic field
Electrostatic	In electrostatic forces between charges
Nuclear	The forces acting between atomic nuclei

Force pathways include:

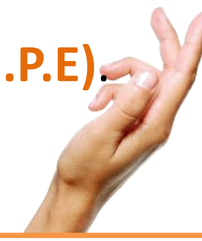
- Mechanically – when a force acts and an object moves
- Electrically – when an electric current flows
- Heating – a temperature difference between objects
- Radiation – electromagnetic waves or sound

Energy stores and systems

Examples of energy changes in a system:

An object thrown (projected) upwards e.g. You throw a tennis ball upwards.

- As the **ball leaves** your **hand** it has a **store** of **kinetic energy**.
- At its **highest point** it has a **store** of **gravitational potential energy (G.P.E)**.
- As you are about to catch it just **before it hits your hand** it has a **store** of **kinetic energy.**



A moving object hitting an obstacle e.g. A bowling ball hitting a pin

- As you move the muscles of your arm to throw the ball the **chemical energy store** in your muscles **decreases** and the **kinetic energy store** of the bowling ball **increases**.
- At the ball hits a pin some of the **kinetic energy** has been transferred to a **store** of **internal (thermal) energy** this causes the ball and its surroundings to warm up a little.
- You will hear a **sound** when the ball hits the pin, the **energy of the sound** is also transferred to the **internal energy store** of the **surroundings**.

Energy stores and systems

Examples of energy changes in a system:

A vehicle slowing down e.g. When you apply the brakes in a lorry

- The **moving** lorry has a **store** of **kinetic energy**.
- At the **brakes** are applied the **kinetic energy store decreases** the energy is transferred to the **internal (thermal) energy store** in the brakes and the brakes get hot.
- You will hear a **sound** when the brakes of the lorry are applied, the **energy of the sound** is also transferred to the **internal energy store** of the **surroundings**.
- When the lorry **stops** its **kinetic energy store** is **zero**.

Bringing water to a boil on a camping stove.

- As the fuel burns the **chemical energy store** in the fuel **decreases** and the **internal (thermal) energy store** of the water **increases.**
- The temperature of the water increases and as bubbles form the **kinetic energy store** of the water increases.

Energy is measured in Joules (J)

1 kilojoule (kJ) = 1000 J (10^3J) **1 megajoule = 1000 000 J (10^6J)**

Energy stores and systems

Energy change – mechanical work is the amount of energy transferred by a force

When a pushback truck is used to move an aircraft, it does work.

Work (J) = Force (N) x Distance (along the line of the force) (m).

$$W = F\,s$$

If the aircraft has a mass of 30 000kg and it is moved a distance of 20m, calculate the work done by the pushback truck.

Force (weight) = mass x gravitational field strength

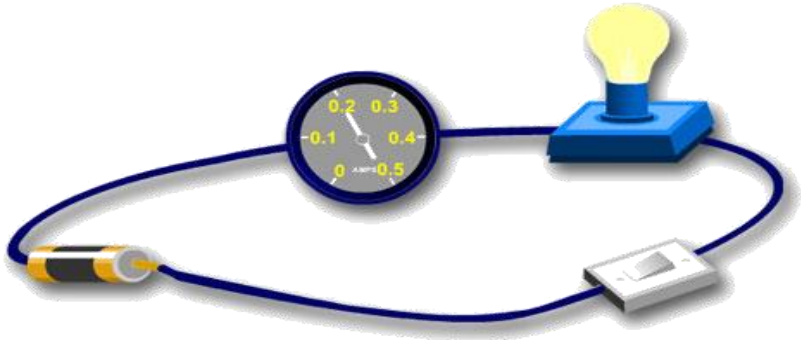
Force = 30 000 x 10 = 300 000 N

$$W = F\,s$$

Work = 300 000 x 20 = 6 000 000 J (6 MJ)

Energy stores and systems

Energy change – Electrical work is done when charge flows in a circuit is the amount of energy transferred.



When a current flows through a circuit, work is done (energy is transferred) and the energy store changes.

Energy transferred (Work) (J) = Charge flow (Q) x Potential difference (V)

$$E = Q\,V$$

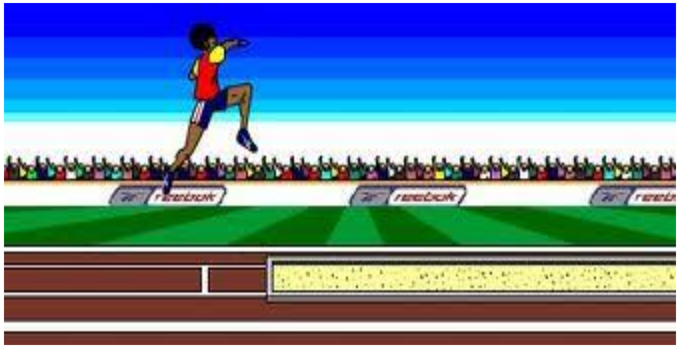
In one minute, 30 Coulombs of charge flows through the bulb when a potential difference of 3 V is placed across it. Calculate the work done (energy transferred).

$$E = Q\,V$$

$$E = 3 \times 30$$

Energy transferred (Work) = 90 J

Changes in Energy - Kinetic Energy



Moving objects have kinetic energy.

The long-jumper is using her **kinetic energy** to carry her body as far as possible. The more kinetic energy she has, the longer her jump will be. Her kinetic energy depends on her mass (which she can not change) and her velocity (she can run faster!).

The kinetic energy of a moving object can be calculated using the equation:

Kinetic energy (J) = 0.5 × Mass (kg)× Speed² (m/s)

$$E_k = \frac{1}{2} m v^2$$

If her mass is 46 kg and she is travelling at 8 m/s, her kinetic energy during her jump will be:

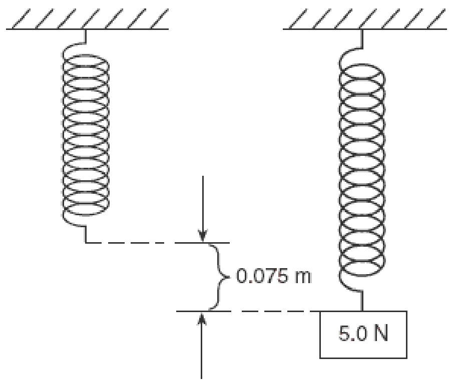
$$E_k = \frac{1}{2} m v^2$$

$$E_k = \frac{1}{2} \times 46 \times 8^2$$

The energy transferred in the jump is: E_k = 1472 J

Changes in Energy - Elastic Energy

Stretched or bent objects have **elastic energy (E_e)** if they have the ability to **recover** to their original shape and dimensions.



When a weight (force) is added to a spring it extends (gets longer).
The spring now has a store of elastic potential energy which will be released if the weight is removed.

The amount of stored elastic energy (E_e) can be calculated using the following equation:

Elastic potential energy (J) = 0.5 × Spring constant (N/m) × Extension^2 (m)

$$E_e = \frac{1}{2} k e^2$$

In the above example the spring has a spring constant of 670 N/m. The elastic potential energy of the spring when a 50 N load is hung from it is:

$$E_e = \frac{1}{2} k e^2$$

$$E_e = 0.5 \times 670 \times 0.075^2$$

The elastic energy stored in the spring is: **E_e = 1.88 J**

Changes in Energy – Gravitational potential energy

When an object is raised above ground level it gains **gravitational potential energy** (GPE). This **stored energy** can be released if the object is allowed to **fall**.

A pile driver is a machine that lifts a heavy weight then drops it on a post to drive it into the ground.

The amount of gravitational potential energy (G.P.E) gained by an object raised above ground level can be calculated using the equation:

G.P.E (J) = Mass (kg) × Gravitational field strength (N/kg) × Height (m)

$$E_p = m\,g\,h$$

The pile driver hammer has a mass of 120 kg and it is raised to a height of 4 m above the ground. How much G.P.E will it have?

$$E_p = m\,g\,h$$

$$E_p = 120 \times 10 \times 4$$

The G.P.E gained is: $E_p = 4800$ J

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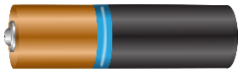
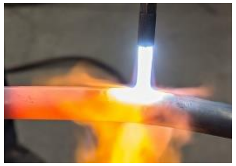
QuestionIT!

Energy changes and energy stores Part 1

- Energy stores and systems
- Changes in energy

Energy stores and Energy systems part 1– AnswerIT

1. What sort of energy store do the following examples have?

a.  b.  c. 

2. Write down the correct answer to complete the statement.

Energy can not…

be transferred from one source to another.

be created or destroyed.

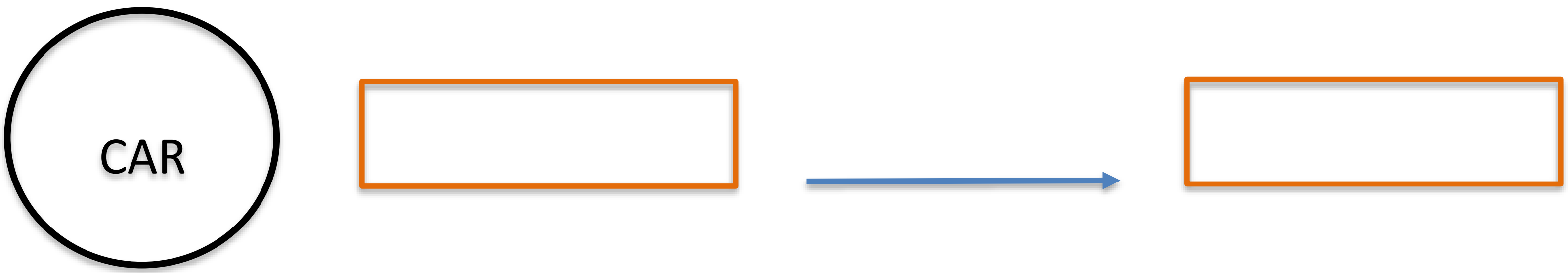
travel along a pathway to another store.

3. A basketball player throws the ball into the hoop. Describe the energy store change which has taken place.

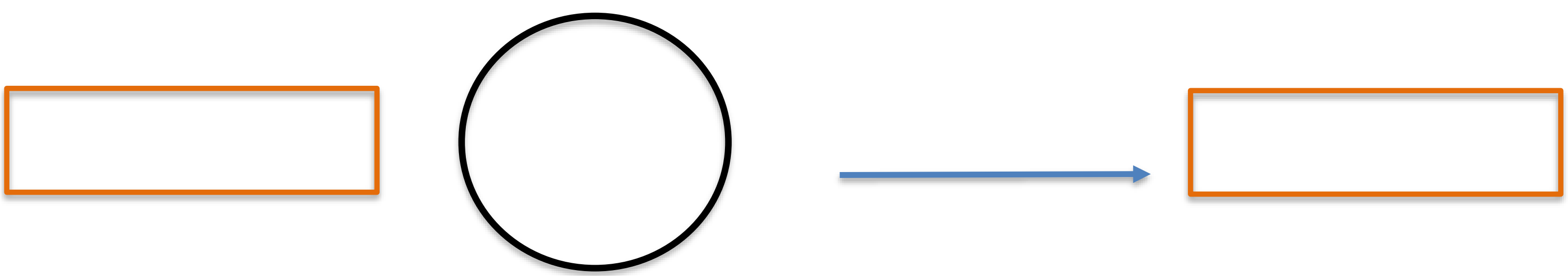
Energy stores and Energy systems part 1– QuestionIT

4. Copy and Complete the **energy store** and **pathway** diagrams for the objects described.

a. A **moving** car **braking** to a stop.



b. Bringing water to the **boil** on a gas hob.



5. Describes the main change in **energy stores** for a **coal fired power station**.

a. Name the energy sources for:

i Input energy

ii Useful output energy

iii Wasted output energy.

b. In one hour, coal supplies 500 000 J of energy. The wasted energy amounts to 380 000 J.

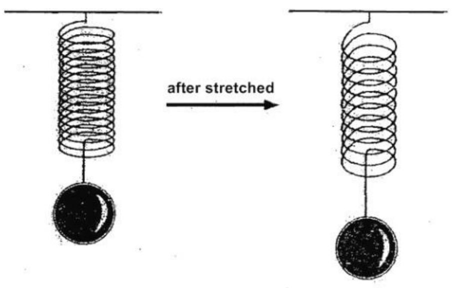
Calculate how much useful energy is produced in one hour.

6. When a football is kicked it gains **kinetic energy**.

   a. What is the **formula** used to calculate kinetic energy?

   b. The football has a mass of 0.4 kg. When the football is kicked, it has a velocity of 15 m/s.
   Calculate the **kinetic energy** of the moving football?

7. The un-stretched spring opposite has a length of 0.5 m but after a mass is added it is 0.6 m long. If the spring constant is 800 N/m.
   Calculate the stored **elastic potential energy**.
   $E_e = \frac{1}{2} k e^2$



8. A pole vaulter just clears the bar which is 5.1 m high. His mass is 62 kg. **(g = 10N/kg)**

a. What type of stored energy does he have as he just clears the bar?

b. Work out how much stored energy the pole vaulter has due to his position above the ground.

c. As he falls back to the ground, this energy store will be transferred into a new energy store. Name this new energy store.

d. When he lands, what happens to the energy stores described above?

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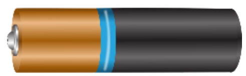
AnswerIT!

Energy changes and energy stores
Part 1

- Energy stores and system
- Changes in energy

Energy stores and Energy systems part 1– AnswerIT

1. What sort of energy store do the following examples have?

a. 

b. 

c. 

Chemical **Elastic potential** **Thermal**

2. Write down the correct answer to complete the statement.

Energy can not.....

be transferred from one source to another.

be created or destroyed. ✓

travel along a pathway to another store.

3. A basketball player throws the ball into the hoop. Describe the change in energy store that has taken place as the ball

Kinetic → **Gravitational**

Energy stores and Energy systems part 1– QuestionIT

4. Copy and Complete the **energy store** and **pathway** diagrams for the objects described.

a. A **moving** car **braking** to a stop.

CAR

i Kinetic

ii Mechanical →

iii Thermal

b. Bringing water to the **boil** on a gas hob.

i Chemical

GAS HOB

ii Heating →

iii Thermal

5. Describes the main change in **energy stores** for a **coal fired power station**.

a. Name the energy sources for:

i Input energy **Chemical (Coal)**

ii Useful output energy **Electrostatic (Electric current)**

iii Wasted output energy. **Thermal (Waste heat)**

b. In one hour, coal supplies 500 000 J of energy. The wasted energy amounts to 380 000 J.

Calculate how much useful energy is produced in one hour.

500 000 – 380 000 = 120 000 J

6. When a football is kicked it gains **kinetic energy**.

a. What is the **formula** used to calculate kinetic energy?

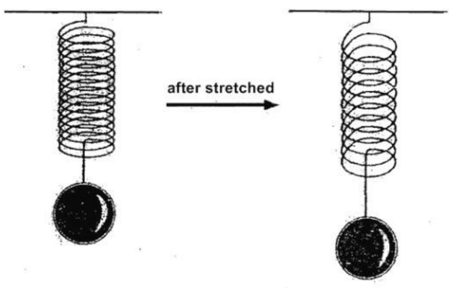
$$E_k = \frac{1}{2} m v^2$$

b. The football has a mass of 0.4 kg and when kicked has a velocity of 15 m/s. Work out the **kinetic energy** of the moving ball?

$$E_k = \frac{1}{2} \times 0.4 \times 15^2$$

$$E_k = 45 \text{ J}$$

7. The un-stretched spring opposite has a length of 0.5m but after a mass is added it is 0.6 m long. If the spring constant is 800 N/m. Calculate the stored **elastic potential energy**.



$$E_e = \frac{1}{2} k e^2$$

extension of spring = 0.6 – 0.5 = 0.1 m

$$E_e = \frac{1}{2} \times 800 \times 0.1^2$$

Stored elastic potential energy of the spring = 4 J

8. The pole vaulter just clears the bar which is 5.1 m high. His mass is 62 kg. **(g = 10N/kg)**

a. What type of stored energy does he have as he clears the bar?

gravitational potential energy

b. Work out how much stored energy the pole vaulter has due to his position above the ground.

GPE = m g h = 62 x 10 x 5.1 = 3162 J

c. As he falls back to the ground, this energy store will be transferred into a new energy store. Name this new energy store.

kinetic energy

d. When he lands, what happens to the energy stores described above?

dissipated as heat and sound

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Energy changes and energy stores Part 2

- Energy changes in systems
- Power

Energy changes in systems

The **thermal (internal) energy store** in a system changes if its **temperature changes**.

When metal is heated in a furnace the **thermal energy store** increases. The amount of energy gained depends on the **mass** of the metal, how much the **temperature increases** and the **specific heat capacity** of the metal.

Specific Heat Capacity (*c*) – the amount of energy required to raise the temperature of 1 kg of a substance by one degree Celsius.

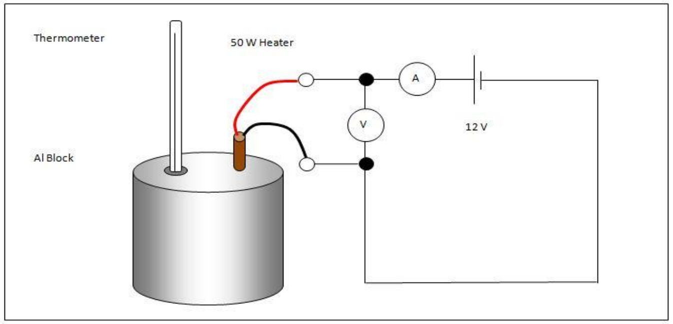
Steel has a specific heat capacity of 450 J/kg °C

Therefore a 1 kg block of steel needs 450 J of thermal energy adding to it to raise the temperature from 20 °C to 21 °C (1 °C rise).

Energy changes in systems and power

Specific heat capacity

The apparatus shown can be used to determine the specific heat capacity of aluminium.



Example: When the heater was left on for 5 mins, the heater supplied 10 800 J of thermal energy to the aluminium block.

The temperature of the 2 kg block of aluminium rose by 6 °C.

The amount of energy stored in or released from a system as its temperature changes can be calculated using the equation:

Change in thermal energy (J) = Mass (kg) x Specific Heat Capacity J/kg°C x Temperature Change (°C)

$\Delta E = m \times c \times \Delta\theta$ rearrange to give $c = \Delta E / m \times \Delta\theta$

$c = 10\,800 / 2 \times 6$ **Specific heat capacity of aluminium = 900 J/kg °C**

Power

Power - the rate at which energy is transferred

the rate at which work is done (rate means "how quickly")

Power is measured in Joules / second 1 J/s = 1 Watt

An object which transfers energy does so at a certain rate.
The metal filament in this light bulb transfers the electrical energy store into heat and light.
This bulb transfers 2400 joules of energy in 60 seconds.

Power can be calculated using the following equation:

Power (W) = Energy transferred (J) / Time (s)

$$P = \frac{E}{t}$$

P= 2400 / 60 = 40 J/s

So this is a **40 Watt** light bulb.

Power

Power - the rate at which energy is transferred

the rate at which work is done (rate means "how quickly")

Mechanical power

Power = work done / time

The crane lifts the 2000 kg container through a height of 5.4m in 30s.
The power of the crane is:

Power = Work / time

But: Work = force x distance

= 20 000 N x 5.4 m = 108 000 J

Power = 108 000 J / 30 s

The Power of the crane is 3600 J/s or 3600 Watts

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QuestionIT!

Energy changes and energy stores Part 2

- Energy changes in systems
- Power

Energy stores and Energy systems part 2 – QuestionIT

1. The specific heat capacity of a substance is………
   A. the ability of a 1 kg object to store transferred energy
   B. the total amount of stored energy in an object
   C. the energy needed to raise the temperature of 1 kg of a substance by 1 ºC.

2. When a bowl of water and a stone are left in hot sunshine, the stone feels much hotter than the water. Which one has the highest specific heat capacity? Explain your answer.

3. Give two alternative units of power?

4. A blowtorch burns butane gas to heat metal pipes.

   a. Describe the energy transfers which occur as it is used.

   ________________ energy is transferred into

   ________________ energy usefully and

   ________________ energy is wasted.

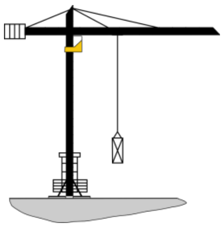
   b. Explain how some of the transferred energy is wasted.

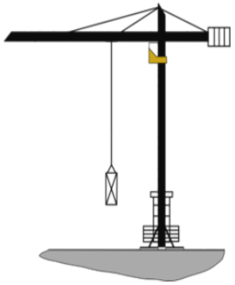
   c. The blowtorch transfers 2 kJ of energy in 4 mins. Work out the power of the blowtorch?

Energy stores and Energy systems part 2 – QuestionIT

5. Two cranes are lifting the same load of 120 kg to a height of 15 m.

Crane A



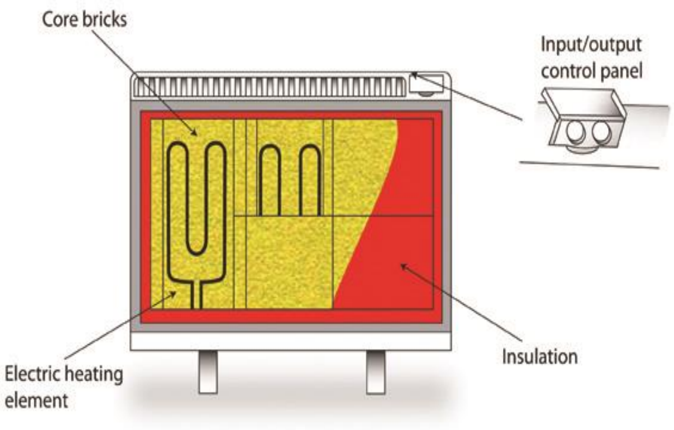


Crane B

Crane A takes 30 s to lift the load. Crane B lifts the same load in 9 s.

Calculate the **difference in power** of the two cranes.

6. Storage heaters contain bricks which warm up and **store the heat energy**.



The bricks in this heater have a mass of 40 kg and are heated from 18 ºC to 40 ºC. If the specific heat capacity of the brick material is 850 J/kg ºC.

Calculate the **change in thermal energy** during heating.

Change in thermal energy = Mass x Specific Heat Capacity x Temperature Change

$$\Delta E = m \times c \times \Delta\theta$$

AnswerIT!

Energy changes and energy stores
Part 2

- Energy changes in systems
- Power

Energy stores and Energy systems part 2 – AnswerIT

1. The specific heat capacity of a substance is ……….
   A. the ability of a 1kg object to store transferred energy
   B. the total amount of stored energy in an object
   C. the energy needed to raise the temperature of 1kg of a substance by 1ºC ✓

2. When a bowl of water and a stone are left in hot sunshine, the stone feels much hotter than the water. Which one has the highest specific heat capacity? Explain your answer.

   The water has a higher heat capacity as it takes more heat energy to raise its temperature to that of the stone

3. Give two alternative units of power?

   Joules/second or Watts

Energy stores and Energy systems part 2 – AnswerIT

4. A blowtorch burns butane gas to heat metal pipes.

a. Describe the energy transfers which occur as it is used.

Chemical energy is transferred into
thermal energy usefully and
light energy is wasted.

b. Explain how some of the transferred energy is wasted.

As thermal energy to the environment

c. The blowtorch transfers 2 kJ of energy in 4 mins. Work out the power of the blowtorch?

Power = energy transferred / time = 2000 / 240

Power of the blowtorch = 8.33Watts

Energy stores and Energy systems part 2 – AnswerIT

5. Two cranes are lifting the same load of 120 kg to a height of 15 m.

Crane A takes 30 s to lift the load. Crane B lifts the same load in 9 s.

Calculate the **difference in power** of the two cranes.

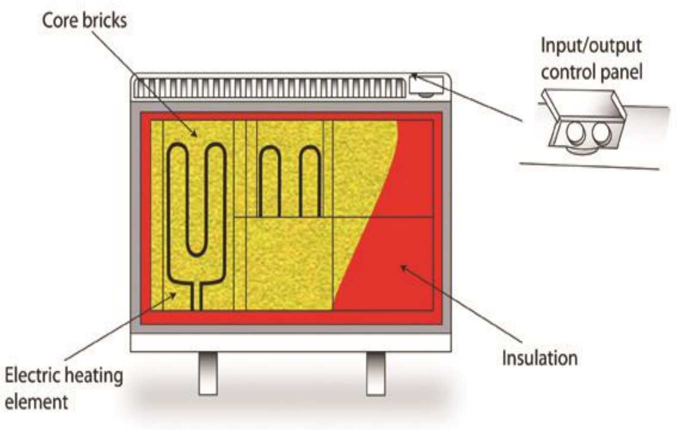
Crane A power = 1200 x 15 / 30 = 600 W

Crane B power = 1200 x 15 / 9 = 2000W

Difference in power = 2000 – 600 = 1400 Watts

6. Storage heaters contain bricks which warm up and **store heat energy**.

The bricks in this heater have a mass of 40 kg and are heated from 18 ºC to 40 ºC. If the specific heat capacity of the brick material is 850 J/kg ºC, calculate the **change in thermal energy** during heating.



Change in thermal energy = Mass x Specific Heat Capacity x Temperature Change

$$\Delta E = m \times c \times \Delta\theta$$

temperature change Δθ = 40 – 18 = 22 °C

change in thermal energy ΔE = 40 x 850 x 22

ΔE = 748 000 J or 748 kJ

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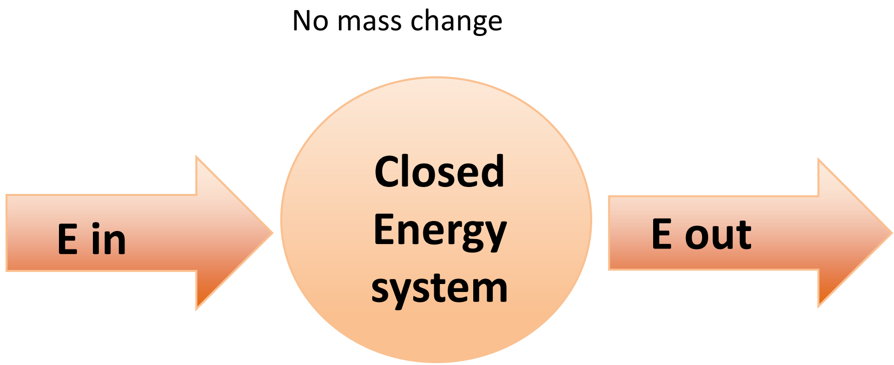
Conservation and Dissipation of Energy

- Energy transfers in a system
- Efficiency

Energy transfers in a system

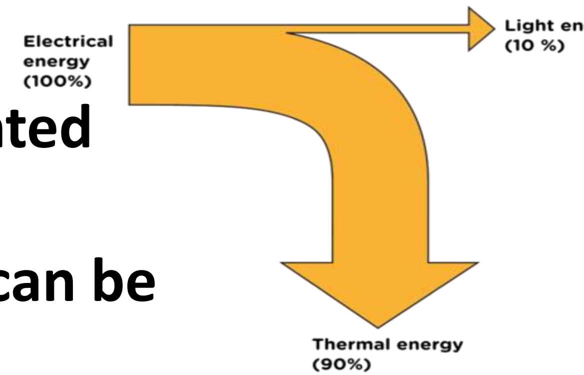
Energy can be stored, transferred or dissipated - but can not be created or destroyed.

In a closed energy system there can be transfer of energy but not mass. There is **no change to the total energy in the system.**



In a **closed energy system** all the energy can be accounted for even when energy stores change.

The diagram shows the energy transfer for a light bulb. All the electrical energy store can be accounted for as light energy and thermal energy.
The thermal energy is not useful in this case and can be considered to be dissipated or "waste" energy.



Energy transfers in a system

<u>Unwanted energy</u> transfers result in energy stores that are not useful.

The F1 car below shows that eventually all the chemical energy (fuel) put in the car ends up as <u>unwanted</u> thermal energy which is dissipated to the surroundings. Unwanted energy is often described as being 'wasted'

Chemical → 

→ Kinetic → Thermal

→ Sound → Thermal

→ Thermal

Kinetic energy is dissipated by the tyres, brakes and air resistance to become <u>unwanted</u> thermal energy stores.
Sound energy is absorbed by materials and becomes thermal energy.
Thermal energy is produced by the engine as fuel is burnt.

Oil is used in the engine, gearbox and other moving parts as a lubricant to reduce friction and reduce unwanted thermal energy in these parts.

Energy transfers in a system

Thermal insulation is often used to reduce unwanted energy transfers.

All the **energy** used to **heat a home** is eventually **transferred** as **thermal energy** to the **surroundings**.
The diagram, shows the percentage energy lost through different parts of the building.

Material	Thermal Conductivity W/m C
Air	0.03
Polyurethane foam	0.03
Fibreglass	0.04
Wool felt	0.05
Wood	0.15
Plaster	0.50
Glass	0.80
Brick	1.00
Concrete	1.04

The higher the thermal conductivity, the quicker heat is transferred through the material.

Houses are often built from brick, concrete, wood and glass. All have quite **high thermal conductivity** values. **Insulation** uses materials with low thermal conductivity, such as fibreglass in the loft, foam in wall cavities and trapped gases in double glazing.

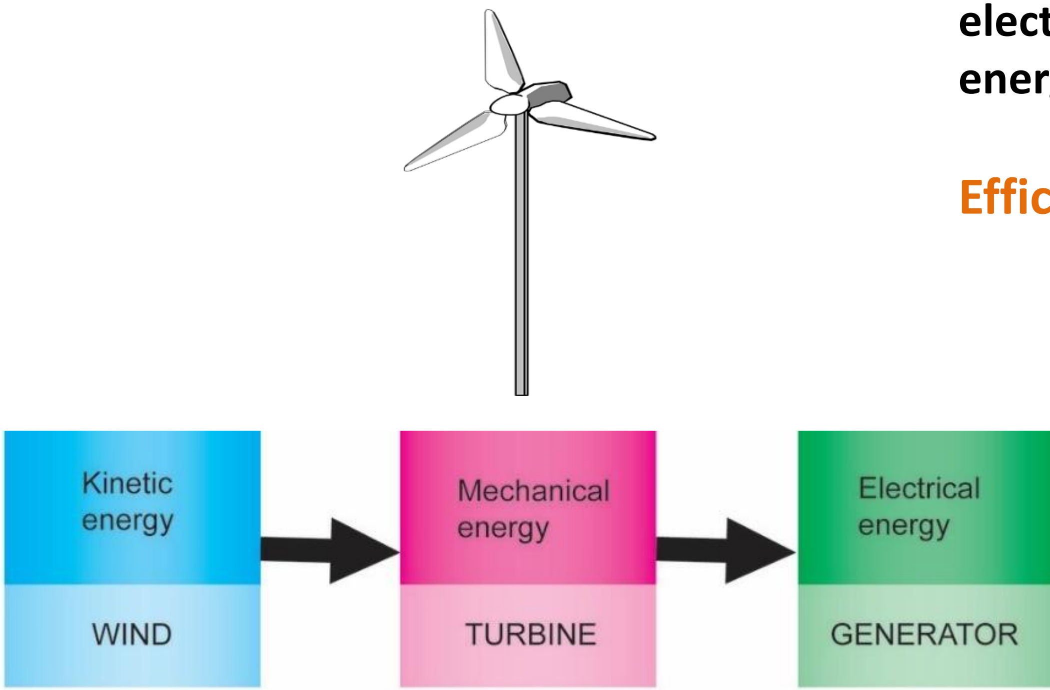
Efficiency

The amount of useful energy you get from an energy transfer, compared to the energy put in, is called the **EFFICIENCY**

$$\text{Efficiency} = \frac{\text{useful output energy transfer}}{\text{total input energy transfer}}$$

This calculation will result in a decimal value which can be multiplied by 100 to give a percentage efficiency.

A wind turbine energy transfer



The wind turbine produces 120 MW of electrical energy for every 500 MW of kinetic energy provided by the wind.

$$\text{Efficiency} = \frac{\text{Useful output energy transfer}}{\text{total input energy transfer}}$$

$$= \frac{120}{500} = 0.24 \text{ efficient}$$

or 0.24 x 100 = 24 % efficient

Efficiency

Efficiency can also be calculated from the power transferred.

$$\text{Efficiency} = \frac{\text{useful power output}}{\text{total power input}}$$

Remember that power is the time it takes to do work.

Work = Force x distance

A water pump lifting water

The 300 W water pump raises 200 kg of water to a height of 2 m in one minute. The efficiency of the pump is:

$$\text{Efficiency} = \frac{\text{useful power output}}{\text{total power input}}$$

Power in = 300 W

Power out $= \frac{2000\text{ N} \times 2\text{ m}}{60} = 66.7\text{ W}$

Efficiency $= \frac{66.7 \times 100}{300} = 22.2\ \%$

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QuestionIT!

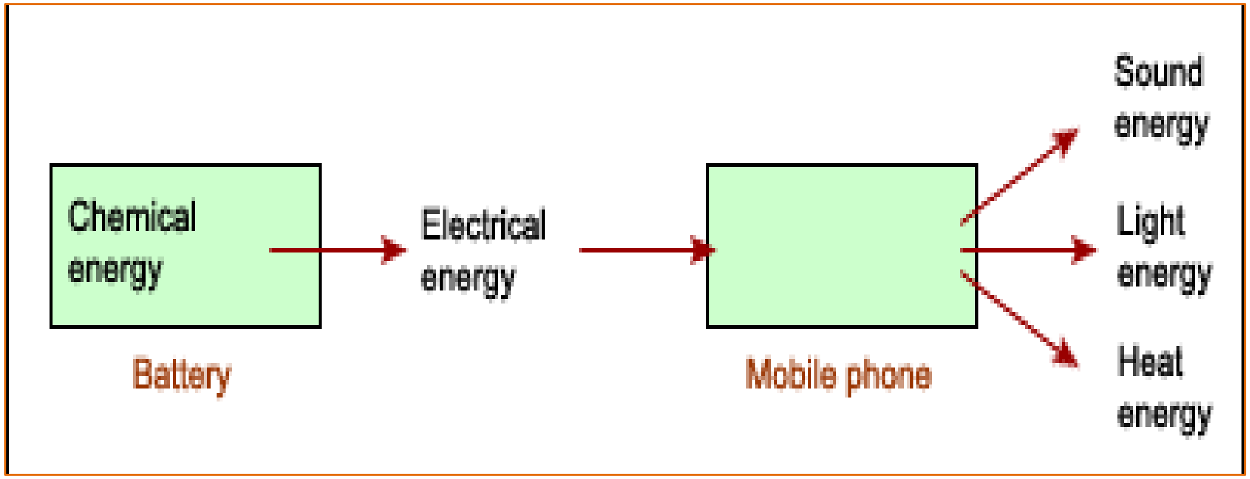
Conservation and Dissipation of Energy

- Energy transfers in a system
- Efficiency

Conservation and Dissipation of Energy - QuestionIT

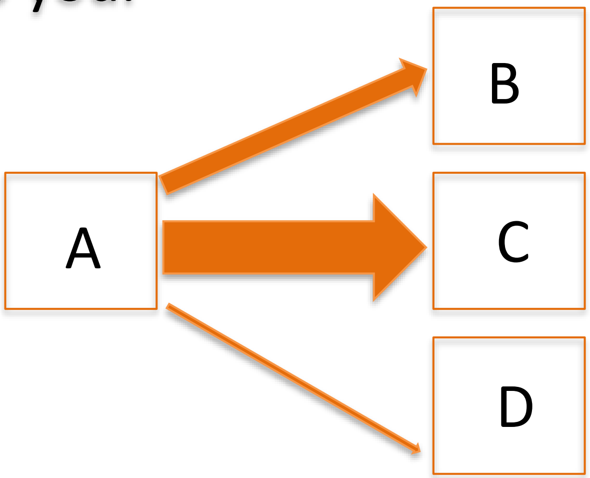
1. In a "closed" system ………….
   A. energy can be transferred but there is no net energy loss.
   B. energy and mass are transferred in and out of the system.
   C. energy cannot be transferred between different energy stores.

2. The energy transfer diagram for a mobile phone shows that 100 J of electrical energy produces 45 J of light energy and 36 J of sound energy.
How much thermal energy will be dissipated by the phone?



3. Describe how the thermal energy produced by a bus driving along a road is dissipated.

4. a. The diagram shows the main energy transfers for an electric fan. Complete boxes A to D showing the energy stores involved. Use the size of the arrows to help you.



b. State why the total energy supplied an electric fan must always equal the total energy transferred by the electric fan.

5. a. The diagrams show two different types of loft insulation.

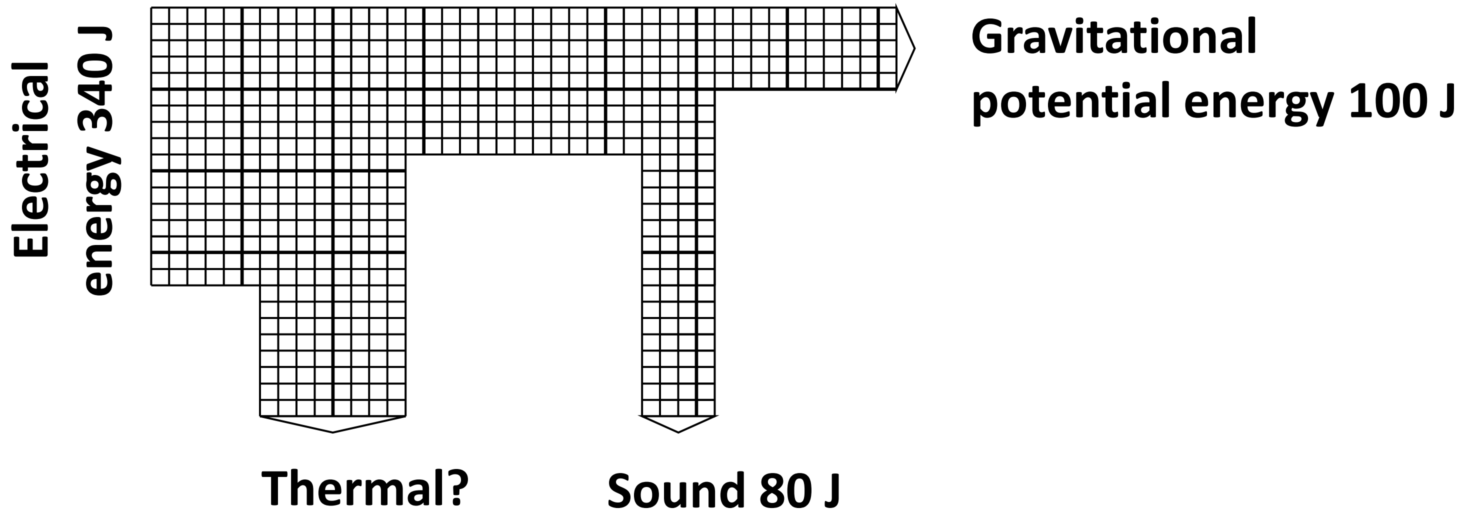
Fiberglass insulation Wool insulation

The wool needs to be thicker to have the same insulating properties. Explain which material has the highest thermal conductivity?

b. Explain how trapped air reduces the rate of heat loss, in terms of thermal conductivity.

Conservation and Dissipation of Energy - QuestionIT

6. The diagram represents the energy store transfers when a motor is lifting a weight.



a. How much electrical energy is transferred to a thermal energy store?

b. What is the total amount of dissipated energy?

c. Calculate the efficiency the of the useful energy transfer

7. The motor for a lift in a tall building uses 12 000 W of power. The lift and its passengers has a mass of 500 kg. The lift motor takes 10 s to raise the lift and its passengers through a height of 20 m.

Work out the percentage efficiency of the lift motor.

8. The low energy bulb below uses 18 000 J of energy in one hour. If the efficiency of the low energy bulb is 78 %.

Work out the amount of light energy given off by the bulb in one hour.

AnswerIT!

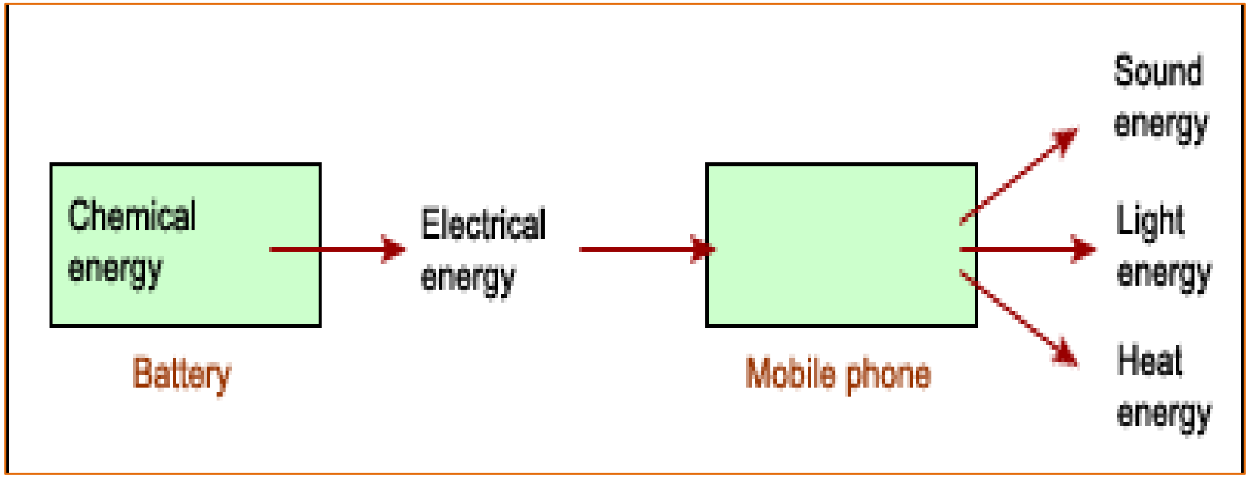
Conservation and Dissipation of Energy

- Energy transfers in a syster
- Efficiency

Conservation and Dissipation of Energy - **AnswerIT**

1. In a "closed" system ....
   A. energy can be transferred but there is no net energy loss. ✓
   B. energy and mass are transferred in and out of the system.
   C. energy cannot be transferred between different energy stores.

2. The energy transfer diagram for a mobile phone shows that 100 J of electrical energy produces 45 J of light energy and 36 J of sound energy.
How much thermal energy will be dissipated by the phone?



45 J + 36 J = 81 J

100 J – 81 J = 19 J

19 J of thermal energy will be dissipated

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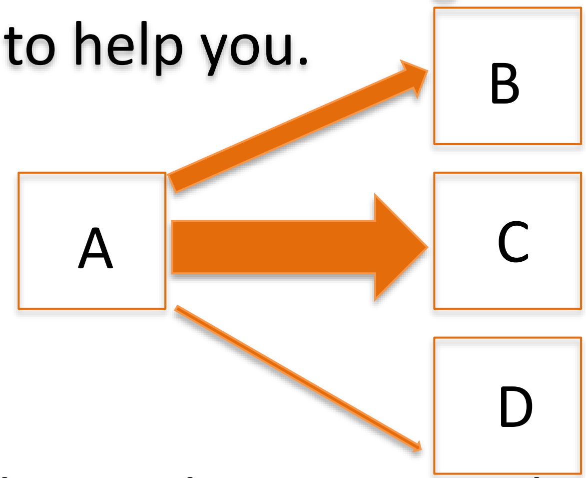
Conservation and Dissipation of Energy - **AnswerIT**

3. Describe how the thermal energy produced by a bus driving along a road is dissipated.

The thermal energy increases the kinetic energy of the air particles therefore warming up the surroundings.

4. a. The diagram shows the main energy transfers for an electric fan. Complete boxes A to D showing the energy stores involved. Use the size of the arrows to help you.



A - Electrical energy

B - Thermal energy

C - Kinetic energy

D - Sound energy

b. State why the total energy supplied to an electric fan must always equal the total energy transferred by the electric fan.

Energy can not be created or destroyed so:

total <u>energy in = total energy out</u>

Conservation and Dissipation of Energy - AnswerIT

5. a. The diagrams show two different types of loft insulation.

Fiberglass insulation

Wool insulation

The wool needs to be thicker to have the same insulating properties. Explain which material has the highest thermal conductivity?

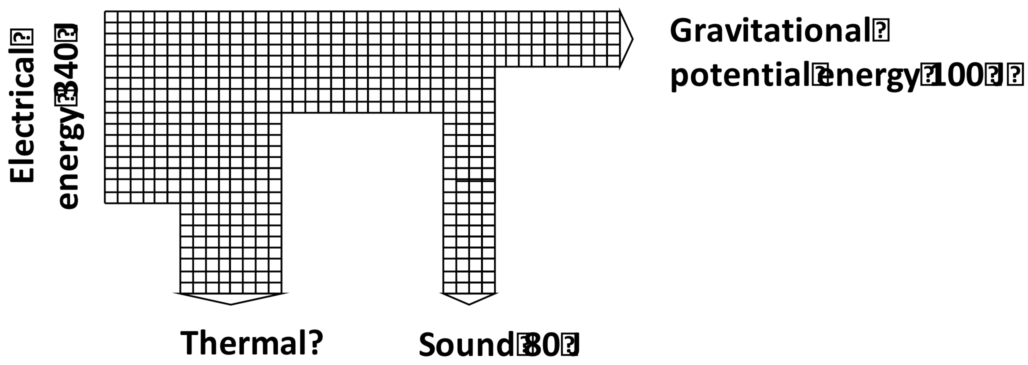
Wool has the highest thermal conductivity as it lets thermal energy through at a faster rate so a thicker layer is needed for the same insulation as the fiberglass.

b. Explain how trapped air reduces the rate of heat loss, in terms of thermal conductivity.

The air trapped inside the fiberglass acts as an insulator because air has a very low thermal conductivity and thermal energy can not pass through it easily.

Conservation and Dissipation of Energy - AnswerIT

6. The diagram represents the energy store transfers when a motor is lifting a weight.



a. How much electrical energy is transferred to a thermal energy store?

340 – (100 + 80) = 160 J

b. What is the total amount of dissipated energy?

160 + 80 = 240 J

c. Calculate the efficiency the of the useful energy transfer

$$\text{Efficiency} = \frac{\text{useful output energy transferred}}{\text{total energy transfer input}} = \frac{100}{340} = 0.294$$

7. The motor for a lift in a tall building uses 12 000 W of power. The lift and its passengers has a mass of 500 kg. The lift motor takes 10 s to raise the lift and its passengers through a height of 20 m.

Work out the percentage efficiency of the lift motor.

$$\text{Efficiency} = \frac{\text{power out} \times 100}{\text{power in}} \qquad \text{Power out} = \frac{\text{work}}{\text{time}} \qquad \textit{work = force x distance}$$

$$\text{Power out} = \frac{5000\ \text{N} \times 20\ \text{m}}{10\ \text{s}} = 10\,000\ \text{W} \qquad \text{Efficiency} = \frac{10\,000 \times 100}{12\,000} = 83\ \%$$

8. The low energy bulb below uses 18 000 J of energy in one hour. If the efficiency of the low energy bulb is 78 %.

Work out the amount of light energy given off by the bulb in one hours.

$$\text{Efficiency} = \frac{\text{energy out} \times 100}{\text{energy in}} \qquad \text{energy out} = \frac{\text{efficiency} \times \text{energy in}}{100}$$

$$\text{Energy out} = \frac{78 \times 18\,000\ \text{J}}{100} = 14\,040\ \text{J}$$

LearnIT!
KnowIT!

National and Global Energy resources

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National and global energy resources

ENERGY RESOURCES	
Non-renewable	
Coal	Fossil fuels They are becoming more difficult to find and extract
Oil	
Gas	
Nuclear	Plentiful but difficult to extract / purify
Renewable	
Bio-fuel	Plant matter usually used as a fuel
Wind	Turbines spin a generator to produce electricity
Hydro-electric	Falling water spins a turbine to produce electricity
Geothermal	Hot rocks underground produce steam
Tides	Rise and fall of the tide can be used to turn a turbine
Sun	To directly heat things or produce electricity
Waves	Up and down movement can turn turbines

National and global energy resources

Non-renewable energy sources are those which will **eventually run out** – there is a finite supply. New supplies are more difficult to find and extract.
Renewable energy sources are those which can **replenish themselves in the short term,** and so will never run out.
Nuclear energy resources are technically non-renewable but they can be produced on an almost indefinite basis.

How energy resources are used.
Transport – cars, trains, buses, planes etc.
Electricity generation – industry, homes, commerce, lighting etc.
Heating – homes, industrial processes, schools and hospitals etc.

Energy use is usually divided between the four economic sectors - **residential, commercial, transportation**, and **industrial**.

Energy resources – Non-renewable

Coal	**Coal is mined then burnt to provide heat or used to generate electricity.**	**Large reserves of coal which are relatively inexpensive to mine. All major coal mines have now closed in the UK.**	**Coal mining is dangerous and burning coal contributes to global warming.**
Oil	**Frequently burnt to produce electricity. Large quantities of oil are refined to provide fuels for transport.**	**Large reserves becoming more difficult to find and extract. Transport and refinement are relatively easy.**	**Oil reserves becoming more difficult to find and extract. The need for oil in developed countries means supplies are politically sensitive. Releases greenhouse gases when burnt.**

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Energy resources – Non-renewable

Gas	**Extracted from underground gas fields sometimes alongside oil extraction. Mainly used for electricity production, domestic heating and industrial processes that require heat.**	**Cleaner than burning oil or coal. Relatively easy to transport and store.**	**UK has good gas reserves but extraction is expensive (often under the sea) and becoming more difficult to reach.**
Nuclear	**Nuclear supplies (Uranium) are mined and purified. The nuclear fission releases heat which is used to produce steam. This spins a turbine and generator to make electricity**	**Potentially in-exhaustable energy supply even though it is extracted form resources in the ground.Very efficient process which produces lots of electricity from little nuclear fuel.**	**Danger of nuclear accidents releasing radioactive materials into the air or water. Security of nuclear sites can be a problem.Start-up costs and decommissioning are very expensive and no real solution to managing radioactive waste has been found.**

Energy resources – Renewable

Solar	**Energy from sunlight is captured in photovoltaic cells and converted into electricity.** **Hot water from solar panels**	**Renewable energy resource.** **Individual houses can have their own electricity/hot water supply.**	**Manufacture and installation of solar panels/cells can be costly.**
Wind	**Wind turbines turn wind energy into electricity by turning a generator.**	**Renewable energy resource and can be used as individual units.**	**Manufacture and installation of wind farms can be costly.** **Some consider an eyesore.**
Tidal	**The movement of tides drives turbines.** **A tidal barrage is built across estuaries to trap water.**	**Ideal for an island such as the UK to potentially generate a lot of energy.** **Tidal barrage can help prevent flooding.**	**Construction of barrage is very costly and can impact on wildlife.** **Only a few estuaries are suitable.**

Energy resources – Renewable

Geothermal	In volcanic regions, cold water is pumped underground and comes out as steam. Steam can be used for heating or to power turbines creating electricity.	Renewable energy resource. Used successfully in some countries, such as New Zealand and Iceland.	Can be expensive to set up and only works in areas of volcanic activity.
Hydroelectric Power (HEP)	Energy harnessed from the movement of water through rivers, lakes and dams. Used to turn turbines for electricity production.	Creates water reserves as well as energy supplies.	Costly to build. Can cause the flooding of surrounding communities and landscapes.

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Energy resources – Renewable

Biomass	An organic material, which can be burned to provide energy, eg heat or electricity. After treatment with chemicals it can be used as a fuel in vehicle engines.	It is a cheap and readily available source of energy. If replaced, biomass can be a long-term, sustainable energy source.	When burned, it gives off greenhouse gases. Growing takes up large amounts of arable land..
Wave	The movement of water in and out of a cavity on the shore compresses trapped air, driving a turbine.	More likely to be small local operations, rather than done on a national scale.	Construction can be costly. Only produces small amounts of electricity.

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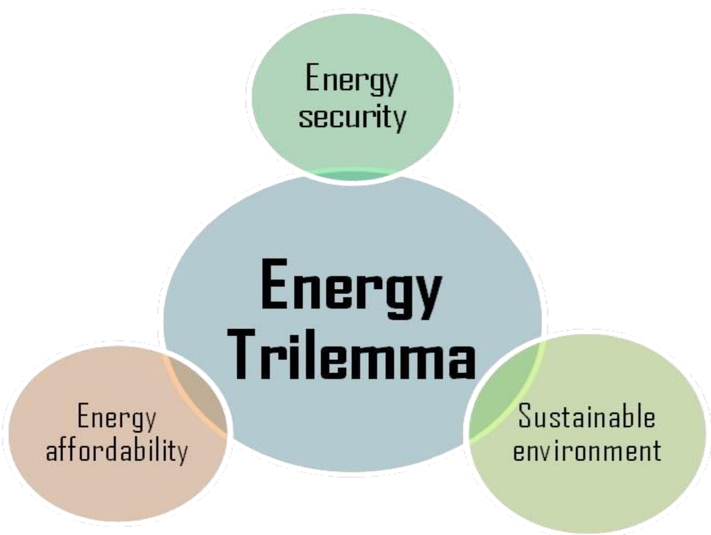
National and global energy resources

Security and reliability of energy supplies

In the UK a **mix** of energy supplies are used so should one supply become **unavailable**, others can be used without **disruption** to supplies.

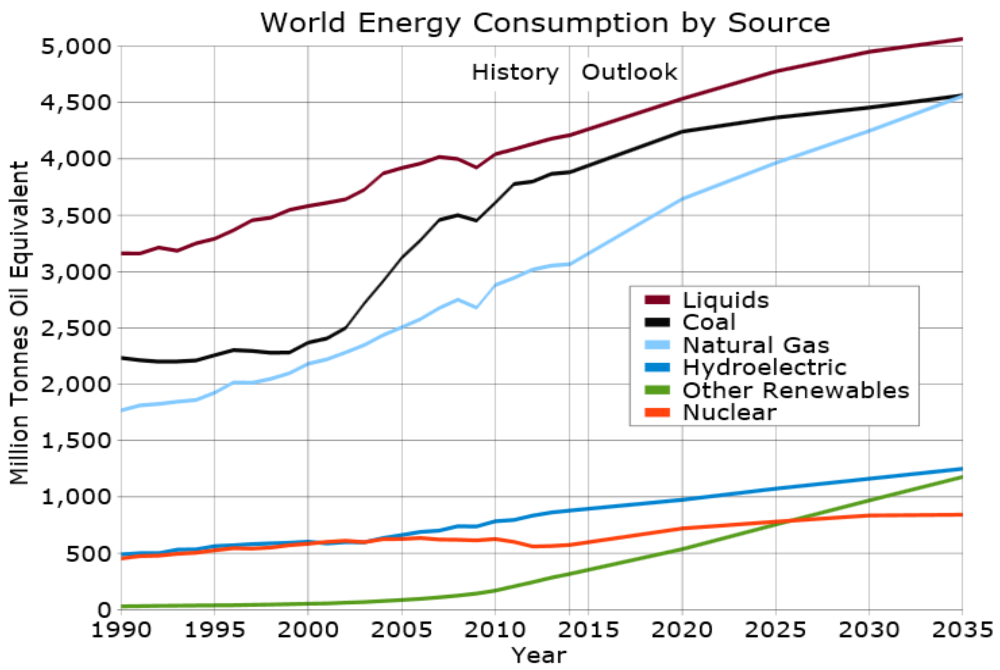
Some energy sources are more **reliable** than others. Coal, oil, gas and nuclear are reliable sources as they can supply a **continuous** flow of electricity.



Electricity from wind turbines relies on the wind blowing, solar power does not work at night and hydro-electric requires a continuous supply of water. These are considered **unreliable** sources.

National and Global energy resources – Trends in energy use

World energy use trends and predictions



The total amount of energy used in the world is increasing as the population increases and each person is using more energy.

Renewable energies only make up around 20% of total energy consumption and this trend is unlikely to change until after 2035.

- **Future world agreements on emissions are likely to determine the trend of using fossil fuels.**
- **As reserves of coal, oil and gas dwindle, an increase in the use of renewable energies is likely.**

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QuestionIT!

National and Global Energy resources

National and Global Energy resources – QuestionIT

1. What is a fossil fuel?

2. Copy and complete the table below by ticking the correct box for each energy source.

Energy source	Renewable	Non-renewable
Bio-fuels		
Oil		
Nuclear		
Hydro-electricity		
Wind turbines		
Coal		
Solar power		
Wave energy		
Natural gas		

3. What is a renewable energy source?

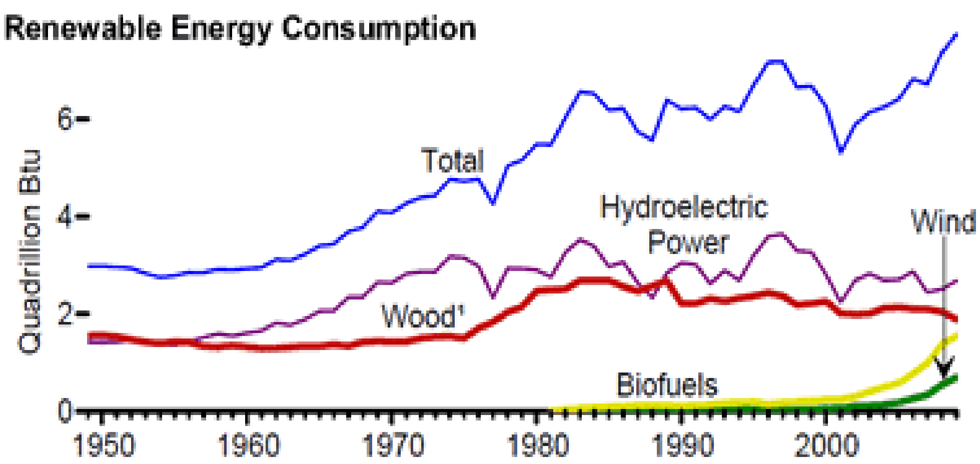
National and Global Energy resources – QuestionIT

4. Why are fossil fuels considered to be a more reliable energy resource than renewable energy resources?

5. Despite a large investment by the UK government in wind power, the amount of fossil fuel used has not seen a decline. Give a possible explanation for this.

6. The UK government is committed to investing in a "blend" of energy supply types to provide the UK's energy needs for the next 100 years. Give an advantage of this rather than using just coal.

7. The graph shows the world use of renewable energies over the past sixty years.



a. Why has the use of wood increased very little over this time?

b. A lot of money has been invested in wind turbines. Why does this energy source not produce as much as any other renewable resource?

8. Copy and complete the table to give **energy sources** that could be used in each situation.

Energy use	Energy source 1	Energy source 2
Running a car		
Producing electricity		
Heating the home		
Powering a train		

9. Describe how human activities have contributed to the greenhouse effect?

10. Explain how burning coal in power stations contributes to global warming.

11. Describe **two** problems associated with the storage of waste from nuclear power stations.

12. State **two** reasons why people might object to having a wind farm built close to their homes.

AnswerIT!

National and Global
Energy resources

National and Global Energy resources – AnswerIT

1. What is a fossil fuel? **A fuel formed in the geological past from the remains of living organisms.**
2. Copy and complete the table below by ticking the correct box for each energy source.

Energy source	Renewable	Non-renewable
Bio-fuels	✓	
Oil		✓
Nuclear		✓
Hydro-electricity	✓	
Wind turbines	✓	
Coal		✓
Solar power	✓	
Wave energy	✓	
Natural gas		✓

3. What is a renewable energy source?
An energy source that can be replenished as it is used.

National and Global Energy resources – AnswerIT

4. Why are fossil fuels considered to be a more reliable energy resource than renewable energy sources?

   Produce a consistent energy supply with no gaps in energy delivery.

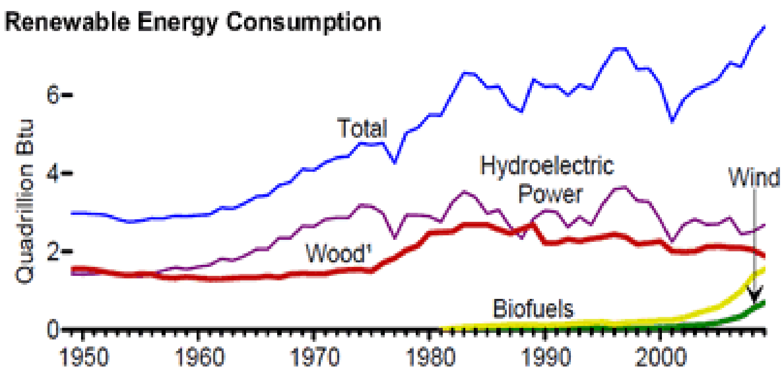
5. Despite a large investment by the UK government in wind power, the amount of fossil fuel used has not seen a decline. Give a possible explanation for this.

   UK is using more energy and wind power can not meet this rise in demand.

6. The UK government is committed to investing in a "blend" of energy supply types to provide the UK's energy needs for the next 100 years. Give an advantage of this rather than using just coal.

   Evens out any variations in supply or cost of the energy source. Using only coal, if supplies stopped or the cost went up greatly, this would have a great impact on the consumer.

7. The graph shows the world use of renewable energies over the past sixty years.



a. Why has the use of wood increased very little over this time?

Limited supplies of wood and it takes a long time to grow new supplies. Also, pressure and legislation to prevent many trees from being cut down.

b. A lot of money has been invested in wind turbines. Why does this energy source not produce as much as any other renewable resource?

Each wind turbine only produces a small amount of electricity and not enough have been installed to match production from other renewable resources.

8. Copy and complete the table to give **energy sources** that could be used in each situation.

Energy use	Energy source 1	Energy source 2
Running a car	Petrol, Diesel, LPG	Any electricity producing source
Producing electricity	Coal, oil, gas	Renewable source
Heating the home	Coal, gas, wood	Any electricity producing source
Powering a train	Coal, Diesel, oil	Any electricity producing source

9. Describe how human activities have contributed to the greenhouse effect.?

Burning fossil fuels for heating, transport and industry has led to a build up of carbon dioxide in the atmosphere (along with other greenhouse gases).

10. Explain how burning coal in power stations contributes to global warming.

Carbon dioxide produced. Carbon dioxide absorbs and reflects infrared radiation leading to additional warming.

11. Describe **two** problems associated with the storage of waste from nuclear power stations.

Waste is radioactive can cause cells to mutate.

Radioactivity lasts for thousands of yeas so needs long term storage.

12. State **two** reasons why people might object to having a wind farm built close to their homes.

Considered unsightly by some. Can be noisy.

Disruption whilst installing and maintaining.

Produce little energy for their environmental impact.