AQA GCSE Physics

Paper 1 Revision

Topic 1: Energy

Name: ____

Form: 11___

Sub-topic	What you need to be able to do	Have I made notes?	What do I need to improve upon?
Stored energy	State a system is an object or a group of objects that can be considered independently		
	State the energy transfers that occurs when a system is changed		
	Describe all the changes involved in the way energy is stored when a system changes		
Calculate energy	Calculate and rearrange the kinetic energy equation		
	Calculate and rearrange the gravitational potential energy equation		
	Calculate and rearrange the gravitational potential energy equation		
	Calculate and rearrange the equation that relates to the specific heat capacity equation		
	Define specific heat capacity		
Power	Calculate and rearrange the work done equation		
	Define power		
	Calculate and rearrange the power equation		
	Define the watt		
Energy changes	State and apply the law of conservation of energy		
	Describe the energy changes that occur within a system		
	Describe what is meant by useful and wasted energy transfers		
	Calculate and rearrange the efficiency equation		
	Explain methods to make a system more efficient		
	Describe what is meant by thermal conductivity		
	Suggest and compare how the thermal conductivty of a buildings wall can be varied		
Resources	Define what is meant by non-renewable and renewable energy sources		
	Describe the 9 main energy sources avilable for use on Earth		
	Compare the ways that different energy sources are used i.e why are some more useful than others?		
	Describe the pros and cons to each energy resources		
	Evaluate environmental impacts arising from the use of different energy resources		
	Describe features of the National Grid (this is also part of the electricity topic)		

Stored energy

What are all of the different types of energy stores?

A system is an object or group of objects that can be considered independent. The total amount of energy in the system must remain constant but energy can still be transferred.

Kinetic energy

Objects that are in motion have a store of kinetic energy.

Kinetic energy is calculated using:

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

E_k = Kinetic energy (J)
m = Mass (kg)
v = Velocity or speed (m/s)

Check you can rearrange these equations.

Gravitational potential energy

Objects that are raised from the ground have a store of gravitational potential energy.

Gravitational potential energy is calculated using:

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

E_p = Gravitational potential energy (J)
m = mass (kg)
g = Gravitational field strength (N/kg) Note: This is 9.8 N/kg on Earth
h = Height (m)

A tennis ball has a mass of 100g and is raised 2 m into the air on Earth. How much GPE does it have at the top? How fast is it travelling as it hits the ground to 2 s.f? [1.96 J, 6.3 m/s]

The gravitational potential energy stored within an object is transferred into kinetic energy as it falls, causing it to speed up. Ignoring friction, the gravitational potential energy at the top of the fall is equal to kinetic energy at the bottom of the fall.

Stored energy

Elastic potential energy

Objects that are stretched or squashed store elastic potential energy?

Elastic potential energy is calculated using:

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

E_e = Elastic potential energy (J)
k = Spring constant (N/m)
e = Extension (m)

The amount of energy transferred when an object's temperature changes

The amount of energy needed to increase the temperature of an object is calculated using:

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

E = Energy transferred (J)
m = Mass (kg)
c = Specific heat capacity (J/kg°C)
$\Delta\theta$ = Change in temperature (°C)

Two substances have two different specific heat capacities of 4200 J/kg°C and 2000 J/kg°C. Which one would it be best to use in a hot water bottle and why?

This equation can also be used to show how much energy is released when an object cools down.

Specific heat capacity is the energy required to heat a 1 kg mass of a substance by 1 °C.

Specific heat capacity required practical

You are required to use an ammeter, voltmeter, stopwatch, metal block, thermometer, leads, immersion heated and insulation to jacket to find the specific heat capacity of the material. Explain how you would use these to estimate the SHC of the metal block and explain why this value would likely be higher than the actual value.

Work, power & energy

Work done

When a force causes an object to move work is done. Work done and energy transferred are often used interchangeably.

Work done (J) = Force applied (N) x Distance moved in the direction of the force (m)

In symbol form:

$$W = F \times d$$

Note: If asked to calculate work done you may be required to use the kinetic energy, gravitational potential energy or use the equation that include specific heat capacity if that is where the energy is being transferred from or to.

Types of stores of energy

Electrical, heat, kinetic, elastic potential, gravitational potential, chemical potential, nuclear, sound and light

Power

Power is the rate at which work is done or energy is transferred.

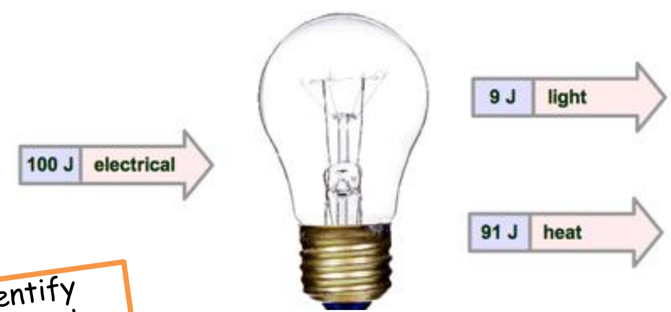
$$\text{Power (W)} = \frac{\text{Energy or wok done (J)}}{\text{Time (s)}}$$

The watt

1 watt means 1 J of energy is transferred every second.

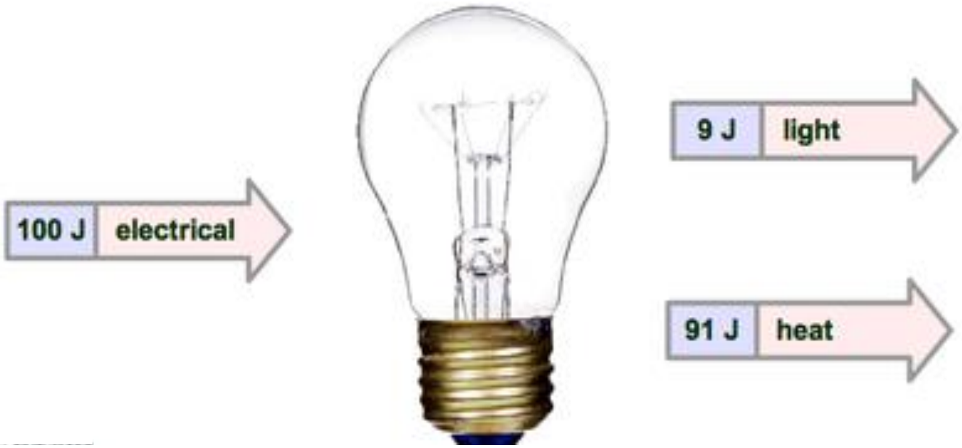
Law of conservation of energy

Energy cannot be created or destroyed, only transferred from one store to another store.



Can you identify examples of each transfers?

Efficiency



Useful and wasted energy transfers
Not all transfers are useful. For example the light bulb also gives out heat. Ideally you would want all of the energy to be transferred to light energy.

Calculating efficiency
You can calculate efficiency using the equation below. Not multiplying by 100 leaves the efficiency as a decimal.

$$\text{Efficiency} = \frac{\text{Useful Energy Output}}{\text{Energy Input}} \times 100\%$$

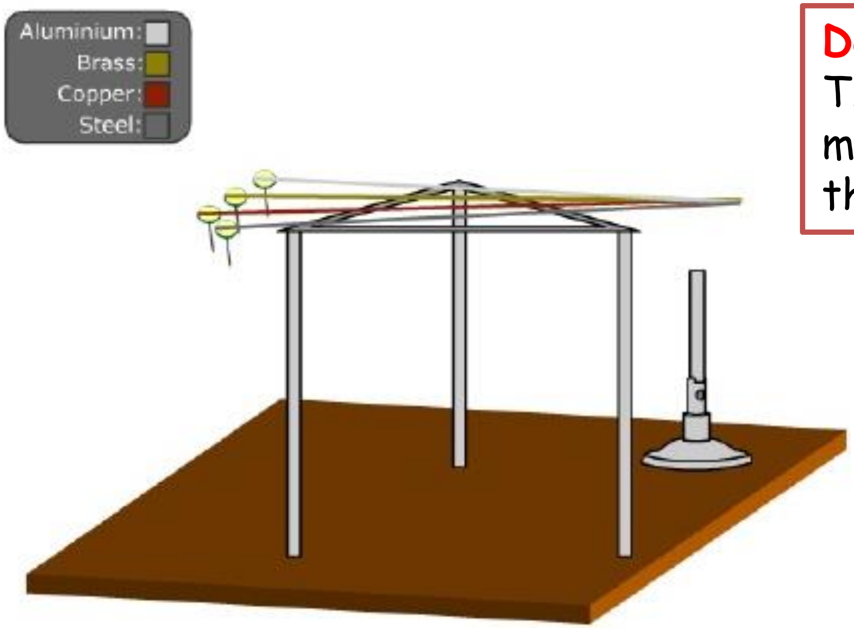
$$\text{Efficiency} = \frac{\text{Useful Power Output}}{\text{Power Input}} \times 100\%$$

What is the efficiency of the lightbulb? If another lightbulb has 150 J of energy input into it and it is 40% efficiency, how much energy is transferred usefully?

Becoming more efficient
You can make some transfers more efficient. Examples include lubricating a bike chain and replacing older lightbulbs with newer lightbulbs.

Heating the surroundings
All energy becomes less useful as it dissipates. Wasted energy is transferred to the surroundings which causes it to warm up.

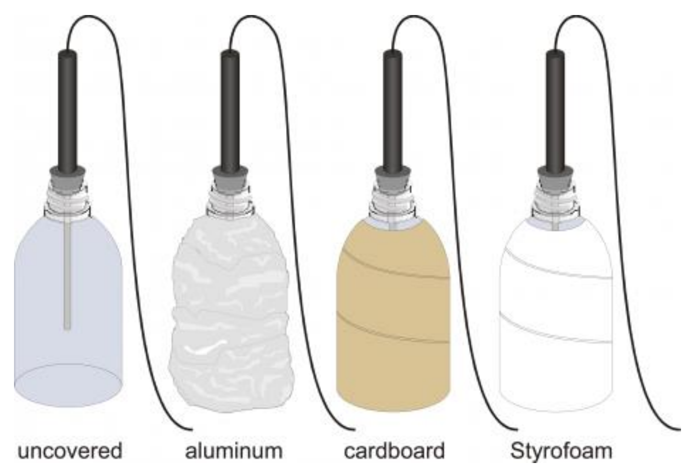
Thermal conductivity



Defining thermal conductivity
Thermal conductivity describes how easy an material passes on heat energy (normally through conduction).

Thermal conductivity and buildings
It is useful to know what the thermal conductivity is for building to know how efficient they are at keeping the heat inside. The material and thickness can affect the thermal conductivity.

Thermal conductivity required practical (separates students only)
If you were given several different materials, beakers, a kettle, a thermometer and a stopwatch, how would you find the best insulating material? What would you need to do to keep it a fair test? How could you extend this investigation to investigate another variable? What would you need to keep the same this time?



Which one does Iceland heavily rely on? Why?

Why is the Government interested in renewable energy at the moment?

Which would you choose to build in the UK? Why?

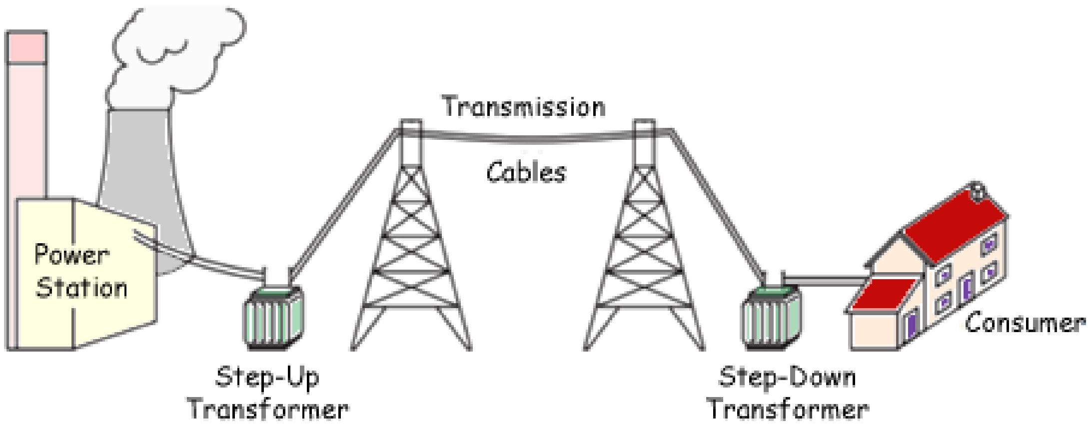
Energy resources

Energy resource	Pros	Cons
Fossil fuels	Cheap, readily available (at the moment), reliable	Emits greenhouse gases, emits gases leading to acid rain, non-renewable
Nuclear	Produces a lot of energy pet kg, no greenhouse gases emitted	Produces radioactive waste (which is difficult to expose of and can lead to cancer), non-renewable, expensive and long start-up time
Biomass	Renewable, carbon neutral, reliable	Can lead to deforestation (and landslides/floods)
Wind	Renewable, free to run, no greenhouse gases emitted	Danger to wildlife, ugly, unreliable, large initial cost
Solar	Renewable, free to run, no greenhouse gases emitted	Large initial cost, unreliable, inefficient
Hydroelectric	Renewable, no greenhouse gases, quick start-up time	Large initial cost, damages wildlife when built, looks ugly
Wave/tidal	Renewable, no greenhouse gases, free once built	Large initial cost, inefficient, shipping obstacles
Geothermal	Renewable, cheap to run, no greenhouse gases	Not many suitable locations, can cause small earth tremors and landslides

The National Grid

This is part of the electricity topic but makes more sense to put it here

The National Grid is a network of transformers and cables connecting power stations to our homes. It means we could be getting our electricity from any power station in the UK and sometimes even France!



Transformers

Step-up transformers occur immediately after a power station. They increase the voltage (to 100's of kV) which reduces the current. This means less energy is lost (through heat) when the current goes through the cables.

Step-down transformers occur just before our homes/factories etc. They decrease the voltage and increase the current which makes it safer to use. All our appliances at home are designed to work with 230 V.

Supply and demand

The National Grid enables the demand to be continuously met. Hydroelectric power stations are very useful for meeting the peaks in demand. Power stations such as nuclear are good at meeting the baseload (the minimum required). Peaks in demand occur during the end of popular TV shows when kettles are being switch on around the country.

Key Equations

Equation	Symbol	Unit
$E_k = \frac{1}{2} mv^2$	E_k = kinetic energy m = mass v = speed	E_k = J (joules) m = kg (kilograms) v = m/s (meters per second)
$E_e = \frac{1}{2} ke^2$	E_e = elastic potential energy k = spring constant e = extension	E_e = J (joules) k = N/m (newton's per meter) e = m (meters)
$E_p = mgh$	E_p = gravitational potential energy m = mass g = gravitational field strength h = height	E_p = J (joules) m = kg (kilograms) g = N/kg (newton's per kilogram) h = m (meters)
$\Delta E = mc\Delta\theta$	ΔE = change in thermal energy m = mass c = specific heat capacity Δθ = temperature change	ΔE = J (joules) m = kg (kilograms) c = J/kg°C (joules per kilogram per degree Celsius) Δθ = °C (degree Celsius)
$P = \frac{E}{t}$	P = power E = energy transferred t = time	P = W (watts) E = J (joules) t = s (seconds)
$P = \frac{W}{t}$	P = power W = work done t = time	P = W (watts) E = J (joules) t = s (seconds)
$\text{Efficiency} = \frac{\text{useful energy out}}{\text{total energy in}}$		
$\text{Efficiency} = \frac{\text{useful power out}}{\text{total power in}}$		
$E_e = \frac{1}{2} ke^2$	E_e = elastic potential energy k = spring constant e = extension	E_e = J (joules) k = N/m (newtons per meter) e = m (meters)

MUST LEARN - NOT SHADED

ON THE DATA SHEET - SHADED