P1 Energy

Energy Stores
There are 8 energy stores:

Store	Stored in…
Kinetic	moving objects
Gravitational potential	objects raised above ground
Elastic potential	Stretched or compressed objects
Thermal	All objects due to particle movement
Chemical	Substances (foods, fuels) that can release energy in a chemical reaction
Nuclear	The nucleus of atoms
Magnetic	Magnets attracting or repelling
Electrostatic	Separation of charges

Conservation of energy law:
Energy is NEVER created or destroyed

Energy is transferred by different pathways – by heating or when work is done

When energy is transferred, some is often transferred to the environment – this is wasted or dissipated energy

Efficiency
Tells us how much of the energy is transferred usefully.

$$\text{Efficiency} = \frac{\text{Useful output energy transferred by the device}}{\text{Total input energy supplied to the device}}$$

$$\text{Efficiency} = \frac{\text{Useful power out}}{\text{Total power in}}$$

Wasted energy always ends up in the **thermal store** of the surroundings

Calculating energy stores

The energy stored in a raised object can be calculated using:

GPE = mass x height x gravitational field strength
GPE= mgh

The energy stored in a moving object can be calculated using:

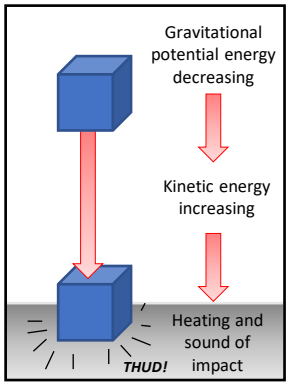
KE = ½ mass x velocity^2
KE = ½ m v^2

Energy stored in a stretched or compressed object can be calculated using :

E = ½ spring constant x extension^2
E = ½ k e^2

Transfers of energy:

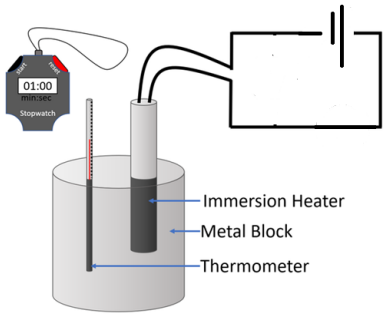
E.g. An object above ground has GPE.
If that object falls:
1. Decreases its GPE store
2. Increases its KE store as it falls
3. Waste energy transferred to the environment by heating and sound



Specific heat capacity
The amount of energy needed to change the temperature of 1Kg of a substance by 1ºC
It is calculated by:
E = specific heat capacity x mass x temp change
E = SHC x m x θ

Units for SHC are J/Kg/°C
Different materials have different specific heat capacity values.

This can be investigated using the equipment below:



- Energy is supplied to the block by the immersion heater over a fixed time period (e.g 5 mins)
- The thermometer measures the temperature of the block at the start and the end of the experiment
- The stopwatch measures the time
- If the power of the heater is known (e.g 50W) the energy transferred to the block can be found using the equation:

Energy (J) = Power (W) x time (s)

The specific heat capacity of different materials can be investigated by:
- changing the metal **(independent variable)**
- measuring the temperature increase **(dependent variable)**
- Keeping the energy supplied, mass and insulation the same **(control variables)**

Insulating the block reduces energy transferred to the thermal store of the environment, improving accuracy

Energy Stores

Complete the table:

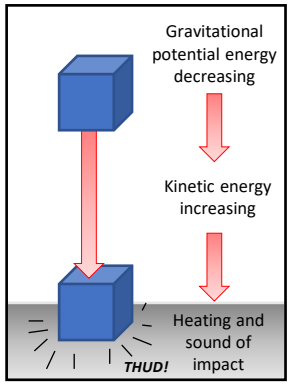
Store	Stored in…
kinetic	
	objects raised above ground
Elastic potential	
	All objects due to particle movement
Chemical	
	The nucleus of atoms
Magnetic	
	Separation of charges

1. What is the conservation of energy law?
2. In what two general ways is energy transferred?
3. What is wasted energy?

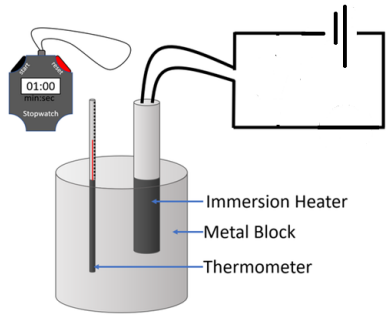
Efficiency

1. What is the equation to calculate efficiency?
2. Where does wasted energy end up?

1. What is the equation linking gravitational field strength, GPE, height and mass?
2. What is the equation linking kinetic energy, mass and velocity?
3. What quantity is found in both equations?
4. What happens to the GPE store when a raised object falls?
5. What happens to the KE store of a raised object when it begins to fall?
6. By which two pathways is energy transferred to the environment when an object falls?



1. What is the specific heat capacity of a substance?
2. In the hypothesis ‘different metals have different specific heat capacity values’ what is the independent variable?



3. What does the immersion heater do?
4. What two readings are taken using the thermometer?
5. What is a sensible time period to use for transferring energy to the block?
6. What should be put round the block?

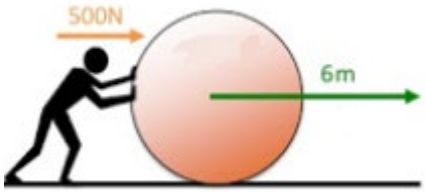
Power and work done

Work done = energy transferred

Energy transferred mechanically is calculated:

Work done = force x distance

W (J) = F (N) x s (m)



Work done = 500N x 6m

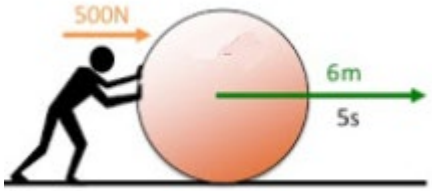
= 3000 J

Power = energy transferred per second

1 Watt = 1 Joule per second

Power = energy transferred ÷ time

P (W) = e (J) ÷ t (s)



Power = Energy ÷ time

= 3000 J ÷ 5 s

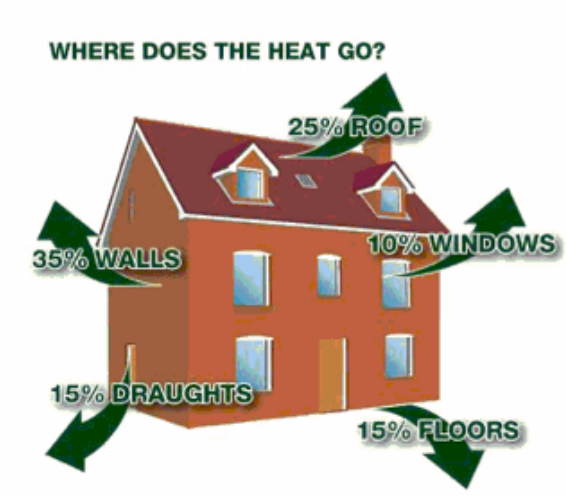
= 600W

A more powerful appliance transfers more energy per second, eg:

Reducing unwanted energy transfers

Reducing wasted energy means lower costs

Materials that conduct heat well have a high **thermal conductivity**.



Reducing energy transfers in homes

- Double glazing
- Thick walls
- Walls made of materials with low thermal conductivity
- Insulation – wall and loft

Reducing energy transfers in appliances:

- Lubrication – reduces friction

- Streamlining – reduces air resistance

Energy resources

We use energy resources for electricity generation, transport and heating

Non-renewable – ones that are being used faster than they can be replaced and will run out.

Example	+	-
Coal, oil, natural gas	Reliable method of generating electricity	Release CO_2 which contributes to global warming
nuclear	No CO_2 released	Produces radioactive nuclear waste

Renewable resources:

Ones that will not run out , they are being replenished as they are used

Example	+	-
Solar	No CO_2 released	Don't work at night or well on cloudy days
wind	No CO_2 released	Doesn't work if it isn't windy
Hydro	No CO_2 released	Damage to habitats
Geothermal	No CO_2 released	Only found in specific places
waves	No CO_2 released	Damage to habitats
Biofuel	Carbon neutral	Uses crop land to grow new forests

1. What are the units for work done?

2. What are the units for force?

3. What is the equation to calculate work done during mechanical work?

4. What is the equation to calculate power?

5. What is the unit for power?

6. What is the unit for time in the power equation?

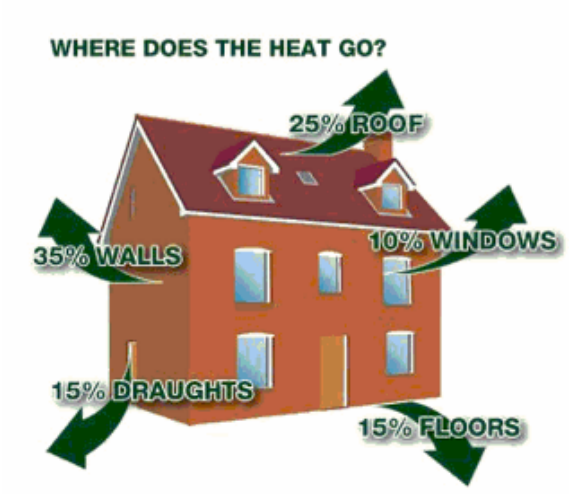
7. What is 1 Watt equivalent to?

8. How would you recognise a more powerful lightbulb?

9. What is meant by a more powerful appliance?

1. Why is reducing unwanted energy transfers from the home important?

2. What is meant by 'high thermal conductivity'?

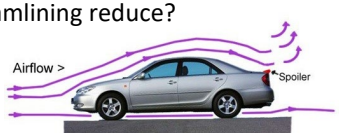


3. Where is most of the heat lost through in a house?

4. Give two ways to reduce the heat lost though the walls of a house.

5. What does lubrication reduce?

6. What does streamlining reduce?



1. Give the three main uses for energy resources

2. What is a non-renewable energy resource?

3. Give 2 examples of non-renewable energy resources

4. Give two disadvantages of using coal and oil

5. Give one advantage to using nuclear resources to generate electricity.

6. What is a renewable energy resource?

7. Give 4 examples of renewable resources

8. Give 2 advantages of using renewable resources to generate electricity

9. Give two disadvantages of using renewable resources to generate electricity