Worksheet: Energy Stores and Transfers

PhysicsSheets

Specification: GCSE Physics (AQA 4.1.1.1 & 4.1.1.2 / Edexcel SP3)

Energy Stores: Kinetic, Gravitational Potential, Elastic Potential, Thermal, Chemical, Electrostatic, Magnetic, Nuclear.

Energy Transfers: Mechanically (by forces), Electrically (by current), By Heating (conduction, convection, radiation), By Radiation (light, sound).

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

Section A: Energy Stores & Transfers

1. Identify the primary energy store described in each case:

a) Energy stored in a moving object. **Kinetic**

b) Energy stored in the bonds of chemicals. **Chemical**

c) Energy stored due to an object's height in a gravitational field. **Gravitational Potential**

d) Energy stored in a stretched or compressed spring. **Elastic Potential**

e) Energy stored in the nucleus of an atom. **Nuclear**

f) Energy stored in a hot object. **Thermal**

2. Complete the sentences below using appropriate scientific terms:

a) The principle of conservation of energy states that energy cannot be **created** or **destroyed**, only **transferred** from one store to another.

b) When energy is transferred, some energy is often **dissipated** to the surroundings, usually as **thermal** energy, making it less **useful**.

c) The four main ways energy can be transferred are by **mechanical** work, **electrical** work, **heating**, and by **radiation** (e.g., light or sound).

Section B: Energy Transfers in Scenarios

3. For each scenario, describe the main energy transfers that occur, including any energy that is dissipated to the surroundings.

a) A child slides down a plastic slide from the top to the bottom.

Model Answer:
Gravitational potential energy (GPE) of the child is transferred to kinetic energy as they slide down. Some energy is dissipated as thermal energy due to friction between the child and the slide, and as sound energy.

b) A battery-powered torch is switched on, producing light.

Model Answer:
Chemical energy stored in the battery is transferred electrically to the torch. This energy is then transferred to light energy and thermal energy (heating up the bulb/LED).

c) A car travelling at speed applies its brakes and comes to a stop.

Model Answer:
The kinetic energy of the car is transferred mechanically by the brakes. This energy is dissipated as thermal energy in the brakes and tyres due to friction, and as sound energy.

d) A compressed spring launches a small ball vertically upwards, which then reaches its maximum height.

Model Answer:
Elastic potential energy stored in the compressed spring is transferred to kinetic energy of the spring and then to kinetic energy of the ball. As the ball rises, its kinetic energy is transferred to gravitational potential energy. Some energy is dissipated as thermal and sound energy due to air resistance.

Section C: Exam Application & Extended Writing

4. A student investigates the efficiency of a small electric motor lifting a mass.

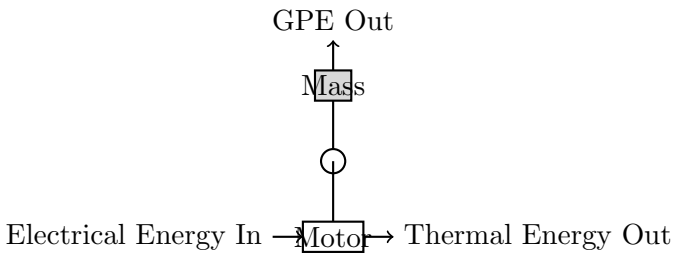

Figure 1: Electric Motor Lifting a Mass

a) The motor is supplied with 200 J of electrical energy. It lifts the mass, gaining 120 J of gravitational potential energy. Calculate the efficiency of the motor and explain what happens to the 'wasted' energy.

Model Answer:
Efficiency = (Useful Energy Out / Total Energy In) $\times 100\%$ = (120 J/200 J) $\times$ 100% = 60%. The 'wasted' energy (80 J) is dissipated to the surroundings, primarily as thermal energy (heating the motor and surroundings) and some sound energy.

b) A 2.0 kW electric kettle is used to boil 1.5 kg of water. Describe the energy transfers involved from the moment the kettle is switched on until the water reaches boiling point. Explain, in terms of the particles, how the thermal energy is transferred through the water and how the internal energy of the water changes as it heats up. (6 marks)

Model Answer:
1. Electrical energy is transferred from the mains supply to the heating element of the kettle.
2. The heating element transfers this energy by heating to the thermal energy store of the water and the kettle itself.
3. Within the water, thermal energy is transferred by convection: hotter, less dense water rises, and cooler, denser water sinks, creating convection currents.
4. Some thermal energy is also transferred by conduction from the heating element to the adjacent water particles.
5. As the water heats up, the kinetic energy of its particles (molecules) increases.
6. This increase in the average kinetic energy of the particles leads to an increase in the internal energy of the water.
7. Some energy is dissipated to the surroundings as thermal energy (heating the air) and sound energy.