P1 – ENERGY AND ENERGY RESOURCES 1.1 Changes in energy stores

Aiming for Grade 4

Energy can be stored in different ways.
List the ways energy can be stored

1. C
2. K
3. G
4. E
5. T

Energy can be transferred between different stores.
List the ways energy can be transferred

1. H
2. L
3. S
4. E

How is chemical energy stored?

How is kinetic energy stored?

How is gravitational potential energy stored?

How is elastic potential energy stored?

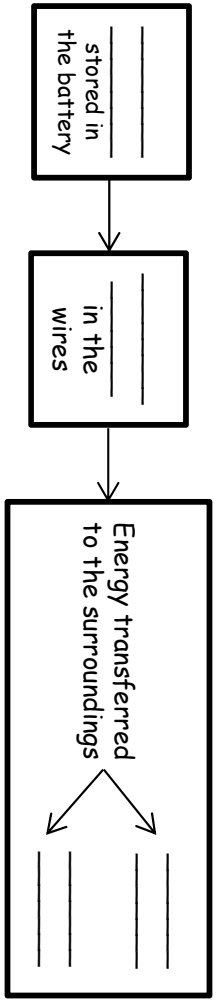
How is thermal energy stored?

Assessment
Grade 4

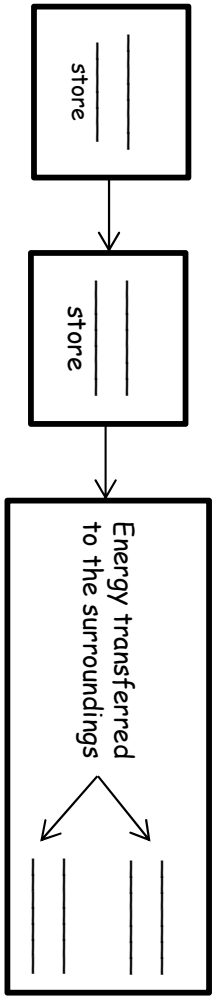
1. I can state some examples of energy stores. ☐
2. I can state the processes that can transfer energy from one store to another. ☐
3. I can identify changes in some energy stores using simple systems. ☐

Aiming for Grade 6

Draw an energy transfer diagram for a torch



Draw an energy transfer diagram for a falling object hitting the ground



Assessment
Grade 6

1. I can describe a wide range of energy stores in different contexts. ☐
2. I can describe changes in energy stores in terms of the process that causes the change. ☐

Aiming for Grade 8

A stone is dropped from a height. Explain why all of the gravitational potential energy is not transferred as kinetic energy.

A battery powers a torch. Explain why all of the chemical energy is not transferred as light energy.

On the axes sketch two lines, one showing how gravitational potential energy changes for a falling object and the other showing how kinetic energy changes..

Assessment
Grade 8

1. I can describe the nature of energy stores in detail including the relationship between objects. ☐
2. I can explain factors that affect the size of changes in energy stores. ☐
3. I can represent energy changes graphically, accounting for changes in all stores. ☐

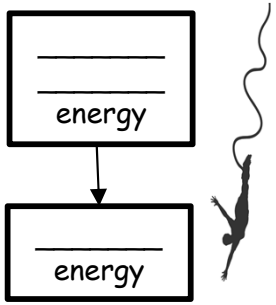
P1 – ENERGY AND ENERGY RESOURCES 1.2 Conservation of energy

Aiming for Grade 4

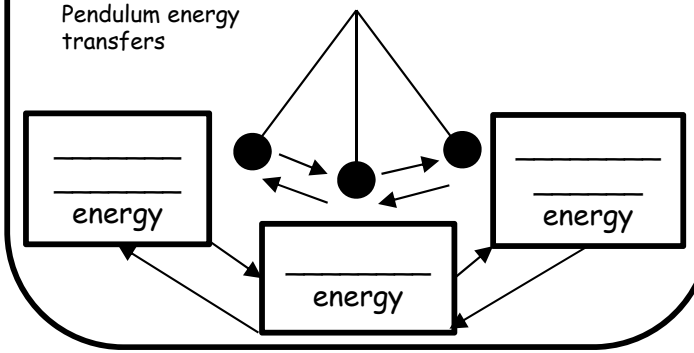
State the law of conservation of energy

What is meant by useful and wasted energy?

Bungee jump energy transfers



Pendulum energy transfers



Assessment

Grade 4

1. I can state that energy is conserved in any transfer. ☐
2. I can state that energy is dissipated (is no longer useful) when it heats the environment.. ☐
3. I can investigate the energy transfers in a pendulum and bungee.. ☐

Aiming for Grade 6

For a light bulb state the useful and wasted energy transfers.

Where does the wasted energy go?

For a roller coaster state the useful and wasted energy transfers.

Where does the wasted energy go?

Why does a bungee jump never bounce as high as it started?

Why is the second hill on a roller coaster never as high as the first?

Why does a pendulum swing become lower on each swing?

Assessment

Grade 6

1. I can apply the law of conservation of energy in straightforward situations.. ☐
2. I can describe changes in energy stores explaining why energy ceases to be useful. ☐
3. I can describe the energy changes in a range of experiments and account for energy dissipation to the surroundings. ☐

Aiming for Grade 8

How do brake pads slow down a car?

When the car slows down what energy store changes?

Where is this energy transferred to and as what ?

What causes this energy transfer?

What is meant by a closed system?

In a closed system 100J of electrical energy is transferred as kinetic energy and heat. How many joules of energy would the kinetic and heat total?

Assessment

Grade 8

1. I can apply the law of conservation of energy to explain why forces cause heating effects ☐
2. I can describe closed systems and the changes to energy stores within them using the principle of conservation of energy. ☐
3. I can evaluate in detail experiments to investigate energy changes. ☐

P1 – ENERGY AND ENERGY RESOURCES 1.3 Energy and work

Aiming for Grade 4

State the unit of energy

Write the equation for work done

Work done = ☐ × ☐

Write down what is meant by work done

A boy pushes a box a distance of 6.0m across flat ground with a force of 50N. How much work is done by the boy?

How would you use a Newton meter and a metre ruler to measure the work done by a force?

Assessment
Grade 4

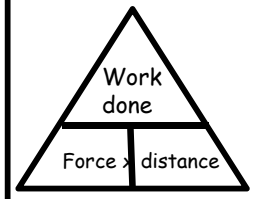
1. I can state that energy is measured in joules (J). ☐
2. I can calculate the work done by a force. ☐
3. I can measure the work done by a force experimentally. ☐

Aiming for Grade 6

When a meteorite falls through the atmosphere why does it burn up?

Why do car brakes get hot?

A car loses 140kJ of kinetic energy to bring it to a standstill. The car stops in 20m. Calculate the force applied by the brakes



How could you make experiment results more valid?

Assessment
Grade 6

1. I can describe the action of frictional forces on objects and the associated heating effect ☐
2. I can use the equation for work done to calculate distances or size of forces. ☐
3. I can use repeat values to measure the work done by a force experimentally.. ☐

Aiming for Grade 8

As a driver applies brakes in a car to bring a car to a standstill, describe why the brake pads become warm in terms of the work done by the braking force.

A cyclist applies his brakes. 1400J of work is done to reduce the kinetic energy store and stop the bicycle. The brakes apply a force of 200N. What distance does the bicycle take to stop?

In the experiment using a Newton meter to measure the work done, why might the results for work done be different each time?

Assessment
Grade 8

1. I can use the principle of conservation of energy and forces to explain why objects become heated by frictional forces.. ☐
2. I can apply the equation for work done in a wide range of contexts. ☐
3. I can evaluate in detail an experiment to measure work done, explaining why there is variation in the measurements.. ☐

P1 – ENERGY AND ENERGY RESOURCES 1.4 Gravitational Potential Energy

Aiming for Grade 4

Write down the equation for gravitational potential energy

Gravitational potential energy E_P = ☐ × ☐

What factors affect the amount of gravitational potential energy that is stored in an object?

1.

2.

A student of weight 450N steps on a box of height 0.2m. Calculate the increase in his gravitational potential energy store.

How could you measure a change in your gravitational potential energy store?

Assessment

Grade 4

1. I can state the factors that affect the change in the gravitational potential energy store of a system. ☐
2. I can calculate the gravitational potential energy store of a system using the weight of an object and its height. ☐
3. I can measure the gravitational potential energy store changes in a system with a simple practical activity. ☐

Aiming for Grade 6

Write down a second equation for gravitational potential energy that uses the effect of gravitational field strength

Gravitational potential energy E_P = ☐ × ☐ × ☐

The gravitational field strength on Earth is 9.8N/kg, the Moon is 1.7N/kg and on Jupiter it is 26.0N/kg. If a 65kg person climbs a 10m ladder on each planet calculate his gravitational potential energy for each.

Earth

Moon

Jupiter

Assessment

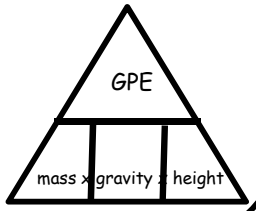
Grade 6

1. I can describe the effect of different gravitational field strength on the gravitational potential energy store changes of a system. ☐
2. I can calculate the gravitational potential energy store of a system using the mass gravitational field strength, and height. ☐

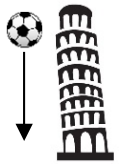
Aiming for Grade 8

A ball stores 100J of gravitational potential energy and is dropped from a height of 10m on Earth. What is the mass of the ball?

A box of mass 50kg stores 250J of gravitational potential energy on Earth. What is the change in the height of the box?



A ball is dropped from the Leaning Tower of Pisa. Describe the changes in the energy stores as the ball falls.



Assessment

Grade 8

1. I can perform calculations using rearrangements of the gravitational potential energy store equations. ☐
2. I can apply gravitational potential energy store equations in a wide range of contexts. ☐
3. I can account for all changes of energy during falls or increases in height. ☐

P1 – ENERGY AND ENERGY RESOURCES 1.5 Kinetic and elastic energy stores

Aiming for Grade 4

What factors affect the amount of kinetic energy that is stored in an object?

1.

2.

What factors affect the amount of elastic potential energy that is stored in an object?

1.

2.

Describe the changes in the energy stores when an arrow is released from a stretched crossbow.

Describe the changes in the energy stores when a stretched elastic band is released.

Assessment

Grade 4

1. I can state the factors that affect the size of a kinetic energy store of an object. ☐
2. I can state the factors that affect the elastic potential energy store of a spring. ☐
3. I can describe energy transfers involving elastic potential energy and kinetic energy stores. ☐

Aiming for Grade 6

Write down the equation for kinetic energy

Kinetic energy E_K = ☐ × ☐ × ☐

Write down the equation for elastic potential energy

Elastic potential energy E_e = ☐ × ☐ × ☐

A vehicle of mass 600kg is moving with a speed of 22m/s. Calculate its kinetic energy store.

A spring has a spring constant k of 0.5N/m. It stretches 20cm when a weight is added to it. Calculate how much elastic potential energy is stored in the spring.

Assessment

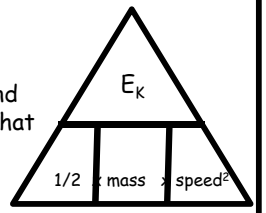
Grade 6

1. I can calculate the kinetic energy store of an object. ☐
2. I can calculate the elastic potential energy store of a stretched spring. ☐
3. I can investigate the relationship between the energy stored in a spring and the kinetic energy store of an object launched from ☐

Aiming for Grade 8

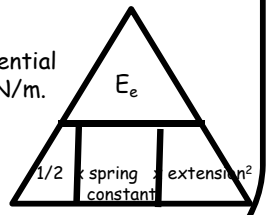
The Flying Scotsman locomotive stores 99MJ of Kinetic energy. It's mass is 98000kg. What speed is it travelling?

A sailing boat travels at 13.5m/s and stores 13.7kJ of kinetic energy. What mass is the boat?



A spring stores 5mJ of elastic potential energy when it is stretched 0.1m. What is the spring constant?

A spring stores 1.5J of elastic potential energy. The spring constant is 0.7N/m. What is the spring's extension?



Assessment

Grade 8

1. I can perform calculations involving the rearrangement of the kinetic energy equation. ☐
2. I can perform calculations involving the rearrangement of the elastic potential energy equation.. ☐
3. I can perform a wide range of calculations involving transfer of energy. ☐

P1 – ENERGY AND ENERGY RESOURCES 1.6 Energy dissipation

Aiming for Grade 4

What is meant by useful energy?

What is meant by wasted energy?

In what form is most energy wasted?

To where is this wasted energy dissipated?

When an aeroplane takes off the chemical energy stored in the fuel is transferred in to what new stores?

Which of these stores is useful and which is wasted?

How could you use a Newton meter to measure the frictional force acting on an object?

Assessment

Grade 4

1. I can identify useful and wasted energy in simple scenarios. ☐
2. I can describe energy dissipation in terms of heating the surroundings ☐
3. I can measure the frictional force acting on an object. ☐

Aiming for Grade 6

Identify the useful and wasted energy

Candle

Chemical energy store → Transferred to the surroundings → Light / Heat

Television

Electrical energy → Transferred to the surroundings → Light / Sound / Heat

A roller coaster has many hills. The amount of gravitational potential energy stored at the top of a hill is always greater than the amount of kinetic energy.

Explain why

Describe ways that you could change the frictional forces acting on an object in a laboratory experiment.

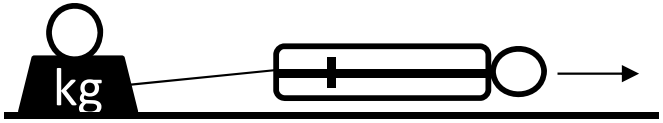
Assessment

Grade 6

1. I can analyse energy transfers to identify useful and less useful energy transfers. ☐
2. I can describe energy dissipation and how this reduces the capacity of a system. ☐
3. I can investigate the factors that affect frictional forces. ☐

Aiming for Grade 8

In an experiment, a kilogram mass is placed on a rough surface and pulled along a distance of 1m with a Newton meter.



Repeated measurements are taken.

How would you know the results were precise?

Why would more work have to be done to pull the mass over rough surfaces?

Write down three ways which friction is useful.

Write down three ways where friction is unwanted.

Assessment

Grade 8

1. I can use a wide range of energy stores and physical processes to decide on wasted and useful energy transfers. ☐
2. I can apply the concept of energy dissipation in a wide range of scenarios ☐
3. I can evaluate in detail an experiment to measure the frictional forces acting on an object. ☐

P1 – ENERGY AND ENERGY RESOURCES 1.7 Energy and efficiency

Aiming for Grade 4

What is meant by energy efficiency?

How efficient can a device be?

How can you improve the efficiency of a device?

Draw energy transfer diagrams for the following electrical devices.

Kettle

Motor

Heater

Assessment

Grade 4

1. I can describe an efficient transfer as one that transfers more energy by a useful process. ☐
2. I can state that the efficiency of a simple energy transfer is always less that 100%. ☐
3. I can describe the energy transfers carried out by electrical devices. ☐

Aiming for Grade 6

Write down the equation for efficiency

Efficiency = $\frac{\square}{\square} \times \square$

A light bulb transfers 40J of electrical energy. 4J is transferred as light and 36J as heat. How efficient is the light bulb?

Explain why the efficiency of a machine or device can never be greater than 100%

Explain why the efficiency of a machine or a device can never be equal to 100%

What four things cause energy to be wasted in devices?

Assessment

Grade 6

1. I can calculate the efficiency of a range of energy transfers. ☐
2. I can use the law of conservation of energy to explain why efficiency can never be greater than 100%. ☐
3. I can describe the processes that waste energy in electrical devices. ☐

Aiming for Grade 8

A machine is 25% efficient. The total energy supplied to the machine is 5600J. How much energy is transferred usefully?

For the four things that cause energy to be wasted in electrical and mechanical devices, how can the efficiency be improved?

Assessment

Grade 8

1. I can describe design features that can be used to improve the efficiency of an energy transfer. ☐
2. I can rearrange the efficiency equation to find input or total output energy. ☐
3. I can explain the operation of electrical devices in terms of forces and electric current. ☐

P1 – ENERGY AND ENERGY RESOURCES 1.8 Electrical appliances

Aiming for Grade 4

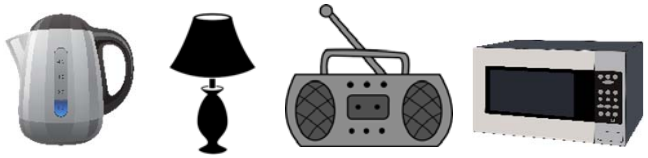
Make a list of electrical appliances that you may use at home

What are the useful energy transfers for the appliances you have listed?

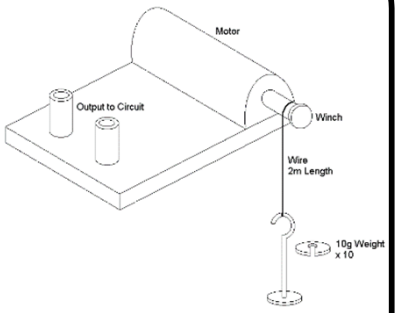
Assessment
Grade 4
1. I can list some electrical appliances. ☐
2. I can survey a range of electrical devices and their operation. ☐
3. I can calculate the efficiency of a simple energy transfer. ☐

Aiming for Grade 6

Rank these devices in order of their power



Using the equipment in the diagram, write a method of how you could test the efficiency of the motor.



Assessment
Grade 6
1. I can rank electrical devices in terms of their power. ☐
2. I can compare mains-powered and battery-powered devices. ☐
3. I can investigate the efficiency of a motor. ☐

Aiming for Grade 8

Which kettle is more efficient?

A. 2000J of electrical energy is transferred as 1600J of heat energy.
B. 2200J of electrical energy is transferred as 1870J of heat energy
C. 2000J of electrical energy is transferred as 300J of sound energy
D. 1700J of heat energy and 200J of sound energy are transferred from the electrical energy

In the motor experiment why is the kinetic energy to gravitational potential energy transfer not 100% efficient?

If you double the mass would you need double the amount of energy?

Assessment
Grade 8
1. I can compare electrical devices in terms of efficiency. ☐
2. I can calculate the efficiency of an electrical device. ☐
3. I can evaluate in detail an efficiency investigation to justify conclusions. ☐

P1 – ENERGY AND ENERGY RESOURCES 1.9 Energy and Power

Aiming for Grade 4

What is the unit of power?

What are the useful and wasted energy transfers for the following appliances?

Assessment

Grade 4

1. I can state the unit of power as the watt and kilowatt. ☐
2. I can, with support, rank electrical appliances in order of power. ☐
3. I can identify 'wasted' and 'useful' energy transfers in electrical devices. ☐

Aiming for Grade 6

Write down the equation for power

Power = $\frac{\square}{\square}$

Write down the equation for efficiency using power ratings

Efficiency = $\frac{\square}{\square} \times \square$

Write down the equation for wasted power

Power wasted = $\square - \square$

A motor is supplied with 5000W of power. It transfers 8000J in 20s to gravitational potential energy. Calculate how much energy is supplied to the motor.

Calculate its efficiency

Assessment

Grade 6

1. I can calculate the energy transferred by an electrical device. ☐
2. I can calculate the efficiency of a device from power ratings. ☐
3. I can find the wasted power of a device. ☐

Aiming for Grade 8

Rank these power ratings in order from least to most powerful

A. 1kW
B. 10W
C. 1200W
D. 1MW

A 12kW electric shower is used 4 times per day for 20 minutes each time. Calculate the energy supplied to it by the electricity in one day.

52MJ of energy is used to heat the water. How efficient is the shower?

Assessment

Grade 8

1. I can compare the power ratings of devices using standard form. ☐
2. I can apply the efficiency equation in a range of situations, including rearrangement of the equation. ☐
3. I can combine the electrical power equation with other equations to solve complex problems. ☐