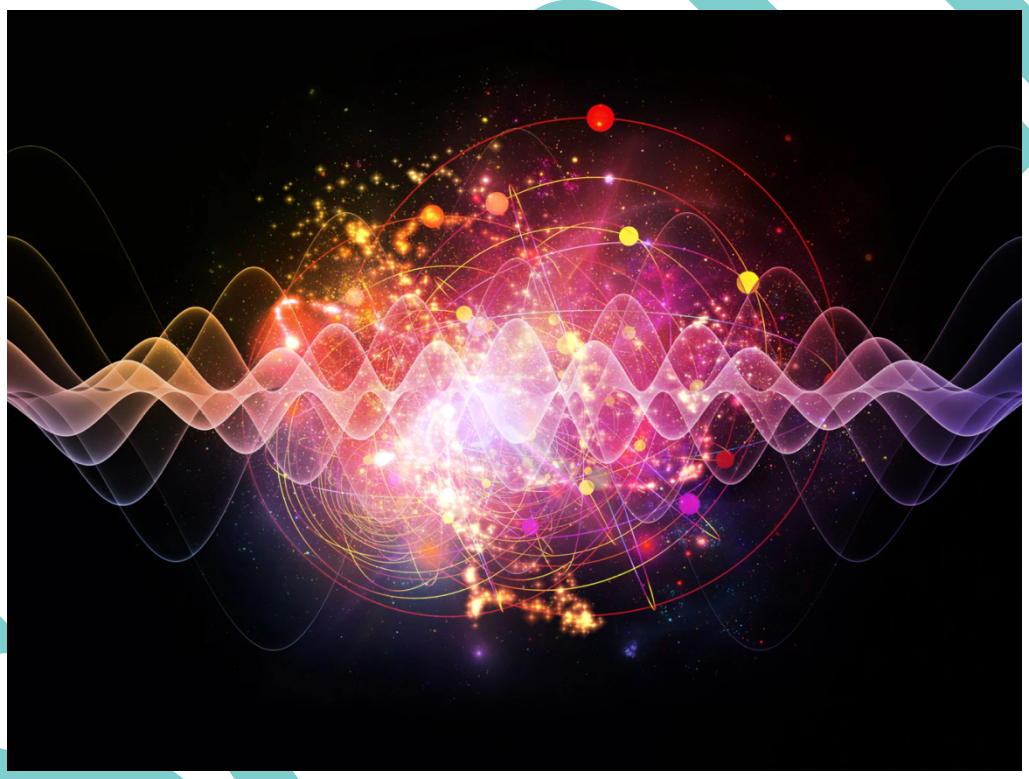
AQA GCSE PHYSICS

STUDENT BOOKLET

TOPIC 1: Energy



Session 1	Conservation of Energy
Session 2	Sankey Diagrams and Efficiency
Session 3	Calculating energy
Session 4	Work & Power

Session 1: Conservation of Energy

Session Objectives
• State and identify the main types of energy stores.
• Describe the ways in which energy transfers take place.
• Explain what is meant by the conservation of energy.

Starter

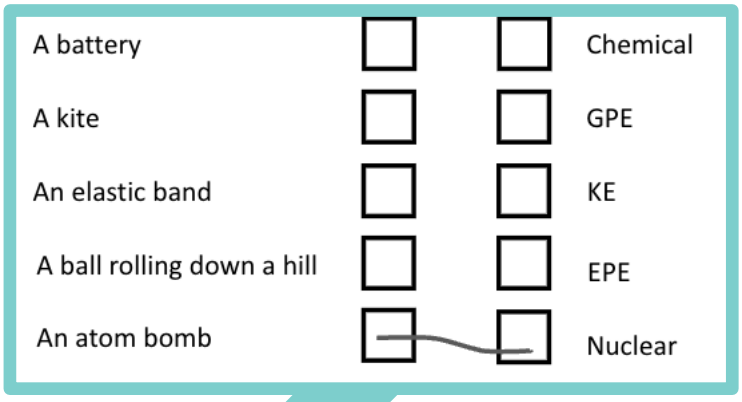
1. **Can you find the words listed below. Match them with their definition by drawing a line and give an example.**

K	E	L	E	C	T	R	O	S	T	A	T	I	C	G	B
V	V	Y	J	R	K	I	N	E	T	I	C	W	J	V	W
B	B	Z	H	X	L	M	A	G	N	E	T	I	C	A	O
X	G	V	R	C	H	E	M	I	C	A	L	P	I	G	G
E	F	R	L	M	P	W	A	H	C	K	W	D	N	N	E
L	F	C	A	A	E	O	K	I	D	E	N	I	O	U	B
E	O	Y	V	V	D	C	T	E	K	Q	T	W	B	C	O
C	T	P	S	M	I	S	H	B	K	A	O	B	E	L	F
T	M	A	T	Y	A	T	H	A	E	D	C	E	K	E	R
R	N	V	J	L	M	I	A	H	N	Q	H	U	S	A	Y
I	X	N	E	A	N	K	H	T	G	I	U	C	Q	R	W
C	C	C	S	E	V	M	S	P	I	E	C	Q	W	F	X
A	T	H	E	R	M	A	L	Y	F	O	H	A	X	W	F
L	R	A	D	I	A	T	I	O	N	K	N	X	L	M	N
L	A	O	G	F	Z	U	F	V	P	O	K	A	E	L	T
Y	W	B	K	U	A	K	P	X	H	J	Z	C	L	S	Y

"729": Can you find any other terms in the wordsearch? What do you think these are?

Word		What is it?	Example
Chemical		The energy of a moving object.	
Kinetic		The energy stored when repelling charges have been moved closer together or when attracting charges have been pulled further apart.	
Gravitational		The energy stored in the nucleus of an atom.	
Elastic		The total kinetic and potential energy of the particles in an object, this is mostly from the particle vibrations. In hotter objects, the particles have more internal energy and vibrate faster.	
Thermal		The energy stored when an object is stretched or squashed.	
Magnetic		The energy of an object at height.	
Nuclear		The energy stored in chemical bonds, such as those between molecules.	
Electrostatic		The energy stored when magnetic materials attract or repel each other.	

Match the energy store to the object.



Energy Stores

A system is an object or group of objects.
When a system changes in any way, the energy stored in that system also changes.

For example:
A ball rolling down a ramp into a wall.

The ball is the system, and when it hits the wall, some of it's kinetic energy is transferred as sound.

Now you try:
A vehicle slowing down.
What is the system and what are the energy changes taking place?

Representing Energy Changes

To represent or describe an energy change for a ball being dropped we need to do 3 steps. Complete the example below:

Energy Pathways

Energy pathways (or transfers) are the mechanisms by which energy changes happen. There are 4 of them.

Electrically

By Heating

Mechanically

By Radiation (light or sound)

State the energy pathway being described below:

When energy is transferred down a wire

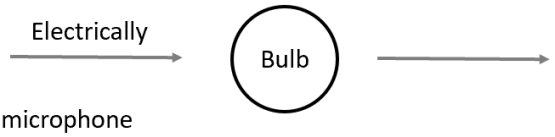
When energy is transferred as objects change position

When energy is transferred as light

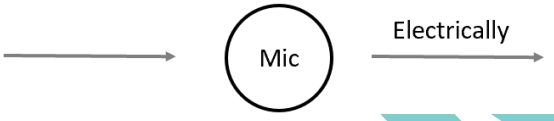
When energy is transferred as objects cool down

Write the pathway for the energy transfer over the arrows.

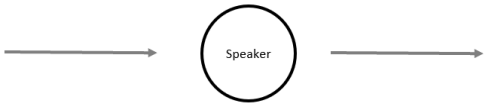
a) A mains powered lamp



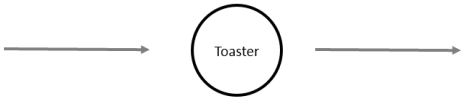
b) A microphone



c) A speaker

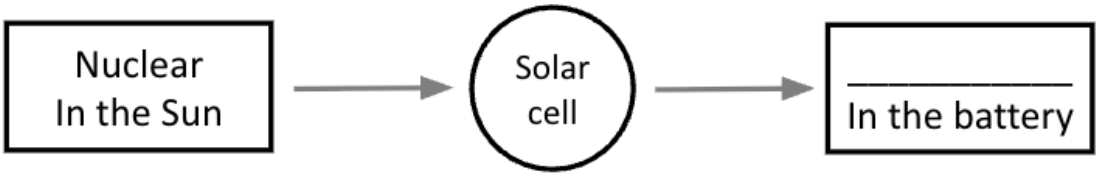


d) A toaster

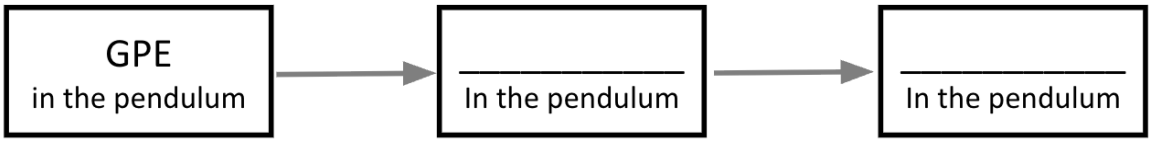


Now fill in the missing energy stores AND pathways for these examples.

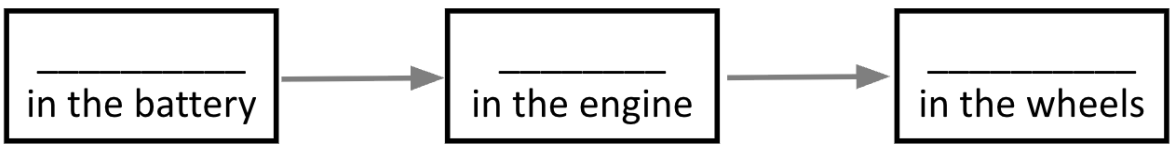
1. A solar powered battery charger



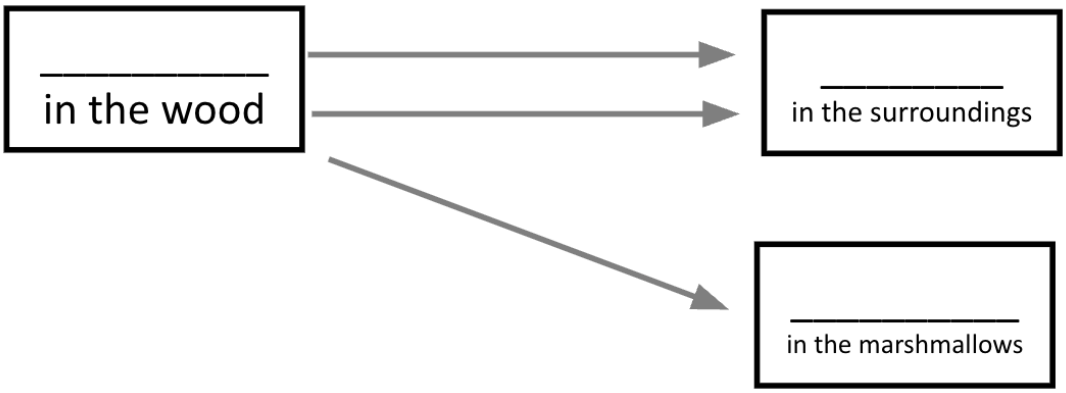
2. A swinging pendulum



3. An electric car



4. Cooking Marshmallows over a fire.

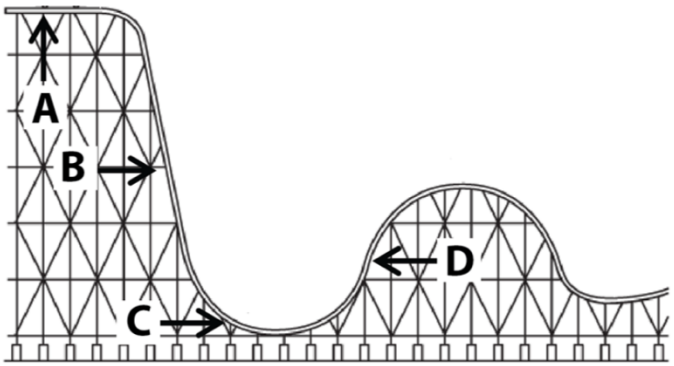


Conservation of Energy

Energy can be transferred usefully, stored or dissipated, but it can not be created or destroyed. This is what we call the "conservation of energy". We will use this idea a lot in our energy calculations later on.

Take the example of a roller coaster. Where the energy is constantly changing between the kinetic store of the car and the gravitational store of the car.

If the total amount of energy in the system (the car), remains the same, complete these boxes to describe what is happening to the energy of the system at each point.



"729" What factors do you think the gravitational potential energy of the car depend on?

What factors do you think the kinetic energy of the car depends on?

(We will be calculating these later on!)

A

GPE KE

At point **A** the roller coaster has energy in it's _____ energy store.
It has no energy in it's _____ energy store.

B

GPE KE

At point **B** _____ of the energy from the roller coaster's gravitational potential energy store has been transferred to its kinetic energy store.

C

GPE KE

At point **C** _____ of the energy in the roller coaster's gravitational potential energy store has been transferred to it's _____ energy store.

D

GPE KE

At point **D** a quarter of the energy in the roller coaster's kinetic energy store has been transferred to it's _____ energy store.

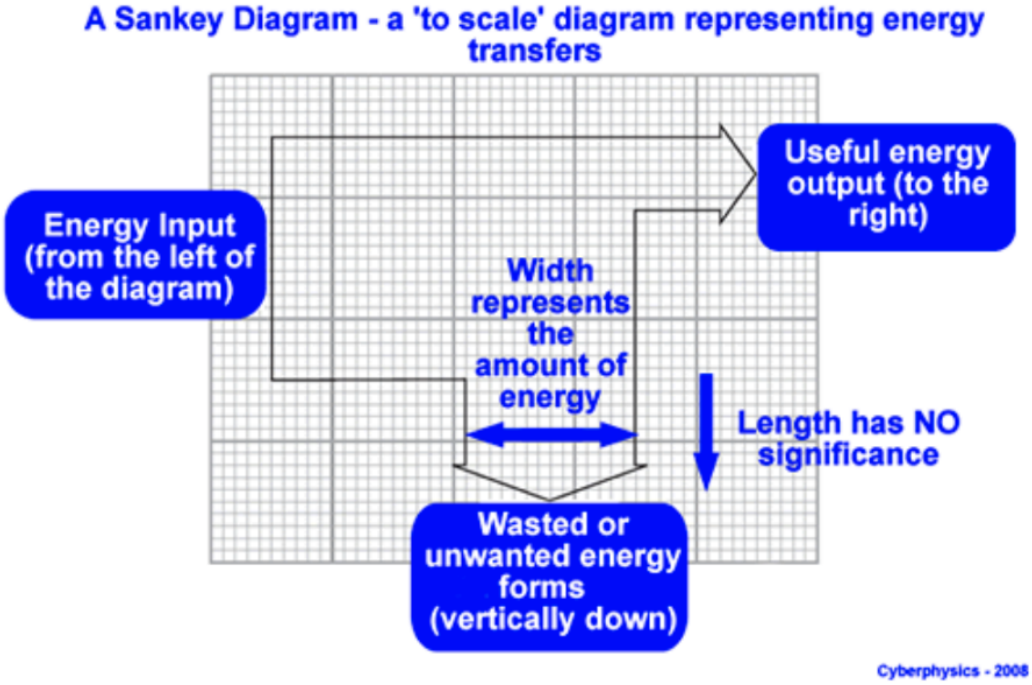
Session 2: Sankey Diagrams & Efficiency.

Session Objectives
• State what is meant by wasted energy and identify examples.
• Describe energy transfers using Sankey diagrams
• Evaluate energy transfers to calculate their efficiency.

A Sankey diagram shows you how well a machine uses energy. In other words, it tells you if it uses it **efficiently** (without much waste) or **inefficiently** (with a lot of waste).

The thickness of the arrows shows how much energy is involved. (The length of the arrows does not matter in a Sankey Diagram.) Useful energy transfers are shown going left to right. Wasteful energy transfers are shown going upwards.

How to draw a Sankey diagram.

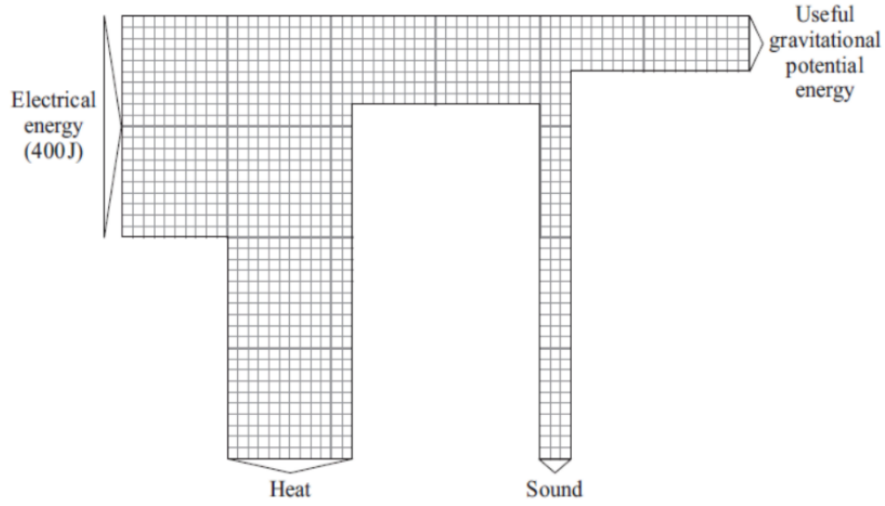


Finding values from Sankey Diagrams

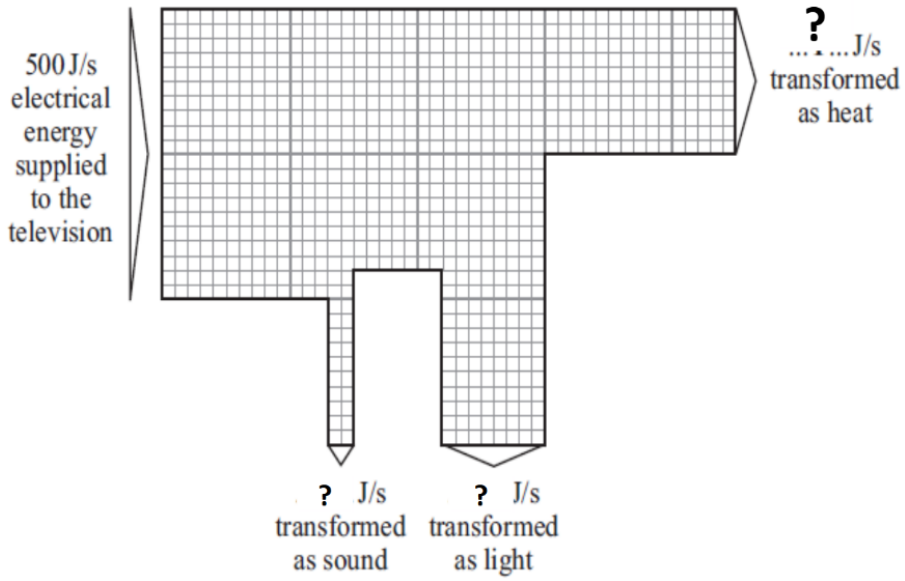
For each of the two diagrams work out how much energy there is for each arrow. Show how you did this.

An electric motor is used to lift a weight.

The Sankey diagram shows the energy transformations that take place each second in the electric motor.



The Sankey diagram shows the energy flow for a television.



We will come back to using Sankey Diagrams in a minute.

Efficiency.

Whilst we know energy can not be created or destroyed, whenever energy is transferred, some energy is always lost. We call this wasted energy. Some appliances waste a lot of energy. The more efficient an appliance is, the less energy it wastes.

Efficiency is a measure of how good a device is at changing energy (or power) from one form to another. Efficiency can be calculated using the formula:

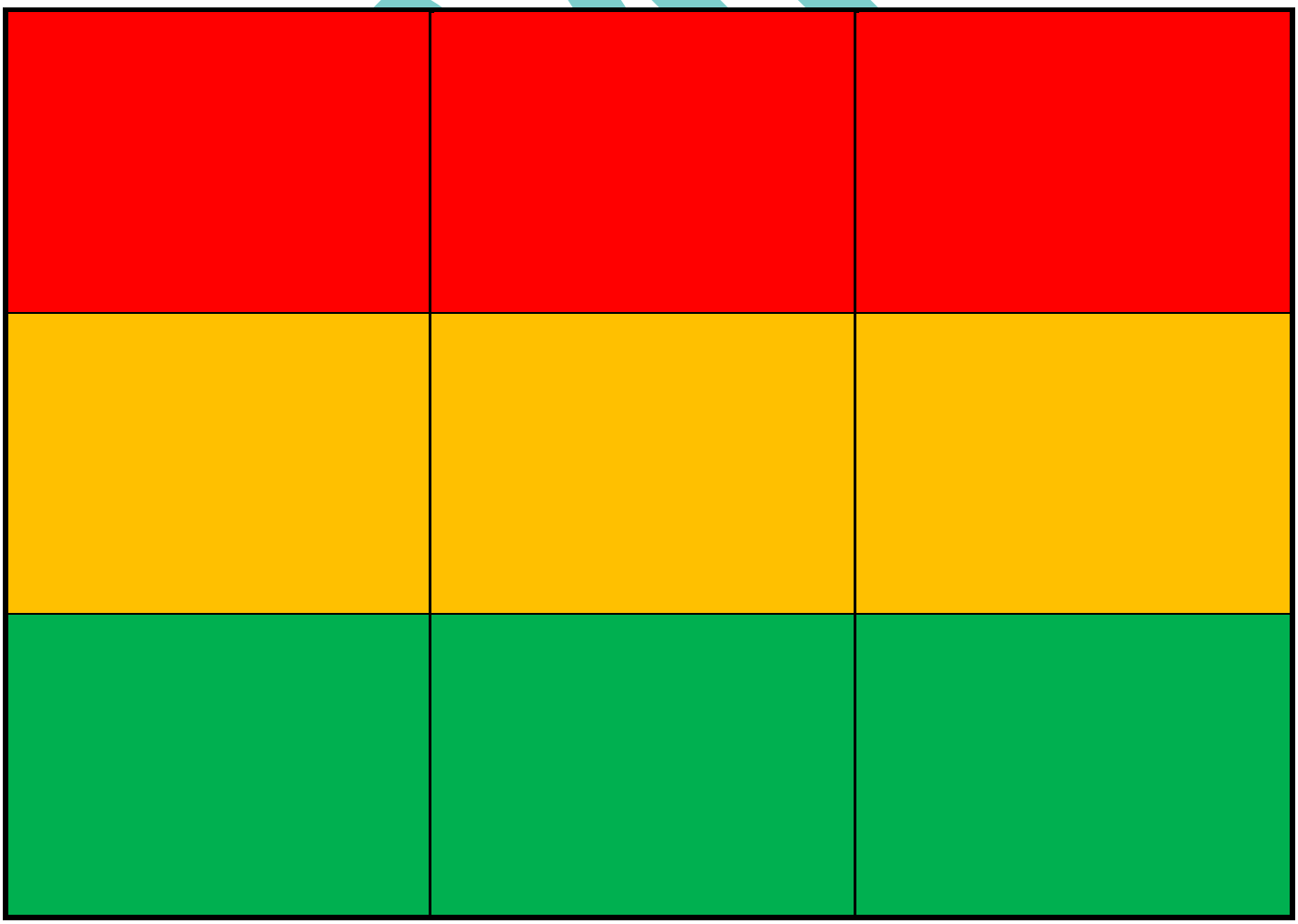
$$\text{Efficiency} = \frac{\text{Useful energy out}}{\text{Total energy in}} \qquad \text{Efficiency} = \frac{\text{Useful power out}}{\text{Total power in}}$$

To then turn this into a percentage; you can multiply either equation by 100:

$$\text{Efficiency} = \frac{\text{Useful energy out}}{\text{Total energy in}} \times 100\%$$

3 in a row

Complete any three examples making a straight line in any direction. The colour of the square signifies the level of challenge.



Efficiency Calculations

Basic:

1. Useful energy out = 100 J
   Total energy in = 120 J
2. Useful energy out = 60 J
   Total energy in = 240 J
3. Useful energy out = 50 J
   Total energy in = 150 J
4. Useful energy out = 2,000 J
   Total energy in = 4,000 J
5. Useful energy out = 117 J
   Total energy in = 443 J
6. Useful energy out = 1,200,000 J
   Total energy in = 1,600,000 J

Medium: (wordy questions)

7. An electric Drill uses a total of 160 J and produces 90 J of kinetic energy and transfers 70J of energy to the thermal energy store of the surroundings.
   What is the efficiency of the electric drill?
8. A hair drier uses a total of 180 J and produces 170J of useful energy and 10J of wasted energy.
   What is the efficiency of the hair drier?
9. A mobile phone charger uses a total of 1 J and produces 0.8 J of electrical energy and transfers 0.2 J to the thermal energy store of the surroundings.
   What is the efficiency of the mobile phone charger?
10. An electric hob uses a total of 1,500 J and produces 1,300 J of useful energy and 200 J of wasted energy.
    What is the efficiency of the electric hob?
11. A kettle uses a total of 2,500 J and produces 2,200 J of useful energy and 300 J of wasted energy.
    What is the efficiency of the kettle?

Hard: (you have to re-arrange the equation)

12. A car engine is 25% efficient. How much input energy produces 100 J of useful energy?
13. A motor has an efficiency of 40%. How much useful energy is produced from 250 J?
14. A hair dryer has an efficiency of 80%. How much useful energy is produced from 2000 J?
15. An electric heater is 90% efficient. How much useful energy is produced from 8000 J?
16. If a 50% efficient motor is supplied with 30 kJ of energy, how much useful energy is transferred?