Year 8 - Physics Revision

What is **Energy**?

The ability to do work or make things happen.

What is the unit used to measure energy?

Joule

What does the **Law of Conservation of Energy** state?

Energy cannot be created or destroyed, only changed from one form to another.

Energy Unit Conversions

How many Joules are in 1 kilojoules (kJ)?

1000

How many Joules are in 1 Mega joule (MJ)?

1000 000

For the conversion calculations below – you MUST show working.

1. How many joules are in 5.5 kJ? 5.5 x 1000 = 5500
2. How many joules are in 650 kJ? 650 000 J
3. Convert 1578 J to kilojoules. 1.578 kJ
3. How many joules are in 6.7 MJ? 6 700 000 J
4. How many joules are in 0.55 MJ? 550 000 J
5. Convert 899,000 J to Mega joules. 0.899 MJ
6. Convert 0.082 MJ to Joules. 82 000 J

Define Kinetic energy:

The energy of an object due to its motion

Define Potential Energy:

The energy stored in an object.

Classify the following energy forms as either **Potential energy** (PE) or **Kinetic Energy** (KE)

Sound energy KE	Gravitational PE	Chemical PE
Heat energy KE	Light KE	Nuclear PE
Elastic PE	Kinetic KE	

Where does all energy available on Earth come from?

The sun

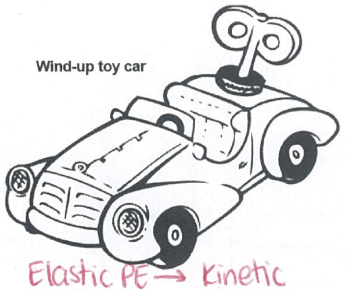
Energy Types: Match the types of energy to their descriptions:

1. Kinetic Energy	i. in vibrating air particles 2
2. Sound Energy	ii. released from glow-worms 5
3. Elastic Potential Energy	iii. Stored inside small particles that make up all matter 7
4. Gravitational Potential Energy	iv. in a stretched or squashed spring 3
5. Light Energy	v. stored in the bonds of chemical compounds/molecules 6
6. Chemical energy	vi. in a moving object 1
7. Nuclear energy	vii. in objects positioned above the ground 4

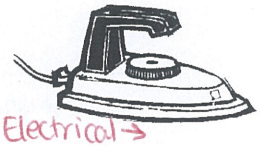
Energy transfers takes place according to the Law of constant energy. For example, as a diver performs a dive, potential energy changes into kinetic energy. The diver falls with increasing speed as more potential energy changes into kinetic energy. Due to friction (air resistance), a small amount of potential energy is converted into heat energy. However, the total energy remains constant. The potential energy at the start of the dive is equal to the kinetic energy at the end of the dive plus the heat energy that is lost.

State the energy transfers (also known as energy transformations or energy flow diagrams) taking place in the different situations below:

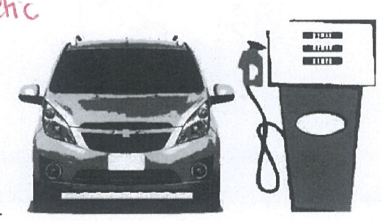
1. Chemical → kinetic → kinetic



2. Elastic PE → Kinetic



3. Electrical → heat



4. Chemical → kinetic

5. Gravitational PE → Kinetic

Energy Efficiency:

Energy efficiency is a measure of how much input energy is converted into useful output energy.

The greater proportion of useful output energy, the greater the energy efficiency of the device. (I.e. if most of the input energy is converted to useful energy output, then the device is energy efficient). If a lot of the input energy is wasted, then the device is inefficient.

$$\text{Energy Efficiency (\%)} = \frac{\text{useful energy output}}{\text{total energy input}} \times 100$$

Energy Efficiency Calculation: *show all working*

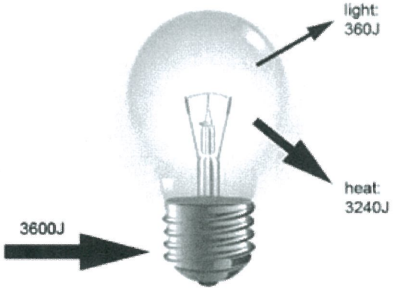
1. In 5 minutes, a gas heater used 2500 J of chemical energy. This input energy converted into 553 J of sound energy, 254 J of light energy and the remainder as heat energy. Calculate the energy efficiency of the Gas heater.

useful heat:
2500 − 553 − 254
= 1693 J

$E = \frac{1693}{2500} \times 100 = 67.72\%$

Question: Compare the efficiency of the two light bulbs shown below. Which is more energy efficient? Explain your reason using calculations.

Diagram 4: Energy transformations of a filament electric light bulb

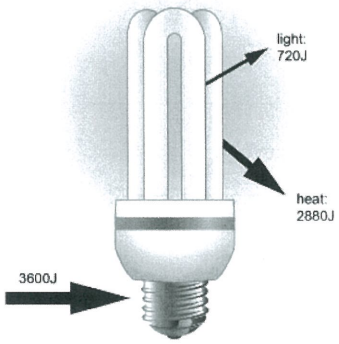


Useful energy is light:

$E = \frac{360}{3600} \times 100$

$= 10\%$

Diagram 5: Energy transformations of an energy efficient electric light bulb



Useful energy is light:

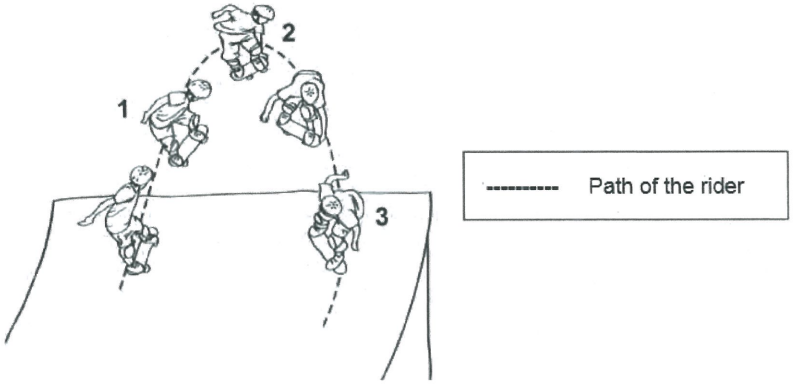
$E = \frac{720}{3600} \times 100$

$= 20\%$

Therefore bulb in diagram 5 is more efficient.

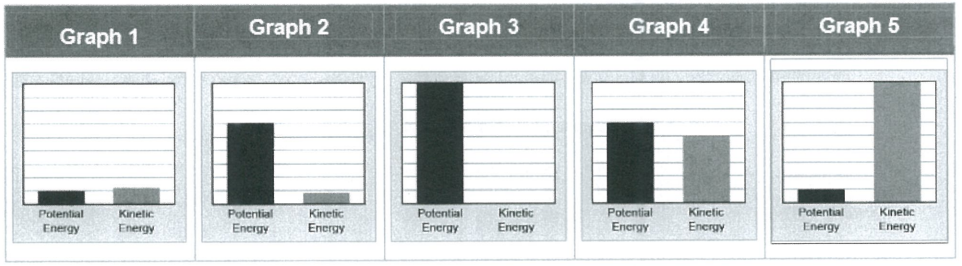
Diagram 6 shows a skateboard rider performing a trick on a ramp.

Diagram 6: Path of skateboard rider



a. Choose the graph in the table below that best represents the potential and kinetic energy of the rider at each of the positions 1, 2 and 3. NOTE: There are two graphs that will not be used when answering this question.

b. Justify your choices.



1. Graph 2: As skater reaches top of ramp, KE is decreasing and PE is high & increasing.
2. Graph 3: Momentarily all KE converts to PE
3. Graph 4: On the way back down, PE begins to decrease & KE increases.

Kinetic Energy (KE)

The amount of Kinetic energy an object has is dependent on two factors. These are

mass and velocity.

The greater the mass / velocity an object has the greater the amount of Kinetic energy (and vice versa).

$$\text{Kinetic Energy} = \tfrac{1}{2} \times m \times v^2$$

m = mass (kg), v = velocity/speed (m/s)

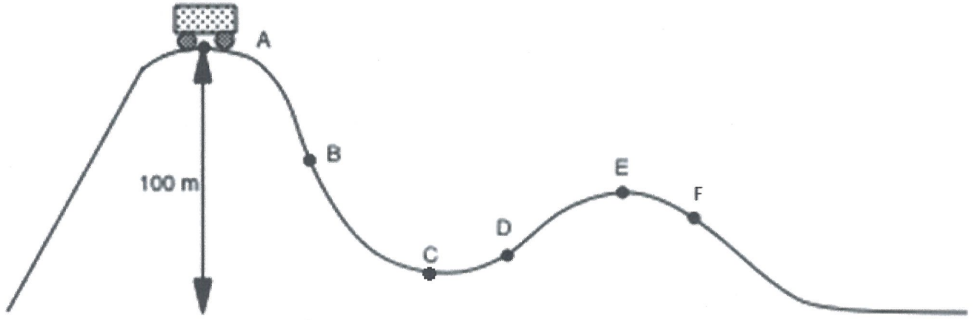
Gravitational Potential Energy (GPE)

The amount of Gravitational Potential energy an object has is dependent on two factors. These are

mass and height.

The greater the mass / height an object has the greater the gravitational potential energy.

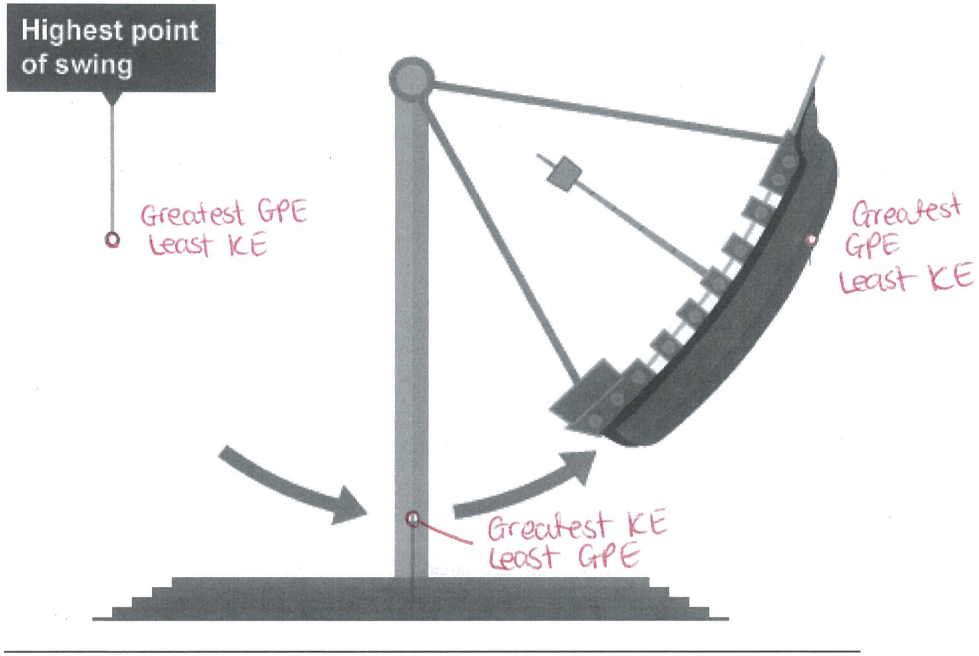
Examine the rollercoaster diagram below to answer the following questions.



Using the letters A - F

1. When does the carriage have the greatest amount of gravitational PE? Justify your choice. A
2. When does the carriage have the least amount of gravitational PE? Justify your choice. C
3. When does the carriage have the greatest amount of Kinetic energy? Justify your choice. C
4. When does the carriage have the least amount of Kinetic energy? Justify your choice. A

Using the diagram below of how the Bounty Ship at Adventure World works, outline when it has the a) greatest amount of KE? b) Least amount of Kinetic energy? c) Greatest amount of GPE? D) Least amount of GPE?



Kinetic Energy Calculation:

1. What is the kinetic energy of a 0.158 kg cricket ball travelling at 28 m/s? Select your answer and show your working.

a. 61936 J

b. 4.42 J

c. 247.74 J

d. 61.94 J

$KE = \frac{1}{2}mv^2$

$= \frac{1}{2} \times 0.58 \times 28^2$

$= 61.94\ J$

2. Calculate the Kinetic energy of an object with a mass of 5kg and moving at a speed of 3m/s. 22.5 J

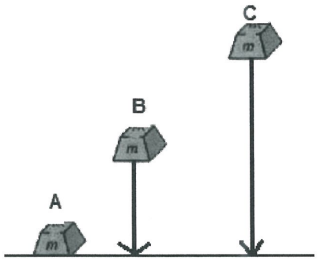
3. Calculate the Kinetic energy of a motor vehicle that is 1000 kg and travelling at a speed of 6m/s. 18000J or 18 kJ.

Two bowling balls (one with a mass of 5kg and one with a mass of 8kg) travelled at the same speed towards the ten pins. Which bowling ball as more Kinetic energy? Explain your reason.

The 8kg ball had more KE. If speed is constant, the higher mass will cause a higher KE.

When two 5kg bowling balls were thrown at different speeds, which would have more Kinetic energy? Explain your reason.

The ball thrown faster will have more KE. KE depends on mass & velocity.



Using the diagram to the right, outline which ball (A, B or C) has the most GPE. C.

Explain your reason.

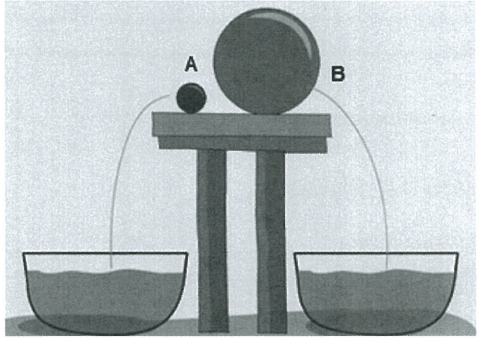
Same masses so highest height above ground will have highest GPE.

Heat Energy (also called thermal energy)

Heat energy is a form of energy because it can do work. Heat energy can come from the Sun, flames and chemical reactions, and is often given off from electrical devices and even people (which is why it is often a wasted or lost energy). In the engine of a motor car, hot gases are produced by burning petrol. The hot gases expand and cause the parts of the engine to move. As the hot gases do work, they lose most of their energy and cool down. Generally, the greater the temperature and mass of an object, the more heat energy is has.

Heat energy is the form of energy which is transferred from places of high temperature to places of low temperature. It is transferred in three ways, which are Conduction, convection and radiation.

Question: List 4 uses of heat energy



Using the diagram to the left, outline which ball (A or B) has more GPE. B*.

Explain your reason.

As long as size is proportional to mass, B has higher GPE due to larger mass as A & B are at same height.

Chemical Energy is the energy stored in substances (held in the chemical bonds). Wood, paper, food (e.g. apples, cereal), petrol and barriers all contain (and are sources of) chemical energy. The energy held in their bonds can be released through applying them to electrical circuits, digestion, and combustion (burning). The chemical energy in petrol, coal and natural gases can do word when the fuels are burnt in engines. Dynamite and other explosives also contain chemical energy.

The foods that we eat originally obtained energy from the sun. Plants capture light from the Sun and convert it into chemical energy in the form of simple sugars. This happens in a process called photosynthesis. Plants such as wheat make sugars and then concert them into starch for storage. When you eat the plants, their seeds, nuts or grains (or eat other animals that have eaten them), your body uses the chemical energy from these simple sugars and starch as your energy source.

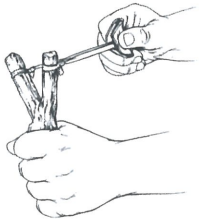
Elastic Potential Energy

If you stretch a rubber band you will give it energy. When you shorten the band you will release its energy. Therefore the energy stored in the rubber band is elastic potential energy.

The potential energy of a stretch object depends on two factors: its elasticity and how much it is stretched. Elasticity is a measure of the stiffness of the stretched object.

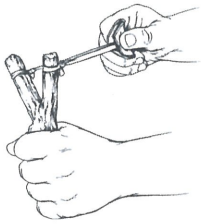
The potential energy of a stretched spring can be used to close a door. The stronger the spring, the heavier the door it can swing shut. Stretching the spring more will also increase the amount of work it can do.

Draw an energy flow diagram to show the energy transformations taking place in a sling shot.



chemical energy (hand) → kinetic (hand) → elastic potential → kinetic

Explain using energy terms: a) what will happen if I increase the stretch of the rubber band b) change the angle of the stretch c) change the rubber band to a firm/rigid band



a) elastic PE of the band increases

b)

c) less elastic potential energy when pulled back the same distance.

Light globes:

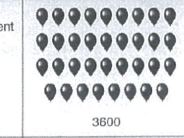
What does wattage give us an indication of? The amount of power required to run the bulb.

How do you calculate Brightness per watt? Cost per hour?

Brightness per watt = $\frac{\text{brightness (lumens)}}{\text{watts}}$

Cost per hour = $\frac{\text{cost (\$)}}{\text{lifespan (hours)}}$.

Table 5.3.1 Comparison of incandescent and compact fluorescent globes

Power	Approximate balloons of greenhouse gas produced over its lifespan	Purchase price	Expected operating hours	Approximate cost per year
75 watt incandescent 	 3600	$1.00–1.20	1000–2000	$12.30
15 watt (75 watt equivalent) fluorescent 	 730	$4.00–10.00 (cheaper if buying a pack of 2 or 3)	Around 8000 hours	$2.30