Answers Energy

Year 8 Science Chapter 10

p209

1 Energy is the ability to do work by producing movement.

2 Energy exists in many different forms: nuclear energy, chemical energy, elastic energy, radiation energy, sound energy, gravitational energy, electrical energy, thermal (heat) energy, kinetic energy.

3 The unit of energy is the Joule (J).

4 Kinetic energy is the energy possessed by moving bodies. All moving things have kinetic energy.

5 Examples of kinetic energy: A moving car, a moving ball, a flowing river, a plane in flight, a running athlete, an orbiting satellite.

6 The formula for Kinetic Energy = $\frac{1}{2}mv^2$ joules

7 The unit of kinetic energy is the Joule (J).

8 Two ways of increasing kinetic energy is to increase mass and to increase speed..

9 45 000 joules = 45 kilojoules.

10 62 000 000 joules = 62 megajoules.

11 75 000 kilojoules = 75 megajoules.

p210

1 What is the kinetic energy of a 5 kg ball moving at a speed of 2 metres per second?

$$KE = \frac{1}{2}mv^2 = 0.5 \times 5 \times 2^2 J = 10J$$

2 What is the kinetic energy of a 5 kg ball moving at a speed of 4 metres per second?

$$KE = \frac{1}{2}mv^2 = 0.5 \times 5 \times 4^2 J = 40J$$

3 What is the kinetic energy of a 2.4 kg ball moving at a speed of 4 metres per second?

$$KE = \frac{1}{2}mv^2 = 0.5 \times 2.4 \times 4^2 J = 19.2J$$

4 What is the kinetic energy of a 2.3 tonne car moving at a speed of 10 metres per second?

$$KE = \frac{1}{2}mv^2 = 0.5 \times 2300 \times 10^2 J = 115\,000J = 115kJ$$

5 What is the kinetic energy of a 2.3 tonne SUV moving at a speed of 20 metres per second?

$$KE = \frac{1}{2}mv^2 = 0.5 \times 2300 \times 20^2 J = 460\,000J = 460\,kJ$$

6 What is the kinetic energy of a 2.3 tonne SUV moving at a speed of 40 metres per second?

$$KE = \frac{1}{2}mv^2 = 0.5 \times 2300 \times 40^2 J = 1\,840\,000J = 1.84\,MJ$$

p210

7 What is the kinetic energy of a 8 tonne 2-axle truck moving at a speed of 20 metres per second?

$$KE = \frac{1}{2}mv^2 = 0.5 \times 8000 \times 20^2 J = 1\,600\,000 J = 1.6\ MJ$$

8 What is the kinetic energy of a 9 tonne 3-axle truck moving at a speed of 25 metres per second?

$$KE = \frac{1}{2}mv^2 = 0.5 \times 9000 \times 25^2 J = 2\,810\,000 J = 2.81\ MJ$$

9 What is the kinetic energy of a 9.7 tonne 3-axle truck moving at a speed of 35 metres per second?

$$KE = \frac{1}{2}mv^2 = 0.5 \times 9700 \times 35^2 J = 5\,940\,000 J = 5.94\ MJ$$

p211

1 Potential energy is stored energy that has the potential to do work or cause movement. Potential energy can become kinetic energy.

2 Energy can either be potential energy or kinetic energy. Potential energy is stored energy that has the potential to do work or cause movement. Kinetic energy is the energy possessed by moving bodies.

3

Energy Source	Potential or kinetic energy	To change to kinetic energy:
Methane gas	Potential energy	Burn to boil water - boiling water has kinetic energy.
Rain	Potential and kinetic energy	Falling rain has kinetic energy - the rain has the potential to fall further until it hits the ground.
Wind	Kinetic energy	
Coal	Potential	Burn and use the heat to produce steam to turn turbines.
Cloud	Potential and kinetic energy	When cloud vapour condenses to water. Rain has kinetic energy.
Petrol	Potential energy	Burn petrol to push pistons to move cars.
Moving car	Kinetic energy	
Sunlight	Potential energy	Solar energy to electrical energy to kinetic energy (fans, motors, etc)
Nuclear	Potential energy	nuclear energy to heat energy to steam to turn turbines (kinetic energy).
Battery	Potential energy	Chemical potential energy to electrical energy to turn motors.
Waves	Kinetic energy	

p213

1 What is the gravitational potential energy of a 2 kg ball at a height of 16 metres above the ground?

$$GPE = mgh = 2 \times 9.8 \times 16\ J = 314\ J$$

2 What is the gravitational potential energy of a 2 kg ball at a height of 32 metres above the ground?

$$GPE = mgh = 2 \times 9.8 \times 32\ J = 627\ J$$

3 What is the gravitational potential energy of a 4 kg ball at a height of 32 metres above the ground?

$$GPE = mgh = 4 \times 9.8 \times 32\ J = 1254\ J = 1.25\ kJ$$

4 What is the gravitational potential energy of a 2 tonne tank of water at a height of 5 metres above the ground?

$$GPE = mgh = 2000 \times 9.8 \times 5\ J = 98\,000\ J = 98\ kJ$$

5 What is the gravitational potential energy of a 4 tonne tank of water at a height of 5 metres above the ground?

$$GPE = mgh = 4000 \times 9.8 \times 5\ J = 196\,000\ J = 1.96\ kJ$$

6 What is the gravitational potential energy of a 2 tonne tank of water at a height of 10 metres above the ground?

$$GPE = mgh = 2000 \times 9.8 \times 10\ J = 196\,000\ J = 1.96\ kJ$$

p213

7 What is the gravitational potential energy of 400 m^3 of water at the top of a 50 m falls?
$GPE = mgh = 400\,000 \times 9.8 \times 50\ J = 196\,000\,000\ J = 196\ MJ$

8 It is estimated that up to 2800 m^3 of water goes over the 50 m Niagra falls every second. Wat is the gravitational potential energy of this amount of water?
$GPE = mgh = 2\,800\,000 \times 9.8 \times 50\ J = 1\,372\,000\,000\ J = 1372\ MJ$

9 Water to the Snowy Mountains hydroelectric power stations falls about 800 m. What would be the gravitational potential energy of 100 m^3 of water at this height?
$GPE = mgh = 100\,000 \times 9.8 \times 800\ J = 784\,000\,000\ J = 784\ MJ$

p215

1 **Elastic potential energy** is stored energy that has the potential to do work or cause movement due to elasticity.

2 **Examples** of elastic potential energy
- The hitting of a tennis ball with a tennis racquet.
- Stretching and shortening the muscles of the leg when jumping.
- The kicking of a soccer ball.
- Spring loaded mouse traps.
- Truck and car suspensions.
- The use of rubber bands.

3 Give three examples of elastic energy being stored when an object is:
a) bent - bending a bow.
b) stretched - pulling a rubber band.
c) compressed - pushing down on a spring.

4 **Heat energy** is a form of energy that is transferred between substances.

5 Heat flows from hotter substances to colder substances.

6 When a balloon is put in a fridge, heat energy flows from the balloon to the fridge. The air molecules in the balloon slow down and take up less space. The balloon becomes smaller.

p217

1 How much energy is produced by a 10 watt solar panel in direct sunlight for 4 hours?
$Energy = Pt = 10 watts \times 4 hrs = 10 watts \times 4 \times 60 \times 60 \sec s = 144\,000 J = 144\ kJ$

2 How much energy is produced by a 200 watt solar panel in direct sunlight for 4 hours?
$Energy = Pt = 200 watts \times 4 hrs = 200 watts \times 4 \times 60 \times 60 \sec s = 2\,880\,000 J = 2.88\ MJ$

3 How much energy is produced by a four 10 watt solar panels in direct sunlight for 2 hours?
$Energy = Pt = 4 \times 10 watts \times 2 hrs = 40 watts \times 2 \times 60 \times 60 \sec s = 288\,000 J = 288\ kJ$

4 Calculate the daily electrical energy output of twelve 200 watt panels (assume 5 hours of sunlight).
$Energy = Pt = 12 \times 200 watts \times 5 hrs = 2400 watts \times 5 \times 3600 \sec s = 43\,200\,000 J = 43.2\ MJ$

5 Calculate the daily electrical energy output of twenty 250 watt panels (assume 3 hours of sunlight).
$Energy = Pt = 20 \times 250 watts \times 3 hrs = 20 \times 250 watts \times 3 \times 3600 \sec s = 54\,000\,000 J = 54\ MJ$

6 Calculate the daily electrical energy output of forty 250 watt panels (assume 3 hours of sunlight).
$Energy = Pt = 40 \times 250 watts \times 3 hrs = 40 \times 250 watts \times 3 \times 3600 \sec s = 108\,000\,000 J = 108\ MJ$

7 Light potential energy is stored energy in light that has the potential to do work or cause movement.

8 Light energy or electromagnetic energy is sometimes called radiant energy.

9 The photoelectric effect: Light striking the surface increases the kinetic energy of electrons and causes them to be emitted from the surface.

10 A microwave oven increases the kinetic energy of water molecules which makes the food hotter.

11 Photosynthesis is the process by which green plants make food using sunlight.

12 Light energy can be changed into chemical energy (photosynthesis), heat energy (microwave), electrical energy (photoelectric effect).

p219

1 Electrical potential energy is stored energy that has the potential to do work or cause movement due to movement of electrons.

2 Electrical energy is easily moved through transmission wires and easily changed into many other types of energy.

3 Electrical energy can be changed into kinetic energy (fan), light energy (light bulb), heat energy (heater), chemical energy (charging a battery), sound energy (speaker).

4 Chemical energy stored in a mobile phone in the battery.

5 A joule is a unit of work, energy, or heat. One joule is the electrical energy needed to produce one watt of power for one second.

6 1 kilojoule = 1000 joules

7 1 megajoule = 1 000 000 joules

8 10 kilowatt-hours = 10 000 watts × 1 hour = 10 000 watts × 60×60 secs = 36 000 000 J = 36 MJ.

9 18 kilowatt-hours = 18 000 watts × 1 hour = 18 000 watts × 60×60 secs = 64 800 000 J = 64.8 MJ.

10 25 kilowatt-hours = 25 000 watts × 1 hour = 25 000 watts × 60×60 secs = 90 000 000 J = 90 MJ.

11 How much energy, in joules, is used by a 15 watt light bulb in an hour?

EE = 15 watts × 1 hour = 15 watts × 60×60 secs = 54 000 J = 54 kJ.

12 How much energy, in joules, is used by a 100 watt light bulb in 3 hours?

EE = 100 watts × 3 hour = 100 watts × 3×60×60 secs = 1 080 000 J = 1.08 MJ.

13 How much energy, in joules, is used by four 100 watt light bulbs in a day?

EE = 4 × 100 watts × 24 hour = 4 × 100 watts × 24×60×60 secs = 34 560 000 J = 35 MJ.

p221

1 Chemical potential energy is stored energy that has the potential to do work through a chemical reaction.

2 An exothermic chemical reaction releases energy.

3 The combustion, or burning, of coal is the reaction of coal (carbon) with oxygen in the air to produce heat energy, and light energy.

carbon + oxygen ➔ carbon dioxide + energy

$C + O_2 \rightarrow CO_2 +$ energy

4 **Respiration** is the release of energy from glucose and other carbohydrates within animal and plant cells. The energy is used to keep the cells alive.

Glucose + oxygen ➔ carbon dioxide + water

$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$ + energy

5 Chemical energy can be changed into electrical energy (battery), light energy (candle), heat energy (fire), kinetic energy (jet engine), sound energy (explosion).

6 Lead-acid batteries can store a lot of chemical potential energy and can quickly deliver large amounts of electrical energy. They can also be recharged. Lead-acid batteries are still popular in vehicles despite their toxic materials.

7 A lead-acid battery contains toxic materials. Lead-acid battery still heavily used in transport and energy storage because lead-acid batteries can store a lot of chemical potential energy and can quickly deliver large amounts of electrical energy. They can also be recharged.

8 1 litre of petrol contains 35 MJ of energy. A car uses about 20% of the energy for movement (to do work). How much energy from 1 litre of petrol is wasted?

Waste energy = 80% of 35 MJ = 0.8× 35 MJ = 28 MJ (7 MJ of 1 litre of petrol is used)

p223

1 Energy flow diagrams illustrate how energy is changed/transferred from one form of energy to other forms of energy.

2 Electromagnetic energy describes all the different types of energies emitted by the sun. These include radio waves, microwaves, visible light, and x-rays. Electromagnetic energy can travel through space, our atmosphere, and through other substances.

3 Light energy can be described as electromagnetic energy.

4 Sketch energy flow diagrams for the following:

a) A battery powering a torch.
b) An electric drill.
c) A television.
d) A solar panel powering a fan.
e) A tablet.
f) A person walking down stairs.
g) A skyrocket.
h) A MP3 player.

5 Name a device that can make the following change in form of energy. Also indicate if heat energy is likely to be a by-product.

a) Electrical energy to light energy: Light bulb. Heat energy is also produced.
b) Electrical energy to kinetic energy: Electric fan Heat energy is also produced.
c) Kinetic energy to elastic energy. Drawing back on a bow. Heat energy is also produced.
d) Kinetic energy to gravitational energy: A falling rock. Heat energy is also produced.

6 Loss of heat energy from a home in winter is expensive.

Tips to reduce the loss of heat energy: Insulation in the roof, insulation in the walls, thicker carpets, double glazing glass, close the underneath of the house if the house is raised, keep doors and windows closed.

p225

1 Photosynthesis is the process by which green plants make food using sunlight (Light energy is converted into chemical energy).

2 Respiration is the release of energy from glucose and other carbohydrates within animal and plant cells (chemical energy is converted into other forms of energy to keep the cells alive).

3 The primary source of energy for food chains is electromagnetic energy from the Sun.

4 The energy in a food chain is eventually converted to heat energy.

5 Energy efficiency is 'using less energy to provide the same service'.

6 A benefit of increased energy efficiency is the use of less energy to perform the same function. For example, A more efficient refrigerator uses less energy to keep your food the same temperature.

7 Calculate the efficiency of a lightbulb that uses 25 J for light of every 100 J supplied.

$$Efficiency = \frac{energy\ used}{energy\ \text{sup}\ plied} \times 100 = \frac{25J}{100\,j} \times 100 = 25\%$$

p226

1 The speed of sound is approximately 340 m/s or 1200 km/h.

2 Mach 10 is ten times the speed of sound at around 3400 m/s or 12 000 km/h.

3 Hypersonic speeds allow people to travel from country to country in shorter times.

4 Some scramjet designers are expecting speeds of Mach 16. Mach 16 =16×1200 km/h = 19 200 km/h.

5 The basic principle of a scramjet depends on compression causing heating. The high compression of air at hypersonic speed produces enough heat to ignite the fuel. There is no need for liquid oxygen or compression equipment. This makes the jet lighter and faster.

p227

1 Household heat pumps are able to draw heat from the cooler outside air to provide hot water for the house. Heat pumps are able to absorb heat energy from the cooler surroundings.

2 The flow of heat in a heat pump is the opposite direction of the normal hot to cool direction.

3 Heat pumps are cheaper to run than conventional electrical hot water systems.

4 A household heat pump is able to extract heat from the outside air. Two other possible sources of heat for heat pumps are the outside water and the ground.

5 A heat pump is able to extract heat from cooler outside air. A heat pump will still be able to provide hot water if the outside air is -10°C because -10°C is above the boiling point of the refrigerant at -26°C.

p230

1 Energy is the ability to do work by producing movement.

2 Energy exists in many different forms: nuclear energy, chemical energy, elastic energy, radiation energy, sound energy, gravitational energy, electrical energy, thermal (heat) energy, kinetic energy.

3 The unit of energy is the Joule (J).

4 Kinetic energy is the energy possessed by moving bodies. All moving things have kinetic energy.

5 Examples of kinetic energy: A moving car, a moving ball, a flowing river, a plane in flight, a running athlete, an orbiting satellite.

6 The formula for Kinetic Energy = $\frac{1}{2}mv^2$ joules

7 The unit of kinetic energy is the Joule (J).

8 Two ways of increasing kinetic energy is to increase mass and to increase speed..

9 67 000 joules = 67 kilojoules.

10 19 000 000 joules = 19 megajoules.

p230

11 What is the kinetic energy of a 4 kg ball moving at a speed of 5 metres per second?

$$KE = \frac{1}{2}mv^2 = 0.5 \times 4 \times 5^2 J = 50\ J$$

12 What is the kinetic energy of a 8 kg ball moving at a speed of 5 metres per second?

$$KE = \frac{1}{2}mv^2 = 0.5 \times 8 \times 5^2 J = 100\ J$$

13 What is the kinetic energy of a 1.6 tonne car moving at a speed of 5 metres per second?

$$KE = \frac{1}{2}mv^2 = 0.5 \times 1600 \times 5^2 J = 20\,000\ J = 20\ kJ$$

14 What is the kinetic energy of a 1.6 tonne car moving at a speed of 10 metres per second?

$$KE = \frac{1}{2}mv^2 = 0.5 \times 1600 \times 10^2 J = 80\,000\ J = 80\ kJ$$

15 What is the kinetic energy of a 8 tonne 2-axle truck moving at a speed of 10 metres per second?

$$KE = \frac{1}{2}mv^2 = 0.5 \times 8000 \times 10^2 J = 400\,000\ J = 400\ kJ$$

16 What is the kinetic energy of a 9 tonne 3-axle truck moving at a speed of 20 metres per second?

$$KE = \frac{1}{2}mv^2 = 0.5 \times 9000 \times 20^2 J = 1\,800\,000\ J = 1.8\ MJ$$

17 What is the kinetic energy of a 9.7 tonne 3-axle truck moving at a speed of 40 metres per second?

$$KE = \frac{1}{2}mv^2 = 0.5 \times 9700 \times 40^2 J = 7\,760\,000\ J = 7.76\ MJ$$

p231

1 What is the gravitational potential energy of a 5 kg ball at a height of 12 metres above the ground?

$$GPE = mgh = 5 \times 9.8 \times 12\ J = 588\ J$$

2 What is the gravitational potential energy of a 5 kg ball at a height of 24 metres above the ground?

$$GPE = mgh = 5 \times 9.8 \times 24\ J = 1176\ J = 1.18\ kJ$$

3 What is the gravitational potential energy of a 10 kg ball at a height of 24 metres above the ground?

$$GPE = mgh = 10 \times 9.8 \times 24\ J = 2352\ J = 2.35\ kJ$$

4 What is the gravitational potential energy of a 4 tonne tank of water at a height of 4 metres above the ground?

$$GPE = mgh = 4000 \times 9.8 \times 4\ J = 156\,800\ J = 157\ kJ$$

5 What is the gravitational potential energy of a 4 tonne tank of water at a height of 20 metres above the ground?

$$GPE = mgh = 4000 \times 9.8 \times 20\ J = 784\,000\ J = 784\ kJ$$

6 What is the gravitational potential energy of 500 m^3 of water at the top of a 40 m falls ($1m^3$ = 1000 kg)?

$$GPE = mgh = 500\,000 \times 9.8 \times 40\ J = 196\,000\,000\ J = 196\ MJ$$

p231

7 **Elastic potential energy** is stored energy that has the potential to do work or cause movement due to elasticity.

8 **Examples** of elastic potential energy
- The hitting of a tennis ball with a tennis racquet.
- Stretching and shortening the muscles of the leg when jumping.
- The kicking of a soccer ball.
- Spring loaded mouse traps.
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9 Give three examples of elastic energy being stored when an object is:
a) bent - bending a bow.
b) stretched - pulling a rubber band.
c) compressed - pushing down on a spring.

10 **Heat energy** is a form of energy that is transferred between substances.

11 The greater the heat energy the greater the kinetic energy of the atomic particles - True.

12 Heat flows from hotter substances to colder substances.

13 When a balloon is put in a fridge, heat energy flows from the balloon to the fridge. The air molecules in the balloon slow down and take up less space. The balloon becomes smaller.

14 Your hand feels warm when it is put in sunlight because electromagnetic energy from the Sun is being transferred to heat energy on your hand.

p232

1 Light potential energy is stored energy in light that has the potential to do work or cause movement.

2 Light energy or electromagnetic energy is sometimes called radiant energy.

3 The photoelectric effect: Light striking the surface increases the kinetic energy of electrons and causes them to be emitted from the surface.

4 A microwave oven increases the kinetic energy of water molecules which makes the food hotter.

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6 Light energy can be changed into chemical energy (photosynthesis), heat energy (microwave), electrical energy (photoelectric effect).

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8 Electrical energy is easily moved through transmission wires and easily changed into many other types of energy.

9 Electrical energy can be changed into kinetic energy (fan), light energy (light bulb), heat energy (heater), chemical energy (charging a battery), sound energy (speaker).

10 How much energy is produced by a 15 watt solar panel in direct sunlight for 3 hours?

EE = 15 watts × 5 hour = 15 watts × 5×60×60 secs = 270 000 J = 270 kJ.

12 How much energy, in joules, is used by a 100 watt light bulb in 3 hours?

EE = 100 watts × 3 hour = 100 watts × 3×60×60 secs = 1 080 000 J = 1.08 MJ.

11 How much energy is produced by a four 250 watt solar panels in direct sunlight for 2 hours?

EE = 4 × 250 watts × 2 hours = 4 × 250 watts × 2×60×60 secs = 7 200 000 J = 7.2 MJ.

12 Chemical potential energy is stored energy that has the potential to do work through a chemical reaction.

13 An exothermic chemical reaction releases energy.

14 The combustion, or burning, of coal is the reaction of coal (carbon) with oxygen in the air to produce heat energy, and light energy.

carbon + oxygen ➔ carbon dioxide + energy

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15 **Respiration** is the release of energy from glucose and other carbohydrates within animal and plant cells. The energy is used to keep the cells alive.

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16 Chemical energy can be changed into electrical energy (battery), light energy (candle), heat energy (fire), kinetic energy (jet engine), sound energy (explosion).

17 Chemical energy is stored in a mobile phone in the battery.

18 How much energy, in joules, is used by a 45 watt light bulb in an hour?

EE = 45 watts × 1 hour = 45 watts × 60×60 secs = 162 000 J = 162 kJ.

19 How much energy, in joules, is used by a 100 watt light bulb in 6 hours?

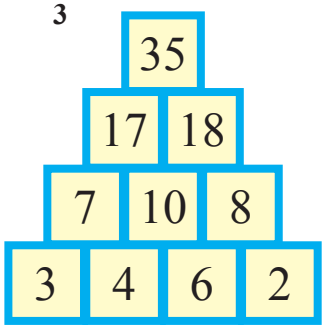
EE = 100 watts × 6 hour = 100 watts × 6×60×60 secs = 2 160 000 J = 2.16 MJ.

20 How much energy, in joules, is used by four 250 watt light bulbs in a day?

EE = 4 × 250 watts × 24 hour = 4 × 250 watts × 24×60×60 secs = 86 400 000 J = 86.4 MJ.

p231

1a) 17 **1b)** 64-17 = 47 **2** 1×(2+1+4) = 7 **3**



p234

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Tips to reduce the loss of heat energy: Insulation in the roof, insulation in the walls, thicker carpets, double glazing glass, close the underneath of the house if the house is raised, keep doors and windows closed.

6 Name a device that can make the following change in form of energy. Also indicate if heat energy is likely to be a by-product.

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d) Kinetic energy to gravitational energy: A falling rock. Heat energy is also produced.

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7 Photosynthesis is the process by which green plants make food using sunlight (Light energy is converted into chemical energy).

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9 The primary source of energy for food chains is electromagnetic energy from the Sun.

10 The energy in a food chain is eventually converted to heat energy.

11 Energy efficiency is 'using less energy to provide the same service'.

12 Calculate the efficiency of a lightbulb that uses 30 J for light of every 100 J supplied.

$$Efficiency = \frac{energy\ used}{energy\ \text{sup}\ plied} \times 100 = \frac{30}{100} \times 100 = 30\%$$

p235

1 a) **2** b)

3 a) - Gravitational potential energy of a falling stone is converted into kinetic energy - thus greatest gravitational potential energy when at lowest kinetic energy.

4 d) - The girl has the largest kinetic energy at the bottom of the swing.

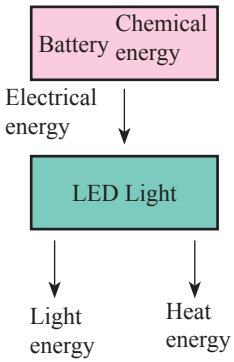
p236

1 **a)** 60% energy is wasted.
b) Two forms of energy into which the wasted energy is changed: Heat energy, light energy, sound energy.
c) Attempt an energy flow diagram for the conversion of the chemical energy in coal to electrical energy.

2 **a)** A burning candle - Chemical energy to light energy.
b) A falling glass - Gravitational energy to kinetic energy.
c) A slamming door - Kinetic energy to sound energy.
d) A door buzzer - Electrical energy to kinetic energy.
e) Blowing up a balloon - Kinetic energy to elastic energy.

3 Sound energy is considered a form of kinetic energy because sound is the vibration of matter. Put rice on a drum, when you strike the drum the rice will dance because of the vibrations.

4



p236

5 The average family uses about 60 MJ of energy each day. Assuming an average of 4 hours of sunlight each day, how many 250 watt solar panels would the average family need to have installed on their roof?

Let n be the number of 250 watt solar panels

$$60 \text{ MJ} = n \times 250 \text{ watts} \times 4 \times 60 \times 60 \text{ secs}$$
$$60\,000\,000 \text{ J} = n \times 3\,600\,000 \text{ J}$$
$$60\,000\,000 \div 3\,600\,000 = n$$
$$16.67 = n$$

Given the above assumptions, the average family would need 17 × 250 watt panels.

6 A 25 watt compact fluorescent light bulb (cost of $15 and last for 8000 hours) is said to provide the same amount of light as a 60 watt incandescent light bulb (cost of $1 and last for 1000 hours). Assuming that electrical energy costs $0.35 for 1000 watts for 1 hour.

Cost of 25 watt fluorescent for 8000 hrs = $15 + 25×8 kWh×$0.35kWh
= $15 + 200 kWh×$0.35kWh
= $15 + $70
= $85

Cost of 60 watt incandescent for 8000 hrs = $1×8 + 60×8 kWh×$0.35kWh
= $8 + 480 kWh×$0.35kWh
= $8 + $168
= $176

The above assumptions, suggest that it is worthwhile replacing an incandescent light bulb with a compact fluorescent light bulb (A saving of $91 over 8000 hours).