Answers Energy Conservation

Year 10 Science Chapter 8

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1 What is the kinetic energy of a 10 kg ball moving at a speed of 5 metres per second?

$KE = \frac{1}{2}mv^2 = 0.5 \times 10 \times 5^2 \text{ J} = 125 \text{ J}$

2 What is the kinetic energy of a 20 kg ball moving at a speed of 10 metres per second?

$KE = \frac{1}{2}mv^2 = 0.5 \times 20 \times 10^2 \text{ J} = 1000 \text{ J} = 1 \text{ kJ}$

3 What is the kinetic energy of a 0.16 kg cricket ball moving at a speed of 30 metres per second (108 km/hr)?

$KE = \frac{1}{2}mv^2 = 0.5 \times 0.16 \times 30^2 \text{ J} = 72 \text{ J}$

4 Convert 108 km/hr to m/s.

108 km/h = (108x1000 m) ÷ (60x60 s) = 30 m/s

5 How many joules in?

a) 1 kilojoule = 1000 J
b) 1 megajoule = 1 000 000 J
c) 1 gigajoule = 1 000 000 000 J

6 What is the kinetic energy of a 1.2 tonne car moving at a speed of 40 metres per second?

$KE = \frac{1}{2}mv^2 = 0.5 \times 1200 \times 40^2 \text{ J} = 960\,000 \text{ J} = 960 \text{ kJ}$

7 What is the kinetic energy of a 1.2 tonne bull running at a speed of 5 metres per second? (5 m/s = 18 km/h)

$KE = \frac{1}{2}mv^2 = 0.5 \times 1200 \times 5^2 \text{ J} = 150\,000 \text{ J} = 150 \text{ kJ}$

8 What is the kinetic energy of a 180 kg motor bike, with a 85 kg rider, moving at a speed of 20 m/s (72 km/h)?

$KE = \frac{1}{2}mv^2 = 0.5 \times 265 \times 20^2 \text{ J} = 53\,000 \text{ J} = 53 \text{ kJ}$

9 What is energy?

Energy is the ability to do work by producing movement.

10 Energy can exist in many different forms and chemical energy is an example. Provide another four examples.

kinetic energy, gravitational energy, thermal (heat) energy, electrical energy,
elastic energy, radiation energy, sound energy, nuclear energy

11 What is the kinetic energy of a 10 tonne 3-axle truck moving at a speed of 10 m/s?

$KE = \frac{1}{2}mv^2 = 0.5 \times 10\,000 \times 10^2 \text{ J} = 500\,000 \text{ J} = 500 \text{ kJ}$

12 What is the kinetic energy of a 4.1 m diameter asteroid (80 tonnes) moving at a speed of 17,000 m/s?

$KE = \frac{1}{2}mv^2 = 0.5 \times 80\,000 \times 17\,000^2 \text{ J} = 1.16 \times 10^{13} \text{ J}$

p188

1 What is the gravitational potential energy of a 5 kg ball at a height of 10 m?

GPE = mgh = 5 × 9.8 × 10 Joules = 490 J

2 What is the gravitational potential energy of a 20 kg ball at a height of 10 m?

GPE = mgh = 10 × 9.8 × 10 Joules = 980 J

3 What is the gravitational potential energy of a 12.3 kg rock at a height of 23.5 m?

GPE = mgh = 12.3 × 9.8 × 23.5 Joules = 2832.69 J = 2.83 kJ

4 Is it possible for a 10 kg ball to have more gravitational potential energy than a 50 kg ball? Give an example.

Yes, there are many examples

A 10 kg ball at a height of 10 m: GPE = mgh = 10 × 9.8 × 10 Joules = 980 J

A 50 kg ball at a height of 1 m: GPE = mgh = 50 × 9.8 × 1 Joules = 490 J

5 What is the gravitational potential energy of a 2 tonne steel beam at a height of 48 m?

GPE = mgh = 2000 × 9.8 × 48 Joules = 940 800 J = 940.8 kJ

6 What is the gravitational potential energy of a 1.2 tonne pallet of pressure pumps at a height of 2.7 m?

GPE = mgh = 1200 × 9.8 × 2.7 Joules = 31 752 J = 31.75 kJ

7 What is the gravitational potential energy of 2.9 m^3 of water at the top of a 3.2 m tank stand?

GPE = mgh = 2900 × 9.8 × 3.2 Joules = 90 944 J = 90.94 kJ

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1 In the above diagram, the ball on the top of step 4 has a gravitational potential energy (GPE) of 200 J. Each step has the same depth.

a) What is the GPE of the ball when it is on each of the other steps, and the ground?

There are 5 levels, and the change in GPE would be proportional, Thus:

Step 4 200 J
Step 3 150 J
Step 2 100 J
Step 1 50 J
Ground 0 J (height = 0 m)

b) What is the height of step 4 above the ground if the ball has a mass of 5 kg?

GPE = mgh
200 = 5 × 9.8 × h
200 = 49 × h
200 ÷ 49 = h
4.08 m = h

p191	**1** What is meant by energy transfer? Energy transfer occurs when the same form of energy is transferred from one object to another object. **2** What are three ways in which heat energy may be transferred from one object to another? **Conduction** is the transfer of heat energy between two objects that are in direct contact with each other. **Convection** is a circular movement of warmer liquid or gas to cooler areas of liquid or gas and the replacement of the original warmer areas by cooler liquid or gas. **Radiation** is the transfer of heat energy between objects that are not in contact. The transfer can move through empty space. **3** What is meant by energy transformation? Energy transformation happens when energy changes from one form to another form. **4** Briefly describe an example of energy transformation. When a light bulb is connected to a battery, the chemical energy in the battery is transformed into electrical energy. The light bulb transforms the electrical energy into light energy and thermal energy. **5** What is energy efficiency? Energy efficiency is 'using less energy to provide the same service'. **6** What is the efficiency of a vehicle that uses 15 MJ of energy from three litres of petrol (102 MJ of energy)? Efficiency $= \frac{\textit{energy used}}{\textit{energy supplied}} \times 100\ \%$ = 15 MJ ÷ 102 MJ × 100 % = 14.17% efficiency. **7** What is the efficiency of a vehicle that uses 11 MJ of energy from a litre of diesel (37 MJ of energy)? Efficiency $= \frac{\textit{energy used}}{\textit{energy supplied}} \times 100\ \%$ = 11 MJ ÷ 37 MJ × 100 % = 29.73.17% efficiency.
p193	**1** What is the law of conservation of energy? When energy is transformed from one form of energy to another form of energy, the total amount of energy remains constant. **2** Use an example to explain the law of conservation of energy. When an electric jug is used to boil water, electrical energy is transformed into heat energy, sound energy, kinetic energy (moving water molecules, air molecules, steam molecules). The total energy in is equal to the total energy out. **3** Calculate the efficiency of the light bulb example on the opposite page. Efficiency $= \frac{\textit{energy used}}{\textit{energy supplied}} \times 100\ \%$ = 86 J ÷ 100 J × 100 % = 86% efficiency. **4** Calculate the efficiency of producing electrical energy in the above coal power plant. Efficiency $= \frac{\textit{energy used}}{\textit{energy supplied}} \times 100\ \%$ = 34 J ÷ 100 J × 100 % = 34% efficiency. **5** Which process in the above coal power plant is the least efficient? The turbine is using up most of the energy transformation from coal to electricity. **6** Which process in the above coal power plant is the most efficient? The generator is using up the least of the energy transformation from coal to electricity. **7** If 500 J of electrical energy is supplied to a 60% efficient appliance: **a)** how much energy is wasted? 40% of the energy is wasted = 200 J **b)** how much energy is used? 60% of the energy is used = 300 J

p195

1 Why do scientists use models?

Scientists use models to represent and communicate their ideas. Models of processes such as energy flow make it easier to describe and explain complex ideas.

2 Use the model of ecological energy flow, on the opposite page, to calculate the efficiency of a primary producer in converting radiation energy from the sun into chemical energy.

Efficiency = $\frac{\text{energy used}}{\text{energy supplied}} \times 100\,\%$ = 100 J ÷ 10 J × 100 % = 10% efficiency.

3 What eventually happens to the energy in a food chain?

The energy is lost as heat energy into the air.

4 How much energy, in joules, is produced by a 20 watt solar panel in sunlight for 5 hours?

Energy = 20 watts × 5 hours
= 20 watts × 5 × 60 × 60 seconds
= 360 000 watt-seconds
= 360 000 joules
Energy = 360 kilojoules

5 How much energy, in joules, is produced by five 1000 watt wind turbines (assume 18 hours of useful wind)?

Energy = 5 × 1000 watts × 18 hours
= 5 × 1000 watts × 18 × 60 × 60 seconds
= 324 000 000 watt-seconds
= 324 000 000 joules
Energy = 324 megajoules

p197

1 Briefy describe the energy transformations during a head-on collision.

There is a considerable amount of noise. Vehicle pieces such as glass, bumper bars, and even engines are spread around the collision site.

Parts of each vehicle are smashed and deformed.

Tyre skid marks are around the collision site.

Both vehicles come to a stop and thus lose all kinetic energy.

The kinetic energy in a two vehicle head-on collision is transformed into sound energy, heat energy, and is absorbed by the crumpling of parts of the vehicles.

2 Briefy describe the energy transformations in a swinging pendulum.

Energy in a pendulum is continually transformed from gravitational potential energy to kinetic energy and back. The pendulum slows down, and eventually stops, as energy is lost through friction.

3 A television is rated at 80% efficiency. If the television is supplied with 10,000 J of electrical energy, how much energy is wasted (mostly lost heat energy)?

20% of input energy is wasted = 0.2 × 10 000 J = 2000 J or 2kJ {20% = 2/100 = 0.2}

4 An electric hot water system is rated at 60% efficiency. If the electric hot water system is supplied with 5,000 J of electrical energy, how much energy is wasted?

40% of input energy is watsed = 0.4 × 5000 J = 2000 J or 2 kJ {40% = 4/100 = 0.4}

5 A 5 kg shot put is dropped from a height of 10 m onto a sand pit. Briefly describe the energy transformations.

As the shot put is held at 10 m, it posseses gravitational potential energy.

As the shotput falls, the gravitational potential energy is transformed into kinetic energy and some heat energy due to friction with the surrounding air.

The sand transforms the kinetic energy of the shotput as it hits the sand into sand kinetic energy, heat energy, and sound energy.

p198	**1** What is the meaning of the word perpetual? Perpetual means to continue for ever ie never ending. **2** What is a perpetual motion machine? A perpetual motion machine is a machine that moves continually without an external energy source. **3** Why have so many people spent so much time trying to build a perpetual motion machine? Perpetual motion machines have attracted enormous attention because, if constructed, they promise a free and unlimited source of energy. **4** Some of Leonardo da Vinci's perpetual motion machines can be viewed, in action, on the Internet. Is 'seeing believing'? While the internet perpetual motion engines appear to be perpetual, it is very likely that they have some form of external energy source and are thus noy a perpetual motion machine. **5** Are the ocean tides an example of a perpetual motion machine? The external energy source for the tides comes from the force of gravitational attraction to the Moon.
p199	**1** What is indicated by the formula $E = mc^2$? Essentially, the equation indicates that mass may be changed into energy, and energy may be turned into mass. The equation also indicates that a small amount of mass can produce an enormous amount of energy. **2** Who is credited with the mass-energy equivalence formula $E = mc^2$? Albert Einstein **3** What is the speed of light? 3×10^8 m/s = 300 000 000 m/s **4** Calculate how much energy may be produced from 1 g of matter. $E = mc^2$ $= 0.001 \text{ kg} \times 3\times10^8 \text{ m/s} \times 3\times10^8 \text{ m/s}$ Energy = 9×10^{13} J **5** What is the method that Stephen Hawking suggests may be used to convert matter into energy? Stephen Hawking has theorised that it is possible to throw matter into a black hole and use the emitted energy to produce power.
p202	**1** What is energy? Energy is the ability to do work by producing movement. **2** How many joules in? **a)** 1 kilojoule = 1000 J **b)** 1 megajoule = 1 000 000 J **c)** 1 gigajoule = 1 000 000 000 J **3** What is the kinetic energy of a 50 kg ball moving at a speed of 30 metres per second? $KE = \frac{1}{2}mv^2 = 0.5 \times 50 \times 30^2 \text{ J} = 22\,500 \text{ J} = 22.5 \text{ kJ}$ **4** What is the kinetic energy of a 0.16 kg cricket ball moving at a speed of 20 metres per second? $KE = \frac{1}{2}mv^2 = 0.5 \times 0.16 \times 20^2 \text{ J} = 32 \text{ J}$ **5** Convert 100 km/hr to m/s. 100 km/h = (100×1000 m) ÷ (60x60 s) = 27.78 m/s

p202	**6** What is the kinetic energy of a 1 tonne car moving at a speed of 50 metres per second? KE $= \frac{1}{2}mv^2$ $= 0.5 \times 1000 \times 50^2$ J = 1 250 000 J = 1.25 MJ **7** What is the kinetic energy of a 250 kg motor bike, with a 90 kg rider, moving at a speed of 50 m/s? KE $= \frac{1}{2}mv^2$ $= 0.5 \times 340 \times 50^2$ J = 425 000 J = 425 kJ **8** Energy can exist in many different forms and chemical energy is an example. Provide another four examples. kinetic energy, gravitational energy, thermal (heat) energy, electrical energy, elastic energy, radiation energy, sound energy, nuclear energy **9** What is the kinetic energy of a 8 tonne 3-axle truck moving at a speed of 50 m/s? KE $= \frac{1}{2}mv^2$ $= 0.5 \times 8000 \times 50^2$ J = 10 000 000 J = 10 MJ **10** What is the kinetic energy of a 4.1 m diameter asteroid (80 tonnes) moving at a speed of 17,000 m/s? KE $= \frac{1}{2}mv^2$ $= 0.5 \times 80\,000 \times 17\,000^2$ J $= 1.16 \times 10^{13}$ J
p203	**1** What is gravitational potential energy? Gravitational Potential Energy = *mgh* joules. **2** What is the gravitational potential energy of a 10 kg ball at a height of 5 m? GPE = mgh = 10 × 9.8 × 5 Joules = 490 J **3** What is the gravitational potential energy of a 20 kg ball at a height of 5 m? GPE = mgh = 20 × 9.8 × 5 Joules = 980 J **4** What is the gravitational potential energy of a 42.5 kg branch at a height of 12.2 m? GPE = mgh = 42.5 × 9.8 × 12.2 Joules = 5081.3 J = 5.08 kJ **5** Is it possible for a 10 kg ball to have more gravitational potential energy than a 80 kg ball? Give an example. Yes, there are many examples A 10 kg ball at a height of 10 m: GPE = mgh = 10 × 9.8 × 10 Joules = 980 J A 80 kg ball at a height of 0.1 m: GPE = mgh = 80 × 9.8 × 0.1 Joules = 78.4 J **6** What is the gravitational potential energy of a 4 tonne concrete beam at a height of 30 m? GPE = mgh = 4000 × 9.8 × 30 Joules = 1 176 000 J = 1.18 MJ **7** What is the gravitational potential energy of a 1.4 tonne pallet of books at a height of 1.9 m? GPE = mgh = 1400 × 9.8 × 1.9 Joules = 26 068 J = 26.07 kJ **8** What is the gravitational potential energy of 3.2 m^3 of water at the top of a 2.6 m tank stand? GPE = mgh = 3200 × 9.8 × 2.6 Joules = 81 536 J = 81.54 kJ **9** **a)** The GPE of the ball, at rest at 10 m, = mgh = 5 × 9.8 × 10 J = 490 J At 10 m, **GPE** = mgh = 5×9.8×10 J = 490 J **KE** = ½mv^2 = 0.5×5×0^2 = 0 J At 8 m, **GPE** = mgh = 5×9.8×8 J = 392 J **KE** = ½mv^2 = 0.5×5×6.3^2 = 99.2 J At 6 m, **GPE** = mgh = 5×9.8×6 J = 294 J **KE** = ½mv^2 = 0.5×5×8.9^2 = 198.0 J At 4 m, **GPE** = mgh = 5×9.8×4 J = 196 J **KE** = ½mv^2 = 0.5×5×10.8^2 = 291.6 J At 2 m, **GPE** = mgh = 5×9.8×2 J = 98 J **KE** = ½mv^2 = 0.5×5×12.5^2 = 390.6 J At 0 m, **GPE** = mgh = 5×9.8×0 J = 0 J **KE** = ½mv^2 = 0.5×5×14.0^2 = 490 J **b)** The 490 J of gravitational potential energy at the 10 m is transformed into 490 J of kinetic energy on the ground. Accepting experimental error, The data suggests that the sum of gravitational potential energy and kinetic energy remains constant at 490 J.

p204

1 What is meant by energy transfer?

Energy transfer occurs when the same form of energy is transferred from one object to another object.

2 What are three ways in which heat energy may be transferred from one object to another?

Conduction is the transfer of heat energy between two objects that are in direct contact with each other.
Convection is a circular movement of warmer liquid or gas to cooler areas of liquid or gas and the replacement of the original warmer areas by cooler liquid or gas.
Radiation is the transfer of heat energy between objects that are not in contact. The transfer can move through empty space.

3 What is meant by energy transformation?

Energy transformation happens when energy changes from one form to another form.

4 Briefly describe an example of energy transformation.

When a light bulb is connected to a battery, the chemical energy in the battery is transformed into electrical energy. The light bulb transforms the electrical energy into light energy and thermal energy.

5 What is energy efficiency?

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

6 What is the efficiency of a vehicle that uses 30 MJ of energy from six litres of diesel (205 MJ of energy)?

Efficiency $= \frac{\textit{energy used}}{\textit{energy supplied}} \times 100\,\%$ = 30 MJ ÷ 205 MJ × 100 % = 14.63% efficiency.

7 What is the efficiency of a vehicle that uses 10 MJ of energy from a litre of diesel (38 MJ of energy)?

Efficiency $= \frac{\textit{energy used}}{\textit{energy supplied}} \times 100\,\%$ = 10 MJ ÷ 38 MJ × 100 % = 26.32% efficiency.

8 What is the law of conservation of energy?

When energy is transformed from one form of energy to another form of energy, the total amount of energy remains constant.

9 Use an example to explain the law of conservation of energy.

When an electric jug is used to boil water, electrical energy is transformed into heat energy, sound energy, kinetic energy (moving water molecules, air molecules, steam molecules). The total energy in is equal to the total energy out.

10 Calculate the efficiency of the light bulb example on the opposite page.

Efficiency $= \frac{\textit{energy used}}{\textit{energy supplied}} \times 100\,\%$ = 86 J ÷ 100 J × 100 % = 86% efficiency.

11 A coal power plant produces 400 J of electrical energy from every 1000 J of chemical energy in coal. What is the efficiency of the coal power plant.

Efficiency $= \frac{\textit{energy used}}{\textit{energy supplied}} \times 100\,\%$ = 400 J ÷ 1000 J × 100 % = 40% efficiency.

12 A plant produces 20 J of chemical energy from every 200 J of electromagnetic energy provided by the Sun. What is the efficiency of the photosynthesis process?

Efficiency $= \frac{\textit{energy used}}{\textit{energy supplied}} \times 100\,\%$ = 20 J ÷ 200 J × 100 % = 10% efficiency.

7 If 1000 J of electrical energy is supplied to a 60% efficient appliance:

a) how much energy is wasted? 40% of the energy is wasted = 400 J

b) how much energy is used? 60% of the energy is used = 600 J

p205	**1** This is a classic problem that many people get wrong because they reason that half of a hen cannot lay an egg, and a hen cannot lay half an egg. However, we can get a satisfactory solution by treating this as a purely mathematical problem where the numbers represent averages. To solve the problem, we first need to find the rate at which the hens lay eggs. The problem can be represented by the following equation, where RATE is the number of eggs produced per hen·day: 1½ hens × 1½ days × RATE = 1½ eggs We convert this to fractions thus: 3/2 hens × 3/2 days × RATE = 3/2 eggs Multiplying both sides of the equation by 2/3, we get: 1 hen × 3/2 days × RATE = 1 egg Multiplying both sides of the equation again by 2/3 and solving for RATE, we get: RATE = 2/3 eggs per hen·day Now that we know the rate at which hens lay eggs, we can calculate how many hens (H) can produce 12 eggs in six days using the following equation: H hens × 6 days × 2/3 eggs per hen·day = 12 eggs Solving for H, we get: H = 12 eggs /(6 days × 2/3 eggs per hen·day) = 12/4 = 3 hens Therefore, the farmer needs 3 hens to produce 12 eggs in 6 days. **2** Hydrogen chloride combines with sodium hydroxide to form common salt (sodium chloride) and water. $HCl + NaOH \rightarrow NaCl + H_2O$ {Needs to mixed in the correct proportion or the solution will be either acidic or basic } **3** Multiply bottom 2 numbers – Multiply top 2 numbers 3 × 4 – 1×2 = 10 4 × 5 – 2 × 3 = 12 5 × 6 – 3 × 4 = 18
p206	**1** Why do scientists use models? Scientists use models to represent and communicate their ideas. Models of processes such as energy flow make it easier to describe and explain complex ideas. **2** Use the model of ecological energy flow, on the opposite page, to calculate the efficiency of a primary producer in converting radiation energy from the sun into chemical energy. Efficiency = $\frac{energy\ used}{energy\ supplied} \times 100\ \%$ = 100 J ÷ 10 J × 100 % = 10% efficiency. **3** What eventually happens to the energy in a food chain? The energy is lost as heat energy into the air. **4** How much energy, in joules, is produced by a 200 watt solar panel in sunlight for 3 hours? Energy = 200 watts × 3 hours = 200 watts × 3 × 60 × 60 seconds = 2 160 000 watt-seconds = 2 160 000 joules Energy = 2.16 megajoules

p206	**5** How much energy, in joules, is produced by five 1000 watt wind turbines (assume 18 hours of useful wind)? Energy = 5 × 1000 watts × 18 hours = 5 × 1000 watts × 18 × 60 × 60 seconds = 324 000 000 watt-seconds = 324 000 000 joules Energy = 324 megajoules **6** Briefy describe the energy transformations during a head-on collision. There is a considerable amount of noise. Vehicle pieces such as glass, bumper bars, and even engines are spread around the collision site. Parts of each vehicle are smashed and deformed. Tyre skid marks are around the collision site. Both vehicles come to a stop and thus lose all kinetic energy. The kinetic energy in a two vehicle head-on collision is transformed into sound energy, heat energy, and is absorbed by the crumpling of parts of the vehicles. **7** Briefy describe the energy transformations in a swinging pendulum. Energy in a pendulum is continually transformed from gravitational potential energy to kinetic energy and back. The pendulum slows down, and eventually stops, as energy is lost through friction. **8** A television is rated at 80% efficiency. If the television is supplied with 2,000 J of electrical energy, how much energy is wasted (mostly lost heat energy)? 20% of input energy is wasted = 0.2 × 2000 J = 400 J {20% = 2/100 = 0.2} **9** An electric hot water system is rated at 85% efficiency. If the electric hot water system is supplied with 2,000 J of electrical energy, how much energy is wasted? 15% of input energy is watsed = 0.15 × 2000 J = 300 J {15% = 15/100 = 0.15} **10** A 5 kg shot put is dropped from a height of 15 m onto a sand pit. Briefly describe the energy transformations. As the shot put is held at 15 m, it posseses gravitational potential energy. As the shotput falls, the gravitational potential energy is transformed into kinetic energy and some heat energy due to friction with the surrounding air. The sand transforms the kinetic energy of the shotput as it hits the sand into sand kinetic energy, heat energy, and sound energy.
p207	**1** Time to a Red Giant = 10 billion years – 4.5 billion years = 5.5 billion years. **Thus c)** **2** How many years hydrogen will last = amount ÷ amount used per year $= 7\times10^{26} \div 1.4\times10^{17}$ $= 5\times10^{26-17} = 5\times10^{9}$ **Thus b)** **3** The largest amount of fatty acids as a source is shown in mild exercise. **Thus b)** **4** As the exercise intensity increases less Fatty acids are shown as a source. **Thus b)**

p208

1 The greater the height, the greater the gravitational potential energy. **Thus a)**

2 As the ball falls it gains kinetic energy. As the ball rises it loses kinetic energy. **Thus b)**

3 The ball bearing would reach D only if there was no loss of energy.

4 **a)** A cyclists rides a bike over a hill.
Riding up the hill the cyclist uses muscular (chemical) energy to pedal up the hill while gaining gravitational potential energy as height is increased. As the cyclist coasts down the hill, gravitational potential energy is transformed into kinetic energy.

b) A stone is thrown up in the air.
Muscular (chemical) energy is transformed into kinetic energy throwing the stone into the air. The stone slows as kinetic energy is transformed into gravitational potential energy. At top top of the stone's path, gravitational potential energy is transformed into kinetic energy as the stone falls to the ground

c) A wound up clock keeps time.
The wound up clock contains elastic potential energy that is gradually transformed into the kinetic energy of the wheels as they turn the hands of the clock.

d) The grass gets longer.
Radiation energy from the Sun is transformed into chemical energy in the plant that provides the energy for the growth of the grass.

5 Assume a litre of unleaded petrol has 35 MJ of chemical energy. If a vehicle produces 7 MJ of usable energy from a litre of petrol, what is the energy efficiency of the vehicle?

Efficiency = $\frac{\textit{energy used}}{\textit{energy supplied}} \times 100\ \%$ = 7 J ÷ 35 J × 100 % = 20% efficiency.

6 GPE = mgh = 100 × 9.8 × 10 = 9800 J

7 KE of block, upon liftoff = 9800 J

8 KE = mgh

9800 = 50 × 9.8 × h

9800 = 490 ×h

9800 ÷ 490 = h

20 m = h The 50 kg block would reach a height of 20 m

9 KE of 25 kg block, upon liftoff = 9800 J

KE = mgh

9800 = 25 × 9.8 × h

9800 = 245 ×h

9800 ÷ 245 = h

40 m = h The 25 kg block would reach a height of 40 m