Energy of moving

Objects

L1 Kinetic energy

Any object that is moving has **kinetic energy**. The greater the mass or velocity of the object, the greater the amount of kinetic energy. It can be calculated using the following equation:

$E_k = ½ \times m \times v^2$

Where E_k is the kinetic energy in joules (J)

m is the mass in kilograms (kg)

v is the velocity in metres per second (m/s)

Worked example 1: Cristiano Ronaldo kicks a football of mass 500 g at a speed of 40 m/s. Calculate the kinetic energy of the football.

Values: m = 500 g = 0.5 kg v= 40m/s

Equation: Ek = ½ x m x v^2

conversion

Substitution: E_k = 0.5 x m x v^2

Rearrange: No need Ek is already the subject

Answer: 400

Units: Joules

Study tip
Don't forget to convert non-standard units into standard units!

Worked example 2: A car of mass 800 kg is travelling with a kinetic energy of 1.44 MJ. Calculate its velocity.

Values: m = 800 kg E_k = 1.44 MJ = 1,440,000 J

Equation: Ek = ½ x m x v^2

conversion

Substitute: 1,440,000 = ½ x 800 x v^2

Re arrange: v^2 = 1,440,000 ÷ (800 x 0.5)   Make v the subject.

V = √(1,440,000 ÷ 400)

Answer: V = 60

Units: m/s

Study tip
Remember to re-arrange the equation!

Independent practice

Basic:

1. What types of objects have kinetic energy?
2. What is the equation for kinetic energy?
3. What are the units of kinetic energy, mass and velocity?
4. Calculate the **kinetic energy** of the following:
   a) A car that travels at a speed of 20m/s and has a mass of 1200 kg.
   b) A Year 10 student with a mass of 55kg swinging back on their chair and falling off it at a speed of 0.6m/s.
   c) A runner with a mass of 62kg running at a speed of 0.8m/s.
   d) A tennis ball traveling at a speed of 46m/s with a mass of 58kg.
   e) A dog running across a field at a speed of 1.2m/s with a mass of 3.2kg.

Medium: Requires rearranging.

5. Rearrange the equation to give an equation for the mass.
6. Calculate the **mass** of the following:
   a) Automatic door closing 0.2m/s, with a kinetic energy of 1.6J.
   b) Wind turbine blade with a kinetic energy of 104040J, turning at 6m/s.
   c) Aeroplane traveling at 75m/s with a kinetic energy of 843700J.
   d) Canoe moving down the river with a kinetic energy of 5J and a speed of 0.5m/s.
   e) Child riding a bike at a speed of 6m/s, with a total kinetic energy of 1224J. If the mass of the child is 30kg, what is the mass of the bike?
7. Rearrange the equation to give an equation for the velocity.
8. Calculate the **velocity** of the following:
   a) Bus traveling through town, with a mass of 5040kg and kinetic energy of 493900J.
   b) A lift traveling up to the top floor of the Empire State building with a mass of 4200kg and a kinetic energy of 4116J.
   c) Bird flying towards its nest with a mass of 0.25kg and a kinetic energy of 40.5J.
   d) A Wii remote flung from a hand through a TV, with a kinetic energy of 1.44J and a mass of 4.5kg.
   e) Hot air balloon with a kinetic energy of 76550J and a mass of 1890kg.

Hard: Rearranging and unit conversions.

9. A 4.2 g bullet travels at 1,700 mph. How much kinetic energy does it have?
10. A car travelling at 10 m/s has 75 kJ of KE. Calculate the car’s mass.
11. A bullet was fired from a gun. The bullet had a mass of 50g and the kinetic energy of the bullet was 25 kJ. How fast did it go?
12. A truck carrying heavy equipment travelled at 40 m/s and had a kinetic energy of 9 MJ, what was its mass?
13. A man started out with 1 kJ of kinetic energy and a mass of 100 kg. He then increased his kinetic energy by 100%. What was his speed after that?
14. An eagle flying at a constant 120 km/h and has kinetic energy of 2,800 J. What is the mass of the eagle?
15. A mosquito has a mass of 5 mg. Given that its kinetic energy is 0.8 mJ, how far will it travel in one hour?

L2 Gravitational potential energy

What is Gravitational Potential Energy?

Gravitational potential energy is the energy an object possesses because of its position in a gravitational field. This field is caused by the Earth's mass, and it affects everything around us. When you lift an object off the ground, you're giving it gravitational potential energy because it now has the potential to fall back to the ground due to gravity.

The Equation for Gravitational Potential Energy

The formula to calculate gravitational potential energy (GPE) is:
$E_p = m \times g \times h$
Where:
E_p is the gravitational potential energy (measured in joules, J).
m is the mass of the object (measured in kilograms, kg).
g is the acceleration due to gravity (approximately 9.81 m/s^2 on Earth).
h is the height of the object above the reference point (measured in meters, m).

How to Calculate Gravitational Potential Energy

Worked example:
Suppose you have a 2 kg object, and it's 5 meters above the ground. The earths gravitational field strength is 9.8 N/Kg. Calculate its GPE
Values: m = 2Kg h=5m
Equation: $E_p = m \times g \times h$
Substitute: $E_p = 2 \times 9.8 N/kg \times 5$
Rearrange: not needed
Answer: 98.1
Units: Joules

So, the gravitational potential energy of the object is 98.1 joules.

Important Points to Remember:

- Gravitational potential energy depends on the mass of the object, the height it's raised to, and the strength of the gravitational field (g).
- On Earth, the acceleration due to gravity (g) is roughly 9.81 m/s^2. However, this value can change slightly depending on your location on Earth.
- Gravitational potential energy is always measured relative to a reference point, often the Earth's surface. The height (h) is the vertical distance from the reference point to the object.
- GPE is always a positive value because it represents the potential energy an object has due to its position relative to the reference point. The higher the object is, the more potential energy it has.

Independent practice

1. **Extended writing (paragraph required):** What is gravitational potential energy, and why is it important in physics?
2. What is the formula to calculate gravitational potential energy (GPE)?
3. On Earth, what is the approximate value of the acceleration due to gravity (g)?
4. Why is GPE always a positive value?
5. If you double the height of an object, what happens to its GPE?
6. If you triple the mass of an object, what happens to its GPE?
7. If you're on another planet with a weaker gravitational field than Earth, how would that affect the GPE of an object?

Basic:

1. What type of objects have gravitational potential energy?
2. What is the equation for gravitational potential energy?
3. What are the units for gravitational potential energy, mass, gravitational field strength and height?
4. What is the value of the gravitational field strength on Earth?
5. Calculate the **gravitational potential energy** of the following objects on Earth:
   a) m = 10 kg
   h = 5 m
   b) m = 20 kg
   h = 15 m
   c) m = 100 g (you must convert g into kg before you calculate E_K)
   h = 100 cm
6. If an object is raised 100m above ground with a mass of 100kg, how much **gravitational potential energy** did it gain?
7. If an object with a mass of 25kg is raised 10m how much **gravitational potential energy** did it gain?
8. A diving platform is 10 m above the ground. When an 80 kg diver climbs to the top of the platform, how much **GPE** does he acquire?
9. A window cleaner, who's mass is 65 kg, is cleaning the first floor windows the academy 2.5 m above the ground. The third floor windows are 7.5 m above the ground. How much **GPE** would she gain climbing to the third floor?

Medium: Rearranging needed

10. Rearrange the equation for GPE to give an equation for the **height**.
11. An object gains gravitational potential energy of 300J. If the mass of the object is 3kg, what is the **height** that the object has been raised?
12. If the Ep of an object is 1000J and the mass is 25kg, what is the **height** of the object?
13. What is the **height** of an object with a mass of 10kg and gravitational potential energy of 3500J?
14. Rearrange the equation for GPE to give an equation for **mass**.
15. What is the **mass** of an object when it is raised 25m and gains gravitational potential energy of 50 000J?
16. An object has a gravitational potential energy of 500 J and is located at a height of 20m above the ground. Calculate the **mass** of the object.
17. Calculate the **mass** of an object that has a gravitational potential energy of 250 J and is up at a height of 20 cm.

Hard: Rearranging and unit conversion needed

18. A rocket is stationary at a height of 3000 m; its gravitational potential energy is 300 kJ, what is its **mass**?
19. A Boeing 747 climbs from 3,000 m to 9,000 m, and gains 19,980,000 kJ of GPE. Calculate the **mass** of the plane.
20. A skier, with a mass of 70 kg, loses 140 kJ of energy when skiing down the slope. What was the **height** which the skier descended.
21. A fighter jet, flying 8 km above the ground, drops a bomb on an enemy target. The bomb loses 160,000 kJ of energy during its decent. What was the **mass** of the bomb?
22. 2 J of GPE are lost by a 50 g conker which falls from a tree. How **high** did it fall from?

L3 Forces and springs

Hooke's law says that the amount a spring stretches is proportional to the amount of force applied to it.

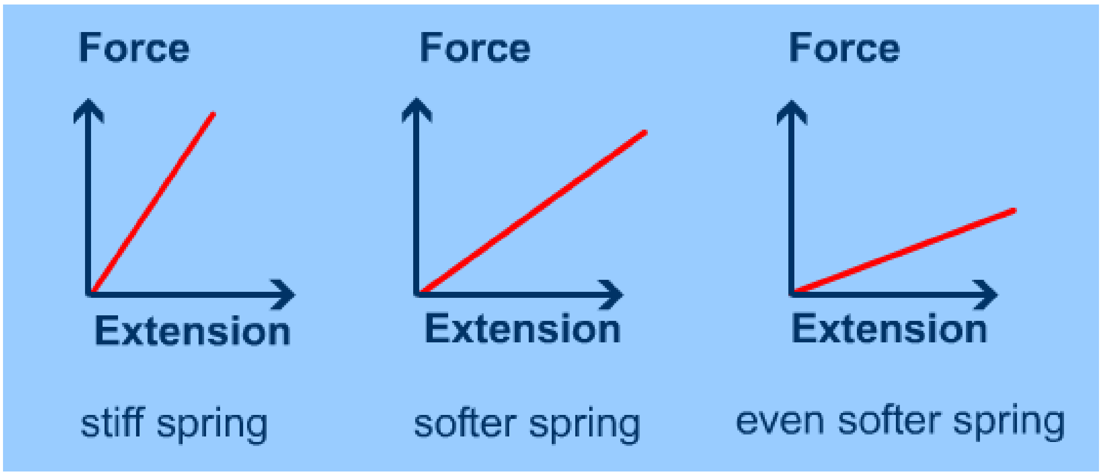
$$F = k \times e$$

Where:

- F is the applied force (in newtons, N),
- e is the extension (in metres, m)
- k is the spring constant (in N/m).

The **spring constant** measures how difficult it is to compress or stretch a spring.

The larger the spring constant the more difficult is to compress or stretch.



If a material returns to its original size and shape when you remove the forces stretching or deforming it (reversible deformation), we say that the material is demonstrating **elastic behaviour.**

A **plastic** (or **inelastic**) material is one that stays deformed after you have taken the force away. If deformation remains (irreversible deformation) after the forces are removed, then it is a sign of **plastic behaviour.**

If you apply too big a force a material will lose its elasticity.

Independent practice

Basic

1. a) What is the equation that links force, spring constant and extension?
   b) What are the units of force, spring constant and extension?
2. Calculate the force on a spring if:
   a) k = 10 N/m, e = 0.20 m.
   b) k = 25 N/m, e = 0.05 m.
   c) k = 150 N/m, e = 0.15 m.
3. If the spring constant is 30 N/m and a spring is stretched by 0.3m, how much force has been applied?
4. If the spring constant is 12.6 N/m and a spring is stretch by 0.25m, how much force has been applied?
5. What force would be needed to extend a spring with a spring constant k = 10 N/m by an extension of 0.3 m?

Medium

6. Re-arrange Hooke's law to give equations for the spring constant k, and the extension e. You will need to use these equations for the rest of the medium questions.
7. Calculate the spring constant if:
   a) F = 150 N, e = 0.075 m.
   b) F = 50 N, e = 0.1 m.
8. Calculate the extension if:
   a) F = 15 N, k = 150 N/m.
   b) F = 45 N, k = 90 N/m.
9. If a 6N weight is hung on a spring, and it extends by 0.2m, what is the spring constant?
10. If the force applied is 4.5 N and the spring constant is 9 N/m, how much will the spring extend by?

Hard

11. A mass of 620 g is hung on a spring of spring constant 31 N/m.
   a) Convert 620 g into kg.
   b) Using F = m × g, what is the force of the mass acting on the spring (g = 10 N/kg)?
   c) Calculate the extension of the spring.

To go from g to kg → ÷ 1000

12. A spring of spring constant 40 N/m starts at a length of 13 cm, and it extends to a length of 21 cm.
   a) What is the extension of the spring (in cm)?
   b) Convert this extension into metres.
   c) What is the force on this spring?

To go from cm to m → ÷ 100

13. A spring has a weight of 200g hanging on it, and has a spring constant of 40 N/m. Calculate the extension of the spring.
14. A spring has a weight of 500g hanging on it, and is stretched from a length of 5cm to a length of 15 cm. What is the spring constant of the spring?
15. A spring has a weight of 750g hanging on it, and is stretched from a length of 2.5cm to a length of 10 cm. What is the spring constant of the spring?

L4 Energy in springs

The energy stored in a spring when work is done in compressing or stretching it is called **elastic potential energy.**

This can be calculated by using the following equation:

$$E_e = ½ \times k \times e^2$$

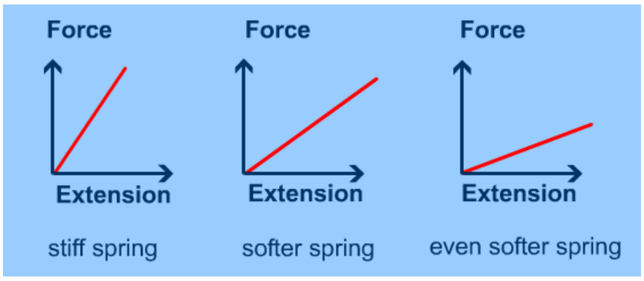
Where E_e is the Elastic potential energy in **Joules**

k is the Spring constant in **Newtons per metre**

e is the Extension in **metres**

The **spring constant** measures how difficult it is to compress or stretch a spring.

The larger the spring constant the more difficult is to compress or stretch.



Worked example 1

How much work must be done to compress a spring by 4.0 cm if the spring constant is 55 N/m.

Values: e = 4 cm = 0.04 m k = 55 N/m ← conversion
Equation: $E_e = 0.5 \times k \times e^2$
Substitute: $E_e = 0.5 \times 55 \times 0.04^2$
$E_e = 0.044$
Units: Joules

Study tip
Don't forget to convert non-standard units into standard units!

Worked example 2

A coil spring on a car's suspension have a value of k = 64 kN/m. When the car strikes a bump the spring briefly stores 80 Joules of energy. How much does the spring compress?

Values: k = 64 kN/m = 64,000 N/m E_e *=80* ← conversion
Equation: $E_e = 0.5 \times k \times e^2$
Substitution: $80 = 0.5 \times 64{,}000 \times e^2$
Rearrange: $e = \sqrt{(80 \div (0.5 \times 64{,}000))}$ ← Make e the subject
Answer: $E_e = 0.05$
Units: m

Independent practice

Basic

1. Calculate the **Elastic Potential Energy** (in J) for each of the following:
   a) Spring constant k = 5 N/m, spring extension e = 0.1 m.
   b) Spring constant k = 20 N/m, spring extension e = 0.15 m.
2. Calculate the **spring constant** (in N/m) for each of the following:
   a) Elastic potential energy 0.1 J, spring extension e = 0.05 m.
   b) Elastic potential energy 5 J, spring extension e = 0.2 m.
3. Calculate the **extension** (in m) for each of the following:
   a) Elastic potential energy 7 J, spring constant k = 15 N/m.
   b) Elastic potential energy 2.5 J, spring constant k = 20 N/m.

Medium

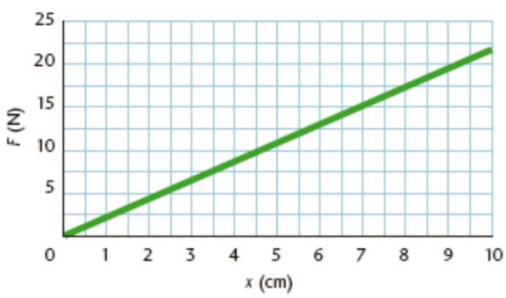
To go from cm to m → ÷ 100

To go from mm to m → ÷ 1000

4. Solve for each unknown.
   a) A spring with k = 450 N/m is compressed by 13 cm. How much **energy** is stored?
   b) A spring with k = 520 N/m stores 7.04 J. How far is it **extended** from the equilibrium position?
   c) A spring, when compressed 20 cm from the equilibrium position, stores 26 J. What is the value of the **spring constant**?
5. The coil springs on a car's suspension have a value of k = 6.4 x 10^4 N/m. When the car strikes a bump the springs briefly compress by 4.0 cm. How much **energy** is momentarily stored in each spring?
6. How much **work** must be done to
   a) compress a spring 4.0 cm if the spring constant is 55 N/m?
   b) stretch a spring 8.0 cm if the spring constant is 85 N/m?

Hard

7. A spring attached to a ceiling has a mass of 500 g suspended from it such that the spring stretches 4.0 cm. Calculate the **spring constant**. (g=9.8 N/kg)
8. To the right is a graph of F versus e for an elastic spring. Determine:



   a) The spring constant.
   b) The spring's maximum amount of elastic potential energy.
   c) The change in elastic potential energy when the spring extends from 3 cm to 4 cm.
9. At maximum extension a bungee cord stores 2.0 × 10^6 J of energy. A 10-kg mass extends the bungee cord 1.3 m. What is the maximum extension of the bungee cord?
10. An arrow of mass 300g is shot directly upwards by a bow of spring constant 2000 N/m, that is extended by a distance of 20 cm. Calculate:
    a) The maximum elastic potential energy stored by the bow.
    b) The initial velocity of the arrow.
    c) The maximum height that the arrow reaches. (g=9.8 N/kg)

L5 Work done.

Work is a measure of energy transfer and can be applied to various situations, like pushing a heavy object or lifting a backpack. In this explanation, we'll break down the concept of work, provide examples, and even ask some questions to test your understanding.

Work: A Quick Definition
Work, in physics, is defined as the product of force and displacement when the force is applied in the direction of the displacement. In other words, work (W) is calculated using the following formula:

$W = F \times s$

Where:
W represents work (measured in joules, J).
F stands for the force applied (measured in newtons, N).
s is the displacement (measured in meters, m).
To perform work, you need both force and movement in the same direction. Think of it as carrying a bag up a flight of stairs. You exert a force vertically to lift the bag, which moves it upwards, hence work is done.

Calculating Work

Now, let's work through a simple example to understand how to calculate work. Suppose you are pushing a 10 kg box along a smooth, horizontal surface with a force of 20 N over 5 meters. Calculate the work done.

Values: $F = 20N$ $s = 5m$
Equation: $W = F \times s$
Substitute: $W = 20\ N \times 5\ m$
Rearrange: Not needed
Answer: $W = 100$
Units: J
So, in this example, you've done 100 joules of work to move the box.

The Straight Line Example

Work done on a straight line is quite straightforward. When you exert a force to move an object in a straight line, you're essentially pushing it along a single path without deviating. The work done is directly proportional to the force applied and the distance over which the force is applied. If you double the force, you'll do double the work. If you double the distance, you'll also do double the work.

The concept of a straight line simplifies the calculation of work because there's no change in direction to consider. It's as if you're on a perfectly straight road, and the only thing that matters is how hard you're pushing and how far you're going.

Independent practice

Basic:

W = F × s

1. What is **work done**?
2. Write the equation for **work done**. Include the units.
3. Rearrange the equation for **force** and **distance**.
4. Calculate the **work done** if:
   a) F = 5 N, d = 5 m b) F = 150 N, d = 0.1 m c) F = 0.2 N, d = 200 m
   d) F = 2000 N, d = 1.5 m e) F = 800 N, d = 25 m f) F = 150,000 N, d = 0.5 m
5. What is the **work done** if we apply a 1.2N force and we move 4m in the direction of force?
6. What is the **work done** if we apply a 7N force and we move 8m in the direction of the force?
7. A car drives with a force of 300,000 N over a distance of 200m. What is the **work done** by the car?

Medium: Rearranging needed

8. Calculate the **distance** moved if:
   a) W = 20 J, F = 10 N b) W = 150 J, F = 7.5 N c) W = 200,000 J, F = 2 N
   d) W = 300 J, F = 0.5 N e) W = 90,000 J, F = 4.5 N f) W = 3,000 J, F = 9 N
9. Calculate the **force** if:
   a) W = 15 J, d = 0.75 m b) W = 450 J, d = 225 m c) W = 9000 J, d = 3000 m
   d) W = 5000 J, d = 1250 m e) W = 140 J, d = 35 m f) W = 800 J, d = 0.2 m
10. What **distance** is moved if we have a 8 N force and the work done is 90 J?
11. What is the **distance** moved if we have a 70 N force and work done is 8 J?
12. What **force** is required to move 7 m if the work done is 9 J?

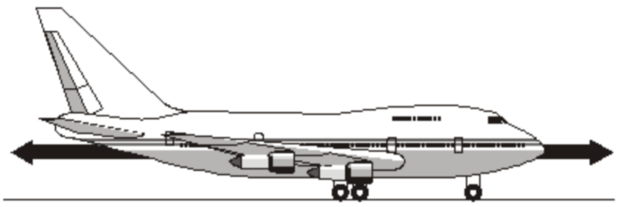
Hard: Rearranging and unit conversion

To go from kN to N → × 1000

To go from km to m → × 1000

To go from cm to m → ÷ 100

13. What is the **work done** when a force of 5kN is applied to a ball and it moves 0.8km?
14. What is the **work done** to a car if a force of 9kN is applied and it moves 7km?
15. What **force** is required if 2.5kJ moves and object 56cm?
16. Dr. Edmunds' cat Lola accelerates with a force of 220 N along a distance of 80 cm. Calculate the **work done**.
17. A teacher is late for a lesson and expends 400,000 J of energy sprinting to a lesson. If the distance covered is 0.2 km, with what **force** does the teacher sprint?
18. An aeroplane does 1.2×10^8 J of work in flying a distance of 400 km. With what **force** is the aeroplane flying?
19. a) The diagram shows an aircraft and the horizontal forces acting on it as it moves along a runway. The resultant force on the aircraft is zero.



   i) What is meant by the term **resultant force**?
   ii) Describe the movement of the aircraft when the resultant force is zero.

   b) The aircraft has a take-off mass of 320,000 kg. Each of the 4 engines can produce a force of 240 kN. The aircraft takes a distance of 0.8 km to take off. Calculate the **work done** by the aircraft in taking off.

L6 Power

Power is defined as the rate at which energy is transferred. Energy has units of joules. Power can be calculated using the formula:

$P = E \div t$ $P = W \div t$

Where:

- P = power in watts (W)
- E = energy in joules (J) W = work done in joules (J)
- t = time in seconds (s)

Note that an alternative unit for energy is the kilowatt hour (kWh). This means that a power of one kilowatt (equal to 1,000 watts) has been used for one hour. The equation can be re-written as follows:

$E = P \times t$

Where:

- P = power in kilowatts (kW)
- E = energy in kilowatt hours (kWh)
- t = time in hours (h)

The kilowatt hour is a convenient unit to measure how much electrical energy a household has used. This is because a household uses a very large number of joules.

One kilowatt hour is equal to 1,000 Watt hours, and as there are 3,600 seconds in one hour one kilowatt hour is equal to 3,600,000 Joules. A smaller number is of kilowatt hours is more appropriate unit to measure electrical energy used within a household.

Worked example:

Calculate the energy transferred from the mains when the TV has 3000 kW of power and is turned on for 3 hours.

Values: P = 3000 kW t = 3 h
Equation: $E = P \times t$
Substitute: E= 3000 x 3
Rearrange: No need
Answer: 9000
Units: kWh
The energy transferred from the mains to the TV is 9000 kWh.

Independent practice

1. Calculate E, from the following:
   P = 1 kW
   t = 10 h
2. Calculate the electrical energy from the following:

   Power = 0.1 kW

   time = 24 h
3. An electrical appliance has a power equal to P = 5 kW. Calculate the energy supplied to the appliance in 10 h.
4. A 1.5 kW hairdryer is switched on for half an hour (0.5 h). Calculate the energy supplied to the hairdryer.
5. A 2 kW kettle is switched on for half an hour. Calculate the energy used by the kettle.
6. An electric heater has a power equal to P = 3 kW. The heater is switched on for a whole day. Calculate the energy used by the heater.
7. Calculate P, from the following:
   E = 20 000 J
   t = 20 s
8. Calculate P from the following:

   E = 5 000 J

   t = 35 s
9. Calculate the power from the following:

   Energy = 800 J

   time = 60 s
10. Calculate the power from the following:
    Energy = 1 000 J
    time = 1 h
    Hint: before you calculate the power you need to convert h (hours) into s (seconds).
11. A kettle is supplied with **100 000 J** for **120 s**. Calculate the power generated by the kettle.
12. A fridge is supplied with 20 000 J of electrical energy for 10 s. Calculate the power generated by the fridge.
13. A television is supplied with 60 000 J of electrical energy. The television is on for 20 s. Calculate the power generated by the TV.
14. An electric motor is supplied with 100 000 J of electrical energy. The motor works for 2 hours. Calculate the power generated by the motor.

L6 Efficiency

The more energy something wastes, the less efficient it is. Energy is wasted by raising the thermal energy store of the surroundings.

Mini-task: For the following devices state what energy is used from this list: Chemical Kinetic Thermal Electrical Light

Light bulb: Input Energy _____________

Useful Energy ____________ Waste Energy _________

Electric Drill: Input Energy ____________

Useful Energy ____________

Waste Energy____________

TV: Input Energy _____________

Useful Energy ____________

Waste Energy ____________

Car engine: Input Energy _____________

Useful Energy ____________

Waste Energy ____________

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:

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

Independent Practice

Basic:

Calculate efficiency

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?