SI units and prefixes

Worked solutions

GCSE science calculations

This topic online

1 Give the SI unit of each quantity.

a. power

b. resistance

(2 marks)

a)

watt, W

b)

ohm, Ω

2 Convert each value to the base SI unit.

a. The power of a hairdryer is 2.4 kW. Give the power in watts.

b. The mass of a bag of sugar is 350 g. Give the mass in kilograms.

(2 marks)

a) kilo means × 1000

2.4 × 1000 = 2400

2400 W

b) 1 kg = 1000 g, so divide by 1000

350 ÷ 1000 = 0.35

0.35 kg

Free for classroom and home use: print, photocopy and share. Not for resale or re-hosting.

3 Nadia records three measurements in a Year 10 lab practical.

a. A time of 3.5 minutes. Give the time in seconds.

b. A length of 45 cm. Give the length in metres.

c. A current of 80 mA. Give the current in amperes.

(3 marks)

a) 1 minute = 60 s

$3.5 \times 60 = 210$

210 s

b) 1 m = 100 cm

$45 \div 100 = 0.45$

0.45 m

c) milli means ÷ 1000

$80 \div 1000 = 0.08$

0.08 A

4 Tera (T) means × 10^{12}, giga (G) means × 10^{9} and nano (n) means × 10^{-9}.

a. A home wi-fi router sends radio waves with a frequency of 2.4 GHz. Give the frequency in hertz.

b. Green light has a wavelength of 550 nm. Give the wavelength in metres, in standard form.

c. A power station transfers 25 TJ of energy in one day. Give the energy in joules, in standard form.

(3 marks)

a) giga means $\times 10^{9}$

$2.4 \times 10^{9} = 2\,400\,000\,000$

2 400 000 000 Hz

b) nano means $\times 10^{-9}$

$550 \times 10^{-9} = 0.00000055$

$0.00000055 = 5.5 \times 10^{-7}$

5.5×10^{-7} m

c) tera means $\times 10^{12}$

$25 \times 10^{12} = 2.5 \times 10^{13}$

2.5×10^{13} J

Free for classroom and home use: print, photocopy and share. Not for resale or re-hosting.

5 A kettle has a power of 2.5 kW. It is switched on for 2 minutes.

Calculate the energy transferred by the kettle in joules. (3 marks)

Energy transferred = power x time

2.5 kW = 2500 W

2 minutes = 2 x 60 = 120 s

$E = 2500 \times 120$

$E = 300\,000$

300 000 J

6 A spring has a spring constant of 25 N/m. Ifeoma hangs a mass on the spring and it stretches by 4.0 cm.

Calculate the force stretching the spring. (2 marks)

Force = spring constant x extension

4.0 cm = 4.0 ÷ 100 = 0.04 m

$F = 25 \times 0.04$

$F = 1$

1 N

7 A football has a mass of 450 g. It is kicked and moves at a speed of 8.0 m/s.

Calculate the kinetic energy of the football. (3 marks)

Kinetic energy = 0.5 x mass x speed^2

450 g = 450 ÷ 1000 = 0.45 kg

$E_k = 0.5 \times 0.45 \times 8^2$

$E_k = 0.5 \times 0.45 \times 64$

$E_k = 14.4$

14.4 J

Free for classroom and home use: print, photocopy and share. Not for resale or re-hosting.

8 Tom rides an e-scooter 1.8 km along a cycle path. The journey takes 6 minutes.

Calculate his average speed in m/s. (3 marks)

Distance travelled = speed x time

1.8 km = 1.8 x 1000 = 1800 m

6 minutes = 6 x 60 = 360 s

$1800 = v \times 360$

$v = 1800 \div 360$

$v = 5$

5 m/s

9 A microwave oven has a power of 800 W. It transfers 96 kJ of energy to a bowl of soup.

Calculate how long the microwave is switched on for, in seconds. (3 marks)

Energy transferred = power x time

96 kJ = 96 x 1000 = 96 000 J

$96\,000 = 800 \times t$

$t = 96\,000 \div 800$

$t = 120$

120 s

10 A small LED in a bike light has a current of 15 mA. A charge of 2.7 C flows through the LED.

Calculate the time the LED is on for, in seconds. (3 marks)

Charge flow = current x time

15 mA = 15 ÷ 1000 = 0.015 A

$2.7 = 0.015 \times t$

$t = 2.7 \div 0.015$

$t = 180$

180 s

Free for classroom and home use: print, photocopy and share. Not for resale or re-hosting.

11 A car of mass 1200 kg is travelling at 54 km/h.

Calculate the kinetic energy of the car. Give your answer in kilojoules (kJ).

Show your working.

(4 marks)

54 km/h means 54 000 m in 3600 s

$v = 54\,000 \div 3600$

$v = 15$ m/s

Kinetic energy = 0.5 × mass × speed^2

$E_k = 0.5 \times 1200 \times 15^2$

$E_k = 135\,000$ J

kilo means × 1000, so divide by 1000

$135\,000 \div 1000 = 135$

135 kJ

12 Aisha fills a kettle with 750 g of water at 18 °C. The kettle has a power of 2.2 kW.

The specific heat capacity of water is 4200 J/kg °C. Assume all the energy transferred by the kettle heats the water.

Calculate the time it takes to heat the water to 100 °C. Give your answer in seconds to 2 significant figures.

Show your working.

(5 marks)

Change in thermal energy = mass × specific heat capacity × temperature change

750 g = 0.75 kg

$\Delta\theta = 100 - 18 = 82\ ^\circ C$

$\Delta E = 0.75 \times 4200 \times 82$

$\Delta E = 258\,300$ J

Energy transferred = power × time

2.2 kW = 2200 W

$258\,300 = 2200 \times t$

$t = 258\,300 \div 2200$

$t = 117.4...$ s

120 s (2 s.f.)

Free for classroom and home use: print, photocopy and share. Not for resale or re-hosting.

13 The label on a food mixer says:

- 230 V
- 600 W
- 50 Hz

Kayode uses the mixer for 3.0 minutes.

Calculate the energy transferred by the mixer. Give your answer in kilojoules (kJ). (3 marks)

Only the power and the time are needed. The 230 V and 50 Hz are not used

Energy transferred = power x time

1 minute = 60 s

3.0 minutes = 3.0 x 60 = 180 s

E = 600 x 180

E = 108 000 J

kilo means x 1000, so divide by 1000

108 000 ÷ 1000 = 108 kJ

108 kJ

14 A delivery drone has a mass of 1.2 kg. It carries a parcel of mass 850 g. The drone lifts the parcel straight up through a height of 30 m in 15 s.

Gravitational field strength = 9.8 N/kg.

Calculate the gravitational potential energy gained by the parcel. (3 marks)

Use the mass of the parcel only. The drone mass and the 15 s are not needed

Gravitational potential energy = mass x gravitational field strength x height

1 kg = 1000 g

850 g = 850 ÷ 1000 = 0.85 kg

E_p = 0.85 x 9.8 x 30

249.9 J

Free for classroom and home use: print, photocopy and share. Not for resale or re-hosting.