Wave speed and period

Worked solutions

GCSE science calculations

This topic online

1 Waves on a boating lake have a frequency of 2 Hz and a wavelength of 0.6 m.

Calculate the speed of the waves. (2 marks)

Wave speed = frequency × wavelength

$v = f\lambda$

$v = 2 \times 0.6$

$v = 1.2$ m/s

2 A wave machine at a leisure centre makes waves with a frequency of 0.5 Hz.

Calculate the period of the waves. (2 marks)

Period = 1 ÷ frequency

$T = \frac{1}{f}$

$T = \frac{1}{0.5}$

$T = 2$ s

3 A tuning fork makes a sound wave with a frequency of 680 Hz. The wavelength of the sound in air is 0.5 m.

Calculate the speed of sound in air. (2 marks)

Wave speed = frequency × wavelength

$v = 680 \times 0.5$

$v = 340$ m/s

4 A smoke alarm gives out a sound with a frequency of 2.5 kHz. The wavelength of the sound is 0.132 m.

Calculate the speed of the sound. (2 marks)

Wave speed = frequency × wavelength

2.5 kHz = 2500 Hz

$v = 2500 \times 0.132$

$v = 330$ m/s

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5 Zainab uses a ripple tank in a Year 10 practical. The waves have a frequency of 12 Hz and a wavelength of 1.5 cm.

Calculate the speed of the waves in m/s. (2 marks)

Wave speed = frequency × wavelength

1.5 cm = 0.015 m

$v = 12 \times 0.015$

$v = 0.18$ m/s

6 A bat makes a sound with a frequency of 40 kHz.

Calculate the period of the sound wave. Give your answer in standard form. (2 marks)

Period = 1 ÷ frequency

40 kHz = 40 000 Hz

$T = \frac{1}{40\,000}$

$T = 0.000025$ s

$T = 2.5 \times 10^{-5}$ s

7 A guitar string makes a sound with a frequency of 170 Hz. The speed of sound in air is 340 m/s.

Calculate the wavelength of the sound wave in air. (2 marks)

Wave speed = frequency × wavelength

$340 = 170 \times \lambda$

$\lambda = 340 \div 170$

$\lambda = 2$ m

8 A local radio station broadcasts on a frequency of 100 MHz. Radio waves travel at 3.0×10^8 m/s.

Calculate the wavelength of the radio waves. (3 marks)

Wave speed = frequency × wavelength

100 MHz = 1.0×10^8 Hz

$3.0 \times 10^8 = 1.0 \times 10^8 \times \lambda$

$\lambda = (3.0 \times 10^8) \div (1.0 \times 10^8)$

$\lambda = 3$ m

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9 Orange light from a street lamp has a wavelength of 600 nm. Light travels at 3.0×10^8 m/s.

1 nm = 1×10^{-9} m

Calculate the frequency of the light. Give your answer in standard form. (3 marks)

Wave speed = frequency × wavelength

600 nm = 6.0×10^{-7} m

$3.0 \times 10^8 = f \times 6.0 \times 10^{-7}$

$f = (3.0 \times 10^8) \div (6.0 \times 10^{-7})$

$f = 5 \times 10^{14}$ Hz

10 Mateo watches waves in a harbour. One wave crest travels 9.0 m along the harbour wall in 6.0 s. The wavelength of the waves is 1.2 m.

a. Calculate the speed of the waves.

b. Calculate the frequency of the waves. Show your working. (4 marks)

a)

Distance travelled = speed × time

$9.0 = v \times 6.0$

$v = 9.0 \div 6.0$

$v = 1.5$ m/s

b)

Wave speed = frequency × wavelength

$1.5 = f \times 1.2$

$f = 1.5 \div 1.2$

$f = 1.25$ Hz

11 A buoy at sea bobs up and down as waves pass it. The time period of the waves is 4.0 s. The wavelength of the waves is 10 m.

Calculate the speed of the waves. Show your working. (3 marks)

Period = 1 ÷ frequency, so frequency = 1 ÷ period

$f = \frac{1}{4.0}$

$f = 0.25$ Hz

Wave speed = frequency × wavelength

$v = 0.25 \times 10$

$v = 2.5$ m/s

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12 A microwave oven uses microwaves with a frequency of 2.45 GHz. Microwaves travel at 3.0×10^8 m/s.

1 GHz = 1×10^9 Hz

a. Calculate the wavelength of the microwaves. Give your answer in metres to 2 significant figures.

b. Calculate the period of the microwaves. Give your answer in standard form to 2 significant figures.

Show your working. (5 marks)

a)

2.45 GHz = 2.45×10^9 Hz

Wave speed = frequency × wavelength

$3.0 \times 10^8 = 2.45 \times 10^9 \times \lambda$

$\lambda = (3.0 \times 10^8) \div (2.45 \times 10^9)$

$\lambda = 0.12244...$ m

$\lambda = 0.12$ m (2 s.f.)

b)

Period = 1 ÷ frequency

$T = \frac{1}{2.45 \times 10^9}$

$T = 4.0816... \times 10^{-10}$ s

$T = 4.1 \times 10^{-10}$ s (2 s.f.)

13 Jade makes water waves in a ripple tank. The horizontal distance from a crest to the next trough is 1.5 cm. Each crest is 0.40 cm above the level of still water. The frequency of the waves is 10 Hz.

Calculate the speed of the waves in m/s. Show your working. (3 marks)

Crest to the next trough is half a wavelength. The 0.40 cm amplitude is not needed

$\lambda = 2 \times 1.5 = 3.0$ cm

1 m = 100 cm

$\lambda = 3.0 \div 100 = 0.030$ m

Wave speed = frequency × wavelength

$v = 10 \times 0.030$

0.3 m/s

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