

How waves carry energy without matter

Grade 7 science (Year 8 · Class 7) · Worksheet answers

Each answer shows the formula, the substitution and the final result with its unit in bold. Check your method as well as your number, and note the common slips such as measuring wavelength from crest to trough.

Level: Grade 7 science (Year 8 · Class 7) · **Curriculum:** MS-PS4-1

Problem 1 Parts of a wave

1. Wavelength is the length of one complete wave, for example from one crest to the next crest.
2. The unit of frequency is the **hertz (Hz)**.
3. A **longitudinal wave** has compressions and rarefactions.

Problem 2 Transverse or longitudinal?

1. Transverse: the water moves up and down while the ripple spreads sideways.
2. Longitudinal: air particles vibrate along the direction the sound travels.
3. Transverse: the rope moves at right angles to the wave direction.
4. Longitudinal: the coils move along the spring's length.

1 T, 2 L, 3 T, 4 L

Problem 3 Counting waves at a pier

1. $f = N \div t$.
2. $f = 45 \div 90 = 0.50$.

f = 0.50 Hz

Problem 4 From frequency to period

1. $T = 1 \div f$.
2. $T = 1 \div 5.0 = 0.20$.

T = 0.20 s

Problem 5 Converting units

1. $2.5 \times 1000 = \mathbf{2500 \text{ Hz}}$
2. $40 \div 100 = \mathbf{0.40 \text{ m}}$
3. $0.8 \times 100 = \mathbf{80 \text{ cm}}$

Problem 6 Reading a wave on a grid

1. The wave reaches 3 cm above the zero line: **amplitude = 3 cm**.
2. One crest is at 2 cm and the next at 10 cm, so **wavelength = 8 cm**.
3. The wave runs 16 cm, which is $16 \div 8 = 2$ **complete waves**.

Problem 7 Speed of a rope wave

1. $v = f \times \lambda$.
 2. $v = 5.0 \times 0.30 = 1.5$.
- v = 1.5 m/s**

Problem 8 Wavelength of a sound

1. $\lambda = v \div f$.
 2. $\lambda = 340 \div 680 = 0.50$.
- $\lambda = 0.50$ m**

Problem 9 Finding the frequency

1. $f = v \div \lambda$.
2. $f = 3.0 \div 1.5 = 2.0$ **Hz**.
3. $T = 1 \div 2.0 = 0.50$ **s**.

Problem 10 The cork that stays put

1. The water particles, and the cork on them, only vibrate up and down around fixed positions. The wave passes through the water without carrying the water along.
2. The ripples carry **energy** to the edge of the pool.

Problem 11 Loud and soft drum beats

1. Wave A has the larger amplitude.
2. Larger amplitude means a louder sound, so **beat 1 (wave A) is louder**.
3. Wave A carries more energy because its amplitude is larger and the frequency is the same.

Problem 12 The bobbing buoy

1. The buoy reaches 0.4 m: **amplitude = 0.4 m**.
2. Crests are at 0.5 s and 2.5 s, so **T = 2.0 s**.
3. $f = 1 \div T = 1 \div 2.0 = 0.50$ **Hz**.

Problem 13 Spot the mistakes

1. Frequency is the number of waves per second, not a length. A 3 Hz wave passes a point 3

times each second; its wavelength could be any value.

2. A wave carries energy, not water. The water moves in small loops and stays near its place.

Frequency is not length; waves move energy, not water.

Problem 14 Pulses along a spring

1. $f = 5 \div 2.0 = \mathbf{2.5 \text{ Hz}}$.

2. $12 \text{ cm} = 0.12 \text{ m}$.

3. $v = f \times \lambda = 2.5 \times 0.12 = 0.30$. **$v = 0.30 \text{ m/s}$**

Problem 15 Doubling the frequency

1. $\lambda = 2.4 \div 3.0 = \mathbf{0.80 \text{ m}}$.

2. $\lambda = 2.4 \div 6.0 = \mathbf{0.40 \text{ m}}$.

3. The wavelength is halved when the frequency doubles, because $v = f \times \lambda$ stays the same.

Problem 16 Waves at Mombasa

1. $f = 12 \div 20 = \mathbf{0.60 \text{ Hz}}$.

2. $v = f \times \lambda = 0.60 \times 5.0 = \mathbf{3.0 \text{ m/s}}$.

3. $t = \text{distance} \div \text{speed} = 120 \div 3.0 = \mathbf{40 \text{ s}}$.

Problem 17 Earthquake waves

1. $t = 2100 \div 6.0 = \mathbf{350 \text{ s}}$.

2. $t = 2100 \div 3.5 = \mathbf{600 \text{ s}}$.

3. $600 - 350 = 250 \text{ s} = \mathbf{4 \text{ min } 10 \text{ s}}$.

Problem 18 Checking a data table

1. $2.0 \times 1.20 = 2.4$; $4.0 \times 0.60 = 2.4$; $5.0 \times 0.48 = 2.4$; $8.0 \times 0.36 = 2.88$ (all in m/s).

2. The last row (8.0 Hz, 0.36 m) does not fit, since the other three give 2.4 m/s.

3. $\lambda = 2.4 \div 8.0 = \mathbf{0.30 \text{ m}}$.

Problem 19 Pitch and wavelength

1. Fork B has the higher pitch because pitch depends on frequency.

2. A: $\lambda = 340 \div 256 = 1.33 \text{ m}$. B: $\lambda = 340 \div 512 = 0.66 \text{ m}$. **A = 1.33 m, B = 0.66 m**

3. The wavelength of B is half that of A: doubling the frequency halves the wavelength at constant speed.

Problem 20 Ocean swell

1. $f = 1 \div 8.0 = \mathbf{0.125 \text{ Hz}}$.

2. $v = f \times \lambda = 0.125 \times 60 = \mathbf{7.5 \text{ m/s.}}$

3. $45 \text{ km} = 45\,000 \text{ m. } t = 45\,000 \div 7.5 = 6000 \text{ s} = \mathbf{100 \text{ min.}}$