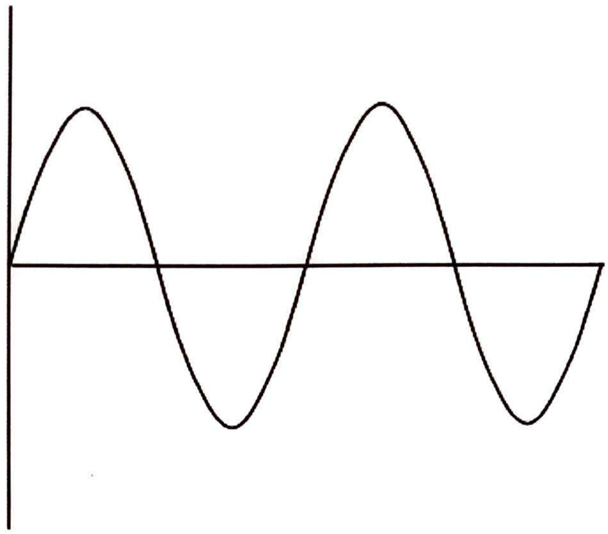
Properties of waves 1

1. Label the **amplitude** and **wavelength** on this wave:



2. What does the **frequency** of a wave mean?

The number of waves per second.

3. If the waves in the diagram passed in 1 second, what is the frequency of the wave in Q1?

2

4. The **period** of a wave is the time taken for it to complete one complete cycle.

a) What is the equation for calculating the period of a wave?

Period = 1/frequency
(time = 1/f)

$$\text{Period } (T) = \frac{1}{\text{frequency } (f)}$$

b) What is the period of the wave in Q1?

0.5

Name: .... Date: ....

Using the wave formula: wave speed, frequency and wavelength

$v = f \times \lambda$	***v* speed** (metres per second, m/s) **λ wavelength** (metres, m) ***f* frequency** (hertz, Hz)	$f = v \div \lambda$ $\lambda = v \div f$

Worked example

Q: *A sound wave of frequency 220 Hz travels at a speed of 340 m/s in air. What is its wavelength?*

A: *Wavelength, $\lambda = v \div f = 340 \div 220 =$ **1.55 m***
(If the wave speed is in metres per second and the frequency is in hertz, the wavelength will be in metres)

Questions

1. Calculate the **wave speed** (in m/s) for the following waves:

a) A sound wave in steel with a frequency of 500 Hz and a wavelength of 3.0 metres.

$v = f \times \lambda = 500 \times 3.0 = 1500$ m/s

b) a ripple on a pond with a frequency of 2 Hz and a wavelength of 0.4 metres.

$v = f \times \lambda = 2 \times 0.4 = 0.8$ m/s

c) A radio wave with a wavelength of 30 m and a frequency of 10,000,000 hertz.

$v = f \times \lambda = 10000000 \times 30 = 300000000$ m/s

$v = f \times \lambda = 1 \times 10^7 \times 30 = 3.0 \times 10^8$ m/s

2. Calculate the **wavelength** (in metres) for the following waves:

a) A wave on a slinky spring with a frequency of 2 Hz travelling at 3 m/s.

$\lambda = v \div f = 3 \div 2 = 1.5$ m

b) An ultrasound wave with a frequency 40,000 Hz travelling at 1450 m/s in fatty tissue.

$\lambda = v \div f = 1450 \div 40000 = 0.036$ m

c) A sound wave with frequency 440 Hz travelling at 340 metres per second in air.

$\lambda = v \div f = 340 \div 440 = 0.773$ m

3. Calculate the **frequency** (in Hz) for the following waves:

a) A sound wave of wavelength 10 metres travelling at 340 metres per second in air.

$f = v \div \lambda = 340 \div 10 = 34$ Hz

b) A wave on the sea with a speed of 8 m/s and a wavelength of 20 metres.

$f = v \div \lambda = 8 \div 20 = 0.4$ Hz

c) A microwave of wavelength 0.15 metres travelling through space at 300,000,000 m/s.

$f = v \div \lambda = 300000000 \div 0.15 = 2000000000$ Hz

$f = v \div \lambda = 3.0 \times 10^8 \div 0.15 = 2.0 \times 10^9$ Hz

Name: .... Date: ....

Investigating the speed of water waves

To do

Using the apparatus provided, investigate the relationship between water depth and wave speed.

Apparatus

- Plastic tray/casserole dish/baking tray with straight(ish) edges
- Ruler
- Timer

Method

1. Add water to a tray/cooking/casserole dish with some straight edges until there is a depth of 1 cm.
2. Place a book under one end of the tray. Hold the other end of tray and quickly remove the book so that the tray drops on to the bench surface. This will create a single wave pulse that travels along the tray.
3. Record the time taken for the wave to travel three lengths of the tray.
4. Calculate the speed of the wave (speed = distance / time).
5. Increase the depth of water by 0.5 cm and repeat steps 2 – 4.
6. Continue with up to a water depth of 4 or 4.5 cm.

Recording and display of results

1. Record the **distance** travelled by the waves: Length of tray x 3 = ...0.99............ m
2. Record your results.

Water **depth** / cm	**Time** taken to travel / s	Wave **speed** / ms^{-1} (Distance/time)
1.0	2.88	11.4
1.5	2.53	13.4
2.0	2.38	13.6
2.5	2.23	14.7
3.0	2.12	15.6
3.5	2.01	16.1
4.0	1.85	17.3

3. Plot a graph of wave **speed** (y-axis) vs water **depth** (x-axis). Draw an appropriate best-fit line.

Analysis

4. Use your graph to describe how the depth of water affects wave speed.

Using the wave formula: wave speed, frequency and wavelength

$$v = f \times \lambda$$

***v* speed** (metres per second, m/s)

λ wavelength (metres, m)

***f* frequency** (hertz, Hz)

$f = v \div \lambda$

$\lambda = v \div f$

Worked example

Q: A sound wave of frequency 220 Hz travels at a speed of 340 m/s in air. What is its wavelength?

*A: Wavelength, $\lambda = v \div f = 340 \div 220 =$ **1.55 m***
(If the wave speed is in metres per second and the frequency is in hertz, the wavelength will be in metres)

Questions

1. Calculate the **wave speed** (in m/s) for the following waves:

a) A sound wave in steel with a frequency of 500 Hz and a wavelength of 3.0 metres.

$v = \lambda \div f = 3 \div 500 = 166$ m/s

b) a ripple on a pond with a frequency of 2 Hz and a wavelength of 0.4 metres.

$v = \lambda \div f = 0.4 \div 2 = 5$ m/s

c) A radio wave with a wavelength of 30 m and a frequency of 10,000,000 hertz.

$v = \lambda \div f = 30 \div 10{,}000{,}000 = 333333$ m/s

2. Calculate the **wavelength** (in metres) for the following waves:

a) A wave on a slinky spring with a frequency of 2 Hz travelling at 3 m/s.

$\lambda = v \div f = 3 \div 2 = 1.5$ m

b) An ultrasound wave with a frequency 40,000 Hz travelling at 1450 m/s in fatty tissue.

$\lambda = v \div f = 1450 \div 40{,}000 = 27.5$ m

c) A sound wave with frequency 440 Hz travelling at 340 metres per second in air.

$\lambda = v \div f = 340 \div 440 = 1.3$ m

3. Calculate the **frequency** (in Hz) for the following waves:

a) A sound wave of wavelength 10 metres travelling at 340 metres per second in air.

$f = v \div \lambda = 340 \div 10 = 34$ Hz

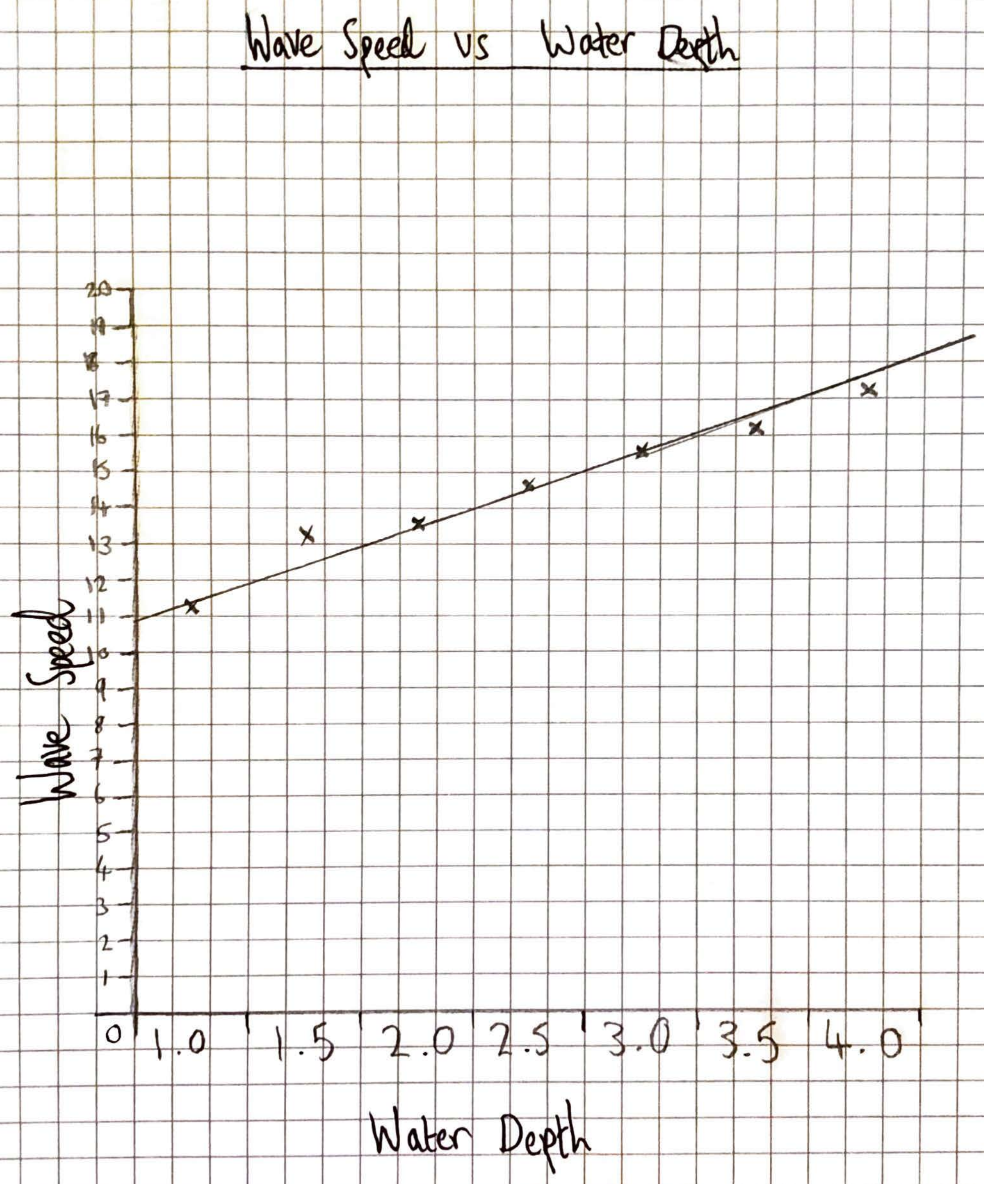
b) A wave on the sea with a speed of 8 m/s and a wavelength of 20 metres.

$f = v \div \lambda = 8 \div 20 = 2.5$ Hz

c) A microwave of wavelength 0.15 metres travelling through space at 300,000,000 m/s.

$f = v \div \lambda = 300{,}000{,}000 \div 0.15 = 2000000000$ Hz

Jago Duston



Wave Speed vs Water Depth
Wave Speed
Water Depth
0
1.0
1.5
2.0
2.5
3.0
3.5
4.0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20