Masters for transparencies

5.1
Waves, sound and light

KNOWLEDGE AREA: WAVES, SOUND AND LIGHT

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                    ┌─────────────────────────┐
                    │  Waves, sound and light │
                    └─────────────────────────┘
        ┌──────────────────┐      │        ┌────────────────────────────┐
        │ Transverse pulses │              │ Electromagnetic radiation  │
        └──────────────────┘              └────────────────────────────┘
        ┌──────────────────┐  ┌────────────────────┐  ┌────────────────┐
        │ Transverse waves │  │ Longitudinal waves │  │     Sound      │
        └──────────────────┘  └────────────────────┘  └────────────────┘
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UNIT 1   TRANSVERSE PULSES

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                          ┌─────────────┐
                          │ Transverse  │
                          └─────────────┘        ┌──────────────┐
                          ┌─────────────┐        │ Destructive  │
                          │ Interference│        └──────────────┘
        ┌──────────┐      ├─────────────┤
        │  Pulses  │─────▶│ Pulse speed │        ┌──────────────┐
        └──────────┘      ├─────────────┤        │ Constructive │
                          │ Pulse length│        └──────────────┘
                          ├─────────────┤
                          │  Amplitude  │
                          ├─────────────┤
                          │Superposition│
                          └─────────────┘
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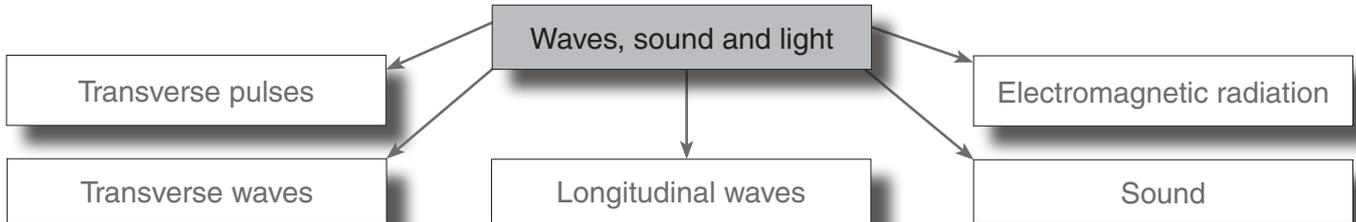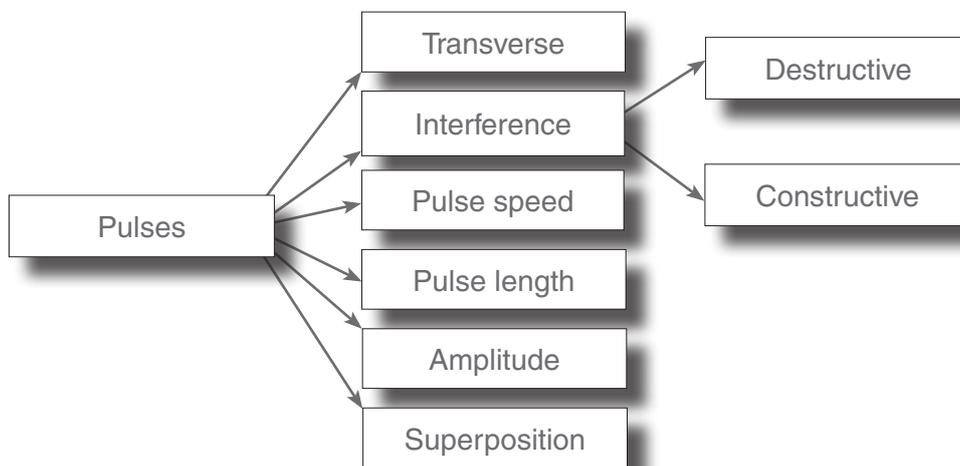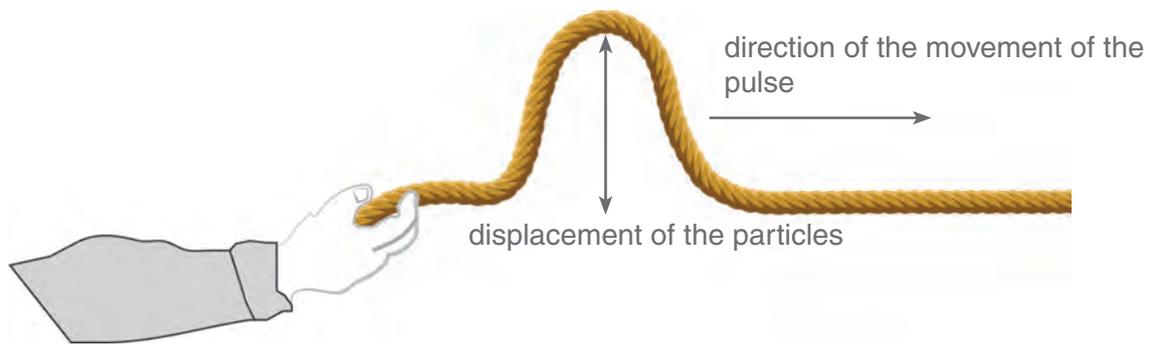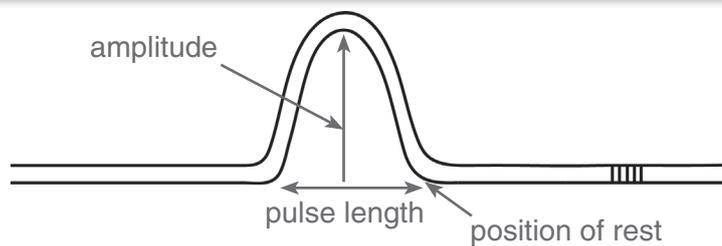
1.1   Pulses
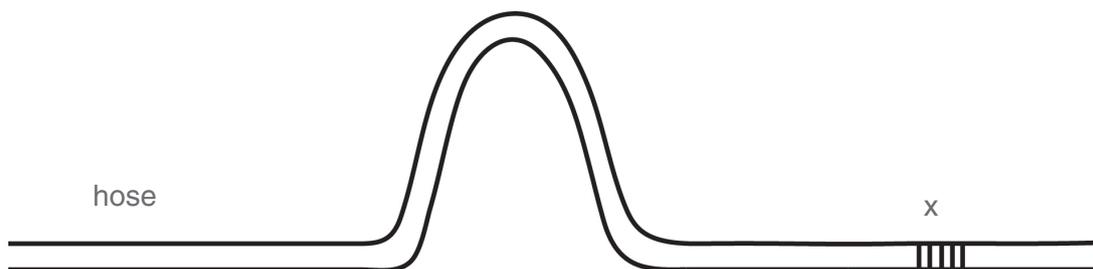
A pulse: A single disturbance that moves through a medium.

Transverse pulse: A pulse in which the displacement of the particles of the medium is perpendicular to the direction of the movement of the pulse.

waves, sound and light

direction of the movement of the pulse

displacement of the particles

> Amplitude (A): Maximum displacement of a particle from its position of rest (equilibrium position)

amplitude

pulse length

position of rest

> Pulse length: Distance between the start and end of a pulse

The speed of a pulse can be calculated using the equation for speed:

distance covered (m)

$$v = \frac{D}{\Delta t}$$

pulse speed (m·s⁻¹)   change in time (s)

Examples

1. It takes 0,2 s to produce a pulse. The distance covered is 300 mm. Calculate the speed of the pulse.

   v = ?
   D = 300 mm
     = 0,3 m
   Δt = 0,2 s

   $v = \dfrac{D}{\Delta t}$
   $= \dfrac{0,3}{0,2}$
   $= 1,5 \text{ m·s}^{-1}$

2. The speed of a pulse is 0,032 m·s⁻¹. Calculate the distance that the pulse will cover in 2 minutes.

   v = 0,032 m·s⁻¹
   Δt = 2 × 60 = 120 s
   D = ?

   $v = \dfrac{D}{\Delta t}$
   $0,032 = \dfrac{D}{120}$
   $D = 0,032 \times 120$
 $D = 3,84 \text{ m}$

Practical activity 1: Page 13

Work in groups for this activity.

**Aim:** To produce a transverse pulse in a rope or a spring.

6. Draw a sketch of what you observe. Mark the following on your sketch: the rest position, the amplitude, the direction of the disturbance in the rope (spring) and the direction in which the pulse moves.

amplitude

pulse length

position of rest

direction of movement or medium
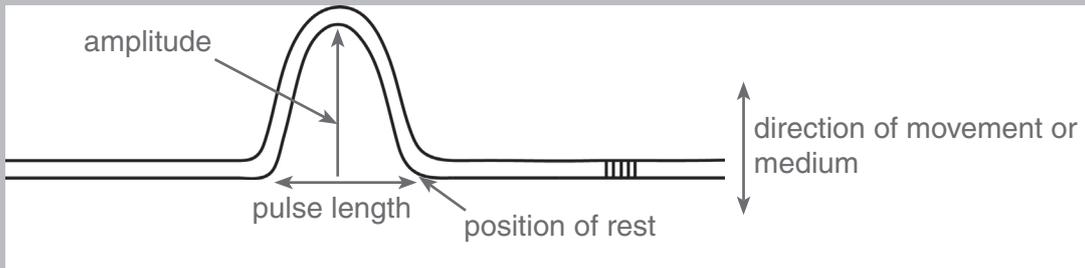
Exercise 1: Page 14

1   Define the following:
1.1   Pulse   **A single disturbance in a medium**
1.2   Amplitude   **The maximum displacement of a particle from its position of rest.**
1.3   Pulse speed   **Distance that the pulse covers in one second.**

2.1   Draw a transverse pulse with a pulse length of 3 cm and amplitude of 4 cm. Label the sketch.

amplitude
4 cm

direction of pulse
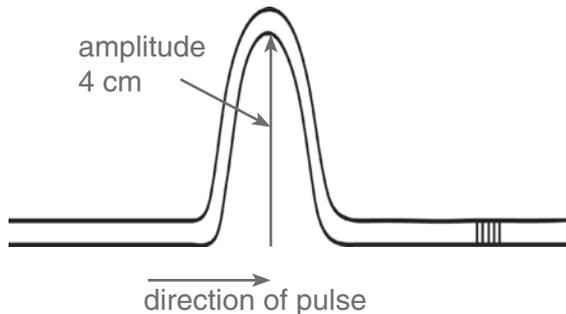
2.2   Draw the same transverse pulse, but halve the amplitude.

amplitude
2 cm

direction of pulse
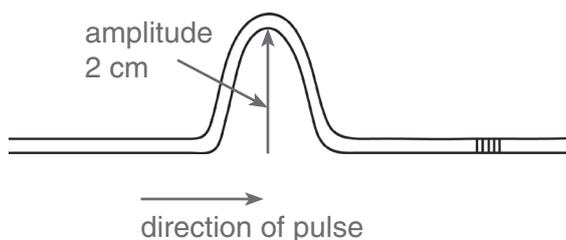
3.   A pulse moves 400 mm in 0,2 s.
        Calculate the speed of the pulse.

$v = \dfrac{D}{\Delta t}$

$= \dfrac{0,4}{0,2}$

$= 2 \text{ m·s}^{-1}$

4.   Christine jumps into the swimming pool, causing a pulse length of 0,9 m. The pulse passes a
        point in 1,2 seconds. What is the speed of the pulse?

$v = \dfrac{D}{\Delta t}$

$= \dfrac{0,9}{1,2}$

$= 0,75 \text{ m·s}^{-1}$

5.   A transverse pulse moves along a spiral spring at 0,8 m·s⁻¹. How far does it move in 0,25 s?

$v = \dfrac{D}{\Delta t}$

$0,8 = \dfrac{D}{0,25}$

$D = 0,8 \times 0,25$

$D = 0,2 \text{ m}$

6.   A transverse pulse moves along a rope at 0,6 m·s⁻¹. The pulse moves 1,2 m along the rope. How
        long will it take the pulse to cover that distance?

$v = \dfrac{D}{\Delta t}$

$0,6 = \dfrac{1,2}{\Delta t}$

$\Delta t = \dfrac{1,2}{0,6}$

$= 2 \text{ s}$