EXERCISE 2.1

MODULE 2 TOPIC 1 and 2, p. 82 – 89
Gr 10 Physical Sciences 3-in-1

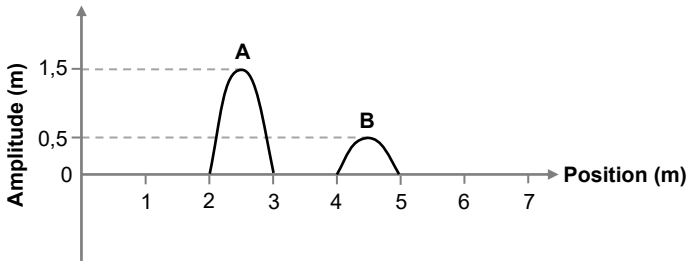
QUESTION 1

1.1 A transverse pulse travels a distance of 50 cm in 10 s. Calculate the pulse speed.

1.2 The speed of a transverse pulse is 0,25 m·s^{-1}. How long will it take to cover 1,5 m?

QUESTION 2

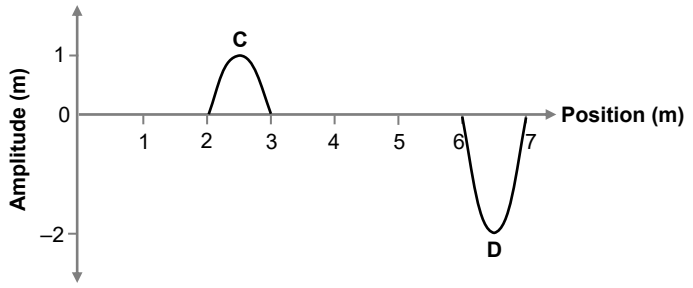
2.1 Consider the following diagram. The two pulses A and B approach each other at 1 m·s^{-1}.



2.1.1 Redraw the diagram three times to show how the wave form will look like after 1 s, 2 s and 4 s.

2.1.2 Give the name of the phenomena that can be observed at a certain time interval.

2.2 Consider the following diagram. The two pulses **C** and **D** approach each other at 1 m·s^{-1}.



2.2.1 Redraw the diagram three times to show how the wave form will look like after 1 s, 2 s and 4 s.

2.2.2 Give the name of the phenomena that can be observed at a certain time interval.

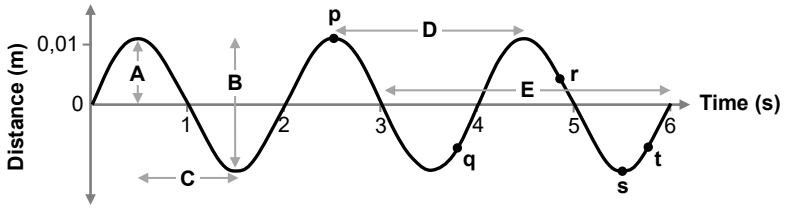
QUESTION 3

Sarah moves the free end of a slinky spring a few times up and down so that several waves are created and move along the spring.

3.1 Describe what happens to the coils of the spring.

3.2 What type of waves move along the spring. Give a definition of this type of wave.

3.3 Look at the wave diagram below and give the LETTER(S):



3.3.1 that represents the amplitude of the wave.

3.3.2 that represents the wavelength of the wave.

3.3.3 of two points that are in phase.

3.3.4 of two points that are out of phase.

3.3.5 that represents a trough of a wave.

3.4 Use the time and distance values indicated on the diagram, and take the length of line **E** as 30 cm. Now determine the values of the following wave terms that describe the wave:

3.4.1 amplitude 3.4.2 wavelength 3.4.3 period

3.4.4 frequency 3.4.5 speed

QUESTION 4

4.1 Calculate:

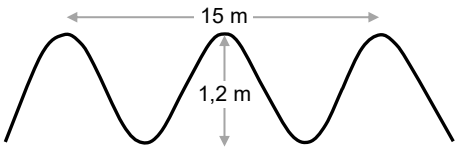
4.1.1 The speed of a wave with a wavelength of 2,5 m and a period of 0,5 s.

4.1.2 The speed of a wave with a wavelength of 200 mm, if the frequency of the vibrating source creating the wave is 25 Hz.

4.1.3 The period of a wave that travels at a speed of 30 $m \cdot s^{-1}$ and has a wavelength of 48 cm.

4.1.4 The frequency of tsunami waves, caused by an underwater earthquake, that have a wavelength of 143 km and travel a speed of 720 $km \cdot h^{-1}$.

4.2 Water waves crash against the rocks near the shore. Five waves hit the rocks every 10 seconds. The height of a wave is 1,2 meters.



4.2.1 How many full waves can be counted in the above diagram?

4.2.2 What is the amplitude of the waves?

4.2.3 Determine each of the following for the waves:

(a) period (b) frequency (c) speed

EXERCISE ANSWERS

QUESTION 1

1.1 $v = \frac{\Delta x}{\Delta t}$

$= \frac{0,5}{10}$

$= 0,05\ m \cdot s^{-1}$

$\Delta x = 50\ cm = 0,5\ m$

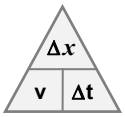
$\Delta t = 10\ s$

NOTE

Remember to convert to SI units.

NOTE

An easy way to change the subject of the formula, is by means of a small triangle:



1.2 $\Delta t = \frac{\Delta x}{v}$

$= \frac{1,5}{0,25}$

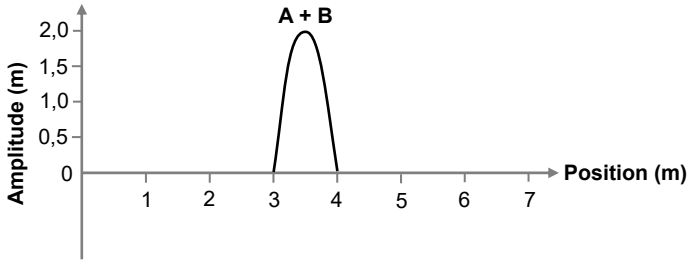
$= 6\ s$

$v = 0,25\ m \cdot s^{-1}$

$\Delta x = 1,5\ m$

QUESTION 2

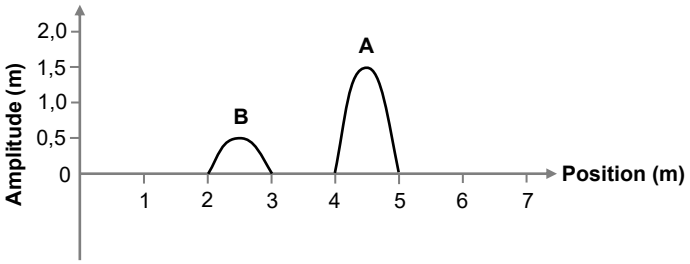
2.1.1 Diagram 1:



NOTE

When the two waves overlap, superposition takes place and the phenomenon of interference (in this case constructive interference) can be observed.

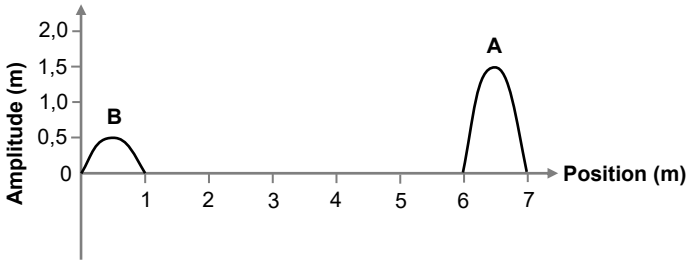
Diagram 2:



NOTE

The two pulses separate again into the original pulses and continue to move in their original directions.

Diagram 3:



2.1.2 constructive interference

2.2.1 Diagram 1:

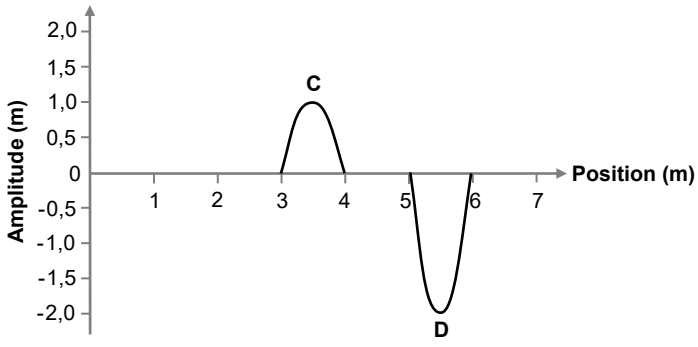


Diagram 2:

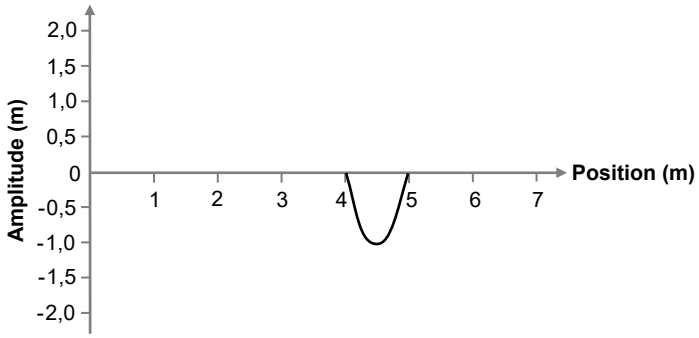


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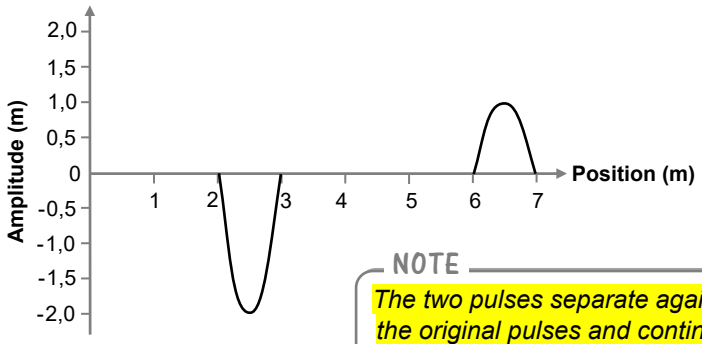
Diagram 3:



NOTE

The two pulses separate again into the original pulses and continue to move in their original directions.

2.2.2 destructive interference

QUESTION 3

3.1 The successive coils move up and down, one after the other, around the equilibrium position.

3.2 Transverse waves.
A transverse wave is a wave in which the particles of the medium vibrate perpendicular to the direction of motion of the wave. It is a succession of transverse pulses.

3.3.1 A 3.3.2 D 3.3.3 q and t

3.3.4 p and r, p and q, p and s, p and t, q and r, q and s, r and s, r and t, and s and t

(any one of these pairs)

3.3.5 s

3.4.1 0,1 m

NOTE

The amplitude is from the equilibrium position to the maximum displacement (crest or trough).

3.4.2 $\lambda = \frac{30}{1,5} = 20 \text{ cm} = 0,2 \text{ m}$

NOTE

E represents 1,5 × wavelength, therefore divide 30 by 1,5

3.4.3 $T = \frac{6}{3} = 2 \text{ s}$

NOTE

3 waves take 6 seconds to pass a fixed point, therefore one wave takes 2 seconds to pass a fixed point.

3.4.4 $f = \frac{1}{T} = \frac{1}{2} = 0,5 \text{ Hz}$

3.4.5 $v = f\lambda$
$= 0,5 \times 0,2$
$= 0,1 \text{ m·s}^{-1}$

OR

$v = \frac{\lambda}{T}$
$= \frac{0,2}{2}$
$= 0,1 \text{ m·s}^{-1}$

QUESTION 4

4.1.1 $v = \frac{\lambda}{T}$ **OR** $v = f\lambda$

$= \frac{2,5}{0,5}$ $= \frac{1}{0,5} \times 2,5$

$= 5\ m{\cdot}s^{-1}$ $= 5\ m{\cdot}s^{-1}$

$\lambda = 2,5\ m$
$T = 0,5\ s$

4.1.2 $v = f\lambda$
$= 25 \times 0,2$
$= 5\ m{\cdot}s^{-1}$

$\lambda = 200\ mm = 0,2\ m$
$f = 25\ Hz$

4.1.3 $T = \frac{\lambda}{v}$ **OR** $f = \frac{v}{\lambda}$

$= \frac{0,48}{30}$ $= \frac{30}{0,48}$

$= 0,016\ s$ $= 625\ Hz$

$T = \frac{1}{f} = \frac{1}{625} = 0,016\ s$

$v = 30\ m{\cdot}s^{-1}$
$\lambda = 48\ cm = 0,48\ m$

4.1.4 $f = \frac{v}{\lambda}$

$= \frac{200}{1,43 \times 10^5}$

$= 0,0014\ Hz$

$\lambda = 143\ km = 1,43 \times 10^5\ m$

$v = 720\ km{\cdot}h^{-1} = \frac{720\,000}{3\,600} = 200\ m{\cdot}s^{-1}$

NOTE

Divide in effect by 3,6 to convert $km{\cdot}h^{-1}$ to $m{\cdot}s^{-1}$

4.2.1 3 full waves

NOTE

count from trough to trough

4.2.2 0,6 m

NOTE

distance from the equilibrium position to the crest or trough

4.2.3 (a) $T = \frac{5}{10} = 0,5\ s$

NOTE

Divide 5 by 10 to calculate the time it takes for 1 wave to reach a cetain point, i.e. the rocks.

(b) $f = \frac{1}{T} = \frac{1}{0,5} = 2\ Hz$

(c) $v = f\lambda$ **OR**

$= 2 \times 7,5$

$= 15\ m{\cdot}s^{-1}$

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

$= \frac{15}{1}$

$= 15\ m{\cdot}s^{-1}$

$2 \times$ wavelength $= 15\ m$
$\therefore \lambda = 7,5\ m$