Unit 6 · Wave Motion

WORKSHEET

Full marks 33

Name _____ Class _____ Roll no. _____ Date _____ Marks _____ / 33

1 Key words [4]

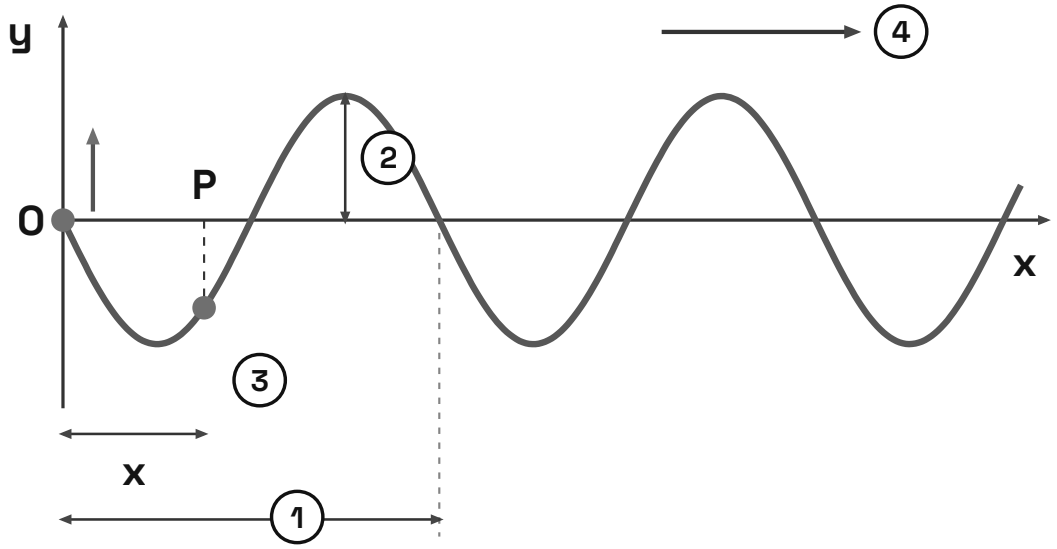
Fill in the blanks with words from the box. Two words in the box are not needed. Each blank carries 0.5 mark.

antinodes	**beat**	**nodes**	**phase change**	**principle of superposition**	**progressive wave**	
resonance	**stationary wave**	**wave**	**wave number**			

A disturbance that travels through a medium carrying energy, while each particle only vibrates about its own place, is a _____. A wave that moves forward continuously in one direction is a _____. The quantity $k = 2\pi/\lambda$ is the _____. When two waves overlap, the resultant displacement is the sum of the displacements each would cause alone: this is the _____. Two identical waves traveling in opposite directions form a _____. In it, the points that never move are _____, and the points that swing furthest are _____. At a fixed end, a pulse is reflected with a _____ of π.

2 Label the diagram [2]

The diagram shows a progressive wave traveling to the right, and a particle P a distance x from O. Write the label that belongs in place of 1 to 4. Each carries 0.5 mark.



1. _____ 2. _____

3. _____ 4. _____

3 Multiple choice [5]

Choose the correct option for each of the following questions.

i. A wave is $y = 0.02\sin(60t - 3x)$ in SI units. It travels: [1]

a. towards $+x$ at 20 m/s
b. towards $-x$ at 20 m/s
c. towards $+x$ at 180 m/s
d. towards $+x$ at 3 m/s

ii. A sound of frequency 550 Hz travels at 330 m/s. Its wavelength is: [1]

a. 1.67 m
b. 0.60 m
c. 0.30 m
d. 1.8×10^5 m

iii. In a stationary wave, the distance between a node and the antinode next to it is: [1]

a. $\lambda/4$
b. $\lambda/2$
c. λ
d. 2λ

iv. When a stationary wave forms on a string tied to a peg, the tied end is always: [1]

a. a node, since it can't move
b. an antinode, since the wave is reflected there
c. a node only for the lowest note
d. halfway between a node and an antinode

v. A string 1.8 m long, fixed at both ends, vibrates in three loops. The wavelength is: [1]

a. 0.6 m
b. 1.2 m
c. 1.8 m
d. 3.6 m

4 Short answers [7]

Write short answers to the following questions.

a. Write any two differences between a progressive wave and a stationary wave. [2]

b. A wave travels along a rope. Why does a leaf, or a ribbon tied to the rope, not travel along with the wave? [2]

c. A wave of frequency 250 Hz travels at 300 m/s. Find its wavelength, the phase difference between two points 0.30 m apart along it, and the phase difference between the motion of one point at two instants 1.0 ms apart. **[3]**

5 Long answer **[4]**

Write a long answer to the following question.

A plane progressive wave of amplitude a and wavelength λ travels with speed v along the +x direction. Starting from the motion of the particle at the origin O, derive the equation $y = a\sin(\omega t - kx)$ for the particle at a distance x.

6 Numerical problems **[8]**

Solve the following problems. Show your working.

a. A wave on a string is $y = 0.004\sin(150\pi t - 2.5\pi x)$, with x and y in meters and t in seconds. Find i. its frequency and wavelength, ii. its speed, and iii. the greatest speed of a particle of the string. **[4]**

Answer:

b. Two waves $y_1 = 0.02\sin(80\pi t - 2\pi x)$ and $y_2 = 0.02\sin(80\pi t + 2\pi x)$ (SI units) travel along a string in opposite directions. Find i. the equation of the stationary wave they form, ii. the positions of the first two nodes from x = 0, and iii. the amplitude of the particle at $x = \frac{1}{6}$ m. **[4]**

Answer: _____

7 Think **[3]**

You send waves along a long rope by shaking its end. If you shake it twice as fast, what happens to the waves' speed and their wavelength? Explain.

8 Activity: Count the loops (not marked)

Tie one end of a long rope or slinky to a post. Shake the other end steadily, faster and faster, until the rope settles into one loop, then two, then three. Measure the rope's length between your hand and the post.

Loops	Length of a loop (m)	Wavelength (m)
1		
2		
3		

Where were the nodes? What happened to the wavelength as you shook faster?