

# Physics II Waves Worksheets

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## Waves worksheet-

(recall:  $c=3.00 \times 10^8$  m/s, speed of electromagnetic waves (including light) in space)

1. What is the wavelength of a radar wave of frequency 10 000.0 MHz ?
2. What is the wavelength of a radio wave of frequency 108 MHz emitted by a transmitter in an artificial satellite?
3. Express in nanometers:  
(a)  $4.5 \times 10^{-3}$  cm      (b)  $6 \times 10^{-5}$  km      (c)  $173 \mu\text{m}$
4. Express in meters:  
(a) 5893 nm      (b) 1.67 nm      (c) 146  $\mu\text{m}$
5. Compute the frequency of green light whose wavelength is 500 nm
6. Compute the wavelength of an AM station that broadcasts on an assigned frequency of 750 kHz.

Table 2-1

Prefixes Used with SI Units			
Prefix	Symbol	Fractions	Example
pico	p	1/1 000 000 000 000 or $10^{-12}$	picometer (pm)
nano	n	1/1 000 000 000 or $10^{-9}$	nanometer (nm)
micro	$\mu$	1/1 000 000 or $10^{-6}$	microgram ( $\mu\text{g}$ )
milli	m	1/1 000 or $10^{-3}$	milligram (mg)
centi	c	1/100 or $10^{-2}$	centimeter (cm)
deci	d	1/10 or $10^{-1}$	decimeter (dm)
Multiples			
tera	T	1 000 000 000 000 or $10^{12}$	terameter (Tm)
giga	G	1 000 000 000 or $10^9$	gigameter (Gm)
mega	M	1 000 000 or $10^6$	megagram (Mg)
kilo	k	1000 or $10^3$	kilometer (km)
hecto	h	100 or $10^2$	hectometer (hm)
deka	da	10 or $10^1$	dekagram (dag)

## Waves WS

Chapter 14 Quiz

NAME: \_\_\_\_\_

Block ~~4~~

1. A periodic transverse wave traveling along a string has a frequency of 45.0 Hz. The distance between a crest and trough is 0.68 m. What is the speed of the wave?


2. A pendulum swings through 35 complete cycles in 1.14 seconds.  
(a) What is the period of the pendulum?

(b) What is its frequency?

3. What is the wavelength of a periodic disturbance with a frequency of 6.8 Hz and a speed of 3.6 m/s?

4. The speed of sound in air is 330.0 m/s. A person standing near a cliff claps their hands and hears the echo 1.6 seconds later. How far is the person from the cliff?

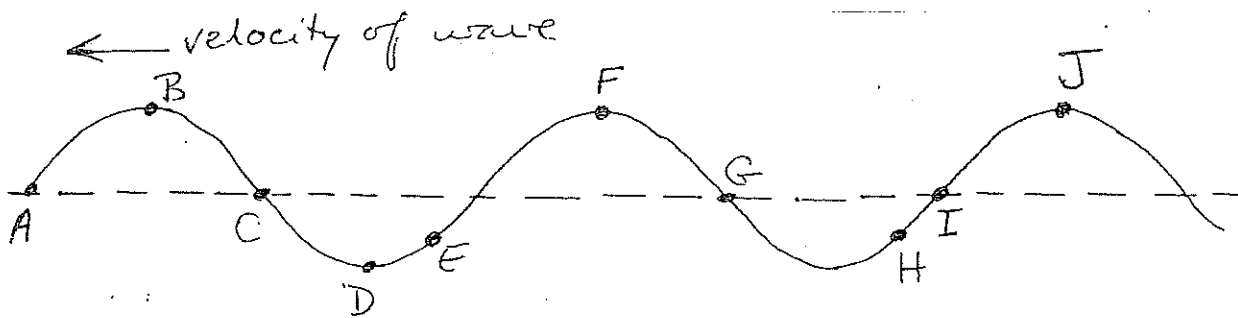
5. A beam of light has a wavelength of 585 nm. What is its frequency?  
(recall, speed of light is  $3.0 \times 10^8$  m/s)

6.  The distance between a crest and the trough beside it is 0.12 m

6. The distance between a crest and the trough beside it is 0.12 m.  
 (a) What is the wavelength of the wave?

(b) If the waves are generated with a frequency of 10.0 Hz, what is their speed?

7. (a) On the diagram of waves shown below, label the following parts:  
 1 - crest  
 2 - trough  
 3 - amplitude  
 4 - nodal line  
 5 - one wavelength



(b) List all of the pairs of points which are "in phase".

(c) List the pairs of points which are perfectly "out of phase".

(d) If the wave is moving to the left, what direction (up or down) are each of the following points moving?

A: \_\_\_\_\_  
 C: \_\_\_\_\_  
 E: \_\_\_\_\_  
 G: \_\_\_\_\_

B: \_\_\_\_\_  
 D: \_\_\_\_\_  
 F: \_\_\_\_\_  
 H: \_\_\_\_\_

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Waves Practice  
Chapter 14 Quiz worksheet

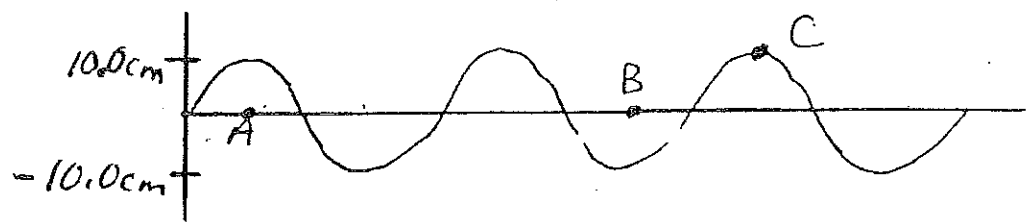
NAME: \_\_\_\_\_

~~Block A~~

1. Calculate the frequency of a tuning fork that vibrates  $2.4 \times 10^3$  times in 90.0 seconds.
2. A T.V. station broadcasts with a frequency of 85.0 MHz. What would be the wavelength of the waves if they travel at  $3.0 \times 10^8$  m/s?
3. How many vibrations would your eardrums experience in 4.0 seconds if your walkman is emitting sound at 2800.0 Hz?
4. A ship travelling in a fog parallel to a dangerous, cliff-lined shore. The captain sounded the boats' whistle and the echo was heard 11.0 seconds later. If the speed of sound in air is 340.0 m/s, how far is the ship from the cliff?
5. The distance between a crest and the next trough of water waves in the ocean was 3.5 m. The waves approached a lighthouse at a speed of 5.6 m/s.
  - (a) What is the frequency of the waves?
  - (b) What is the period of the waves?
  - (c) How many waves will crash against the shore in 5.0 minutes?

6. In seconds, what is the period of the minute hand of a clock or watch?

7. Consider the diagram shown below. The distance between "A" and "B" is 15.0 cm and the waves frequency is 35.0 Hz.



(a) What is the wavelength of the wave? (give the measurement)

(b) What is the amplitude of the wave?

(c) What distance would point "C" move in 1.0 second?

(vertical - up and down)

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## Standing Waves Worksheet

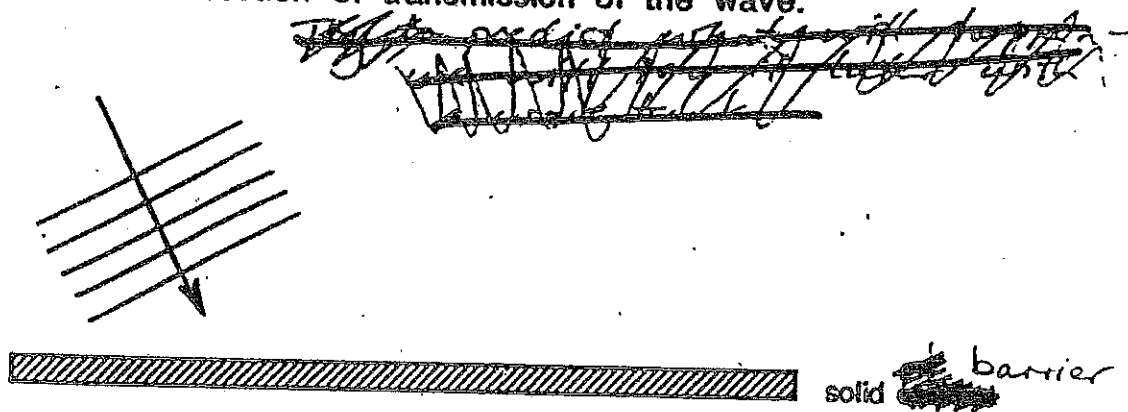
For each problem show a diagram of the standing waves, and show all work in finding the solution.

1. A string, fixed at both ends, is 50.0 cm long. What are the first three natural frequencies that can be produced by the spring?  $v = 325 \text{ m/s}$
2. A standing wave with a wavelength of 2.3 m is produced on a string fixed at both ends. How far from the end are the first 2 antinodes?
3.
  - a) What are the wavelengths of the 4 longest waves that can produce standing waves on a string of length 30.0 cm, fixed at both ends?
  - b) If the speed of the waves in the spring is 225 m/s, what are the frequencies that correspond with the wavelengths found in (a)?
4. What is the fundamental frequency sounded by a guitar string 55 cm long if the speed of sound in the string is 195 m/s?
5. A rope is fastened at one end and the other end is shaken with a frequency of 10.0 Hz. If the speed of the standing wave in the rope is 25.0 m/s, how far away from the attached end are:
  - a) the nearest antinode
  - b) the nearest node
6. The distance between adjacent nodes in a stretched string is 35.0 cm.
  - a) If the frequency of vibration is 350.0 Hz, calculate the speed of the wave.
  - b) If the frequency is reduced to 150.0 Hz, what is the new wavelength?

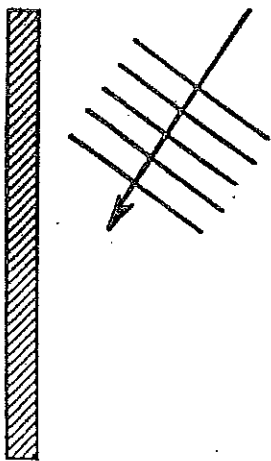
# REFLECTION AND DIFFRACTION

Show the location of each of the waves a few seconds later. On each drawing indicate the direction of transmission of the wave.

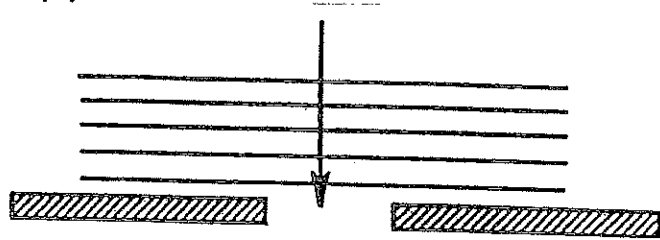
(a)



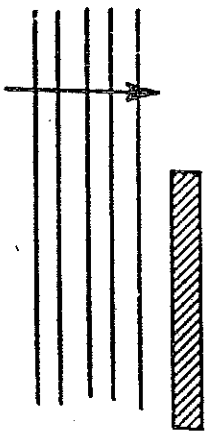
(b)



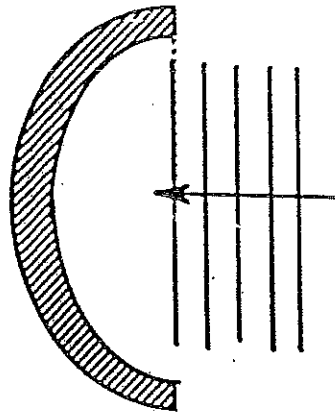
(c)



(d)

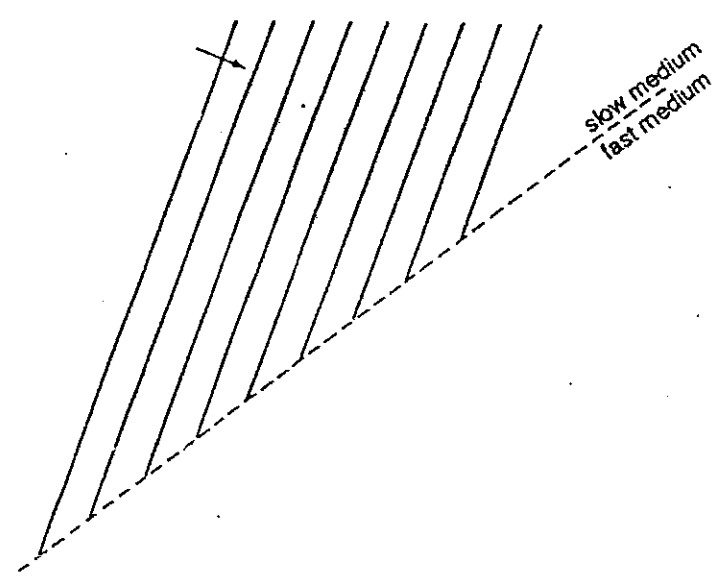
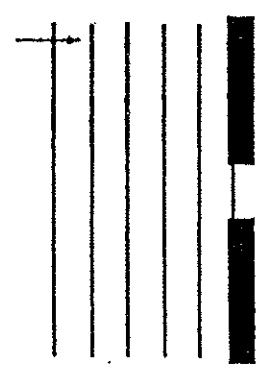
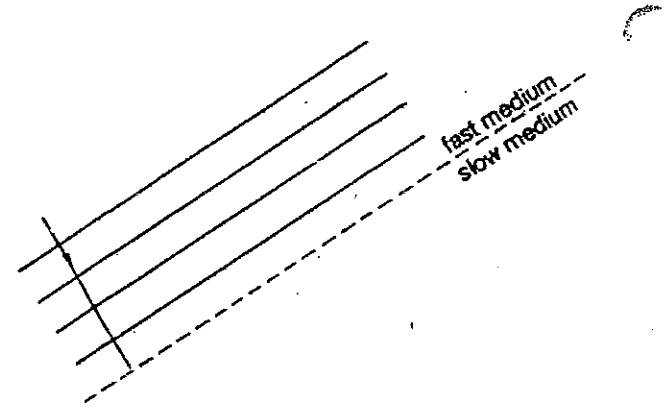
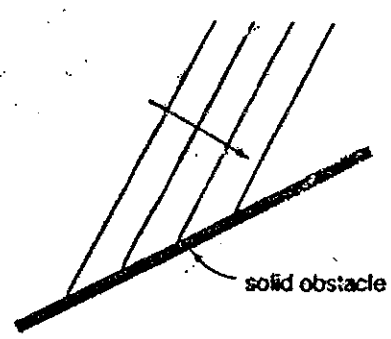


(e)



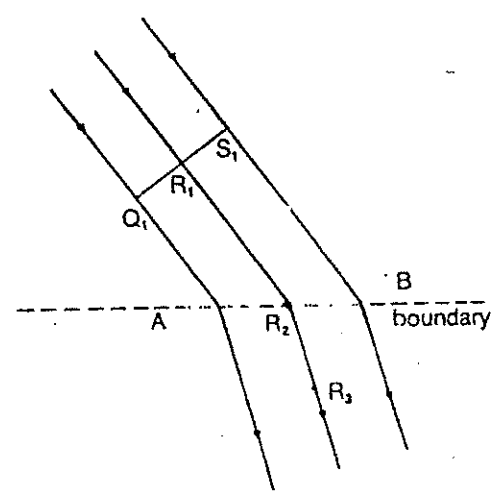
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tracing. Complete the diagrams, showing the location of the waves a few seconds later. Indicate on each diagram the direction(s) of transmission.



The Properties and Behaviour of Waves

25. In this diagram, QRS is a straight wave, and the wave rays indicate the direction of its motion towards a refracting surface, AB. Copy the diagram into your notebook and draw the wavefront  $Q_1 R_1 S_1$  when it has reached  $R_2$  and  $R_3$ . Label the corresponding wavefronts at these points  $Q_2 R_2 S_2$  and  $Q_3 R_3 S_3$ .
26. The speed of water waves is 30 cm/s in deep water and 15 cm/s in shallow water. If the wavelength in deep water is 1.0 cm, what is the wavelength in shallow water?
27. The velocity of sound waves in cold air is 320 m/s, and in warm air it is 384 m/s. If the wavelength of the sound waves was 3.0 m in cold air, what would it be in warm air?
28. As water waves approach a beach, their wavelengths become shorter. Why?





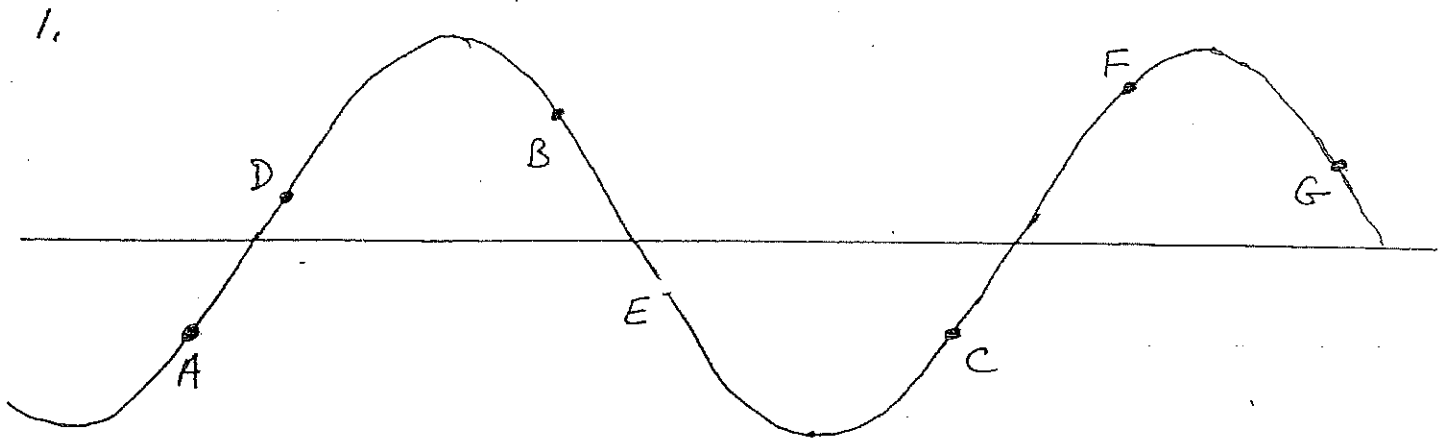
QUIZ practice

Equations:  $f = \frac{1}{T}$   
 $v = f\lambda$   
 $v = \frac{d}{t}$

Name: \_\_\_\_\_

Total marks [15]

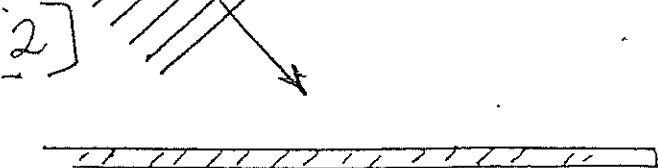
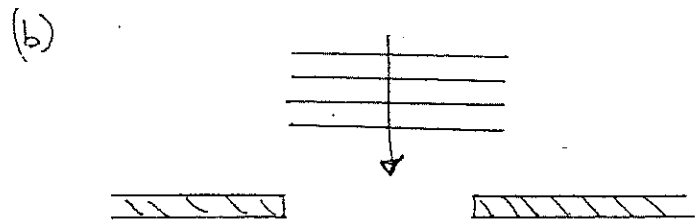
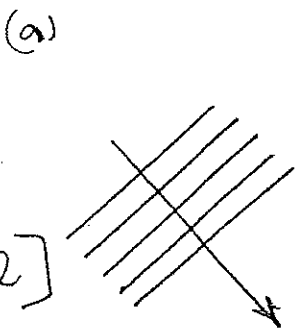
direction of wave motion  $\rightarrow$



On the diagram, identify the following: (show them on the diagram)

- (a) one wavelength
- (b) the amplitude
- (c) the nodal line
- (d) show the direction of motion of points A, B, and C
- (e) identify the points that are "in phase"

2. On the diagrams below, show the positions of the wavefronts a few seconds later.



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3. Waves of  $6.5\text{ Hz}$  travel along a string with a wavelength of  $15\text{ cm}$ . What is the speed of the wave?

[3]

4. The distance between crests in certain water waves is  $2.0\text{ m}$  and the waves travel  $10\text{ m}$  in  $3.5\text{ s}$ . Calculate the frequency and period of the waves.

[5]

11/5/2011

# WAVES worksheet

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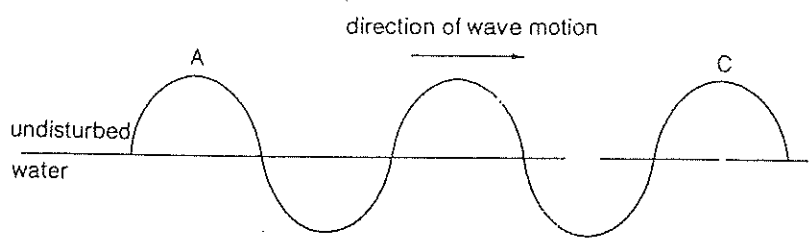
1. A pendulum swings back and forth 20 times in 15 s. Calculate its period and its frequency.
2. A swimmer notices that 30 waves strike a breakwater in 1.00 min. What is the period of the waves in seconds?
3. Determine the frequency in each of the following.
  - (a) a basketball player who scores 36 points in 24 min
  - (b) a roadrunner who escapes from a coyote 27 times in a 9 min cartoon
  - (c) a fan that turns 170 times in 15.0 s
4. Determine the period of each of the following.
  - (a) the pulse from a human heartbeat that is heard 30 times in 12 s
  - (b) a tuning fork that vibrates 2048 times in 8.0 s
  - (c) the moon, which travels around the Earth six times in 163.8 d
5. Calculate the frequency of each of the following periods.
 

(a) 5.0 s	(d) 0.80 s
(b) 0.01 s	(e) 6.0 s
(c) $2.5 \times 10^{-2}$ s	(f) 0.40 min
6. Calculate the period of each of the following frequencies.
 

(a) 10 Hz	(d) 0.10 Hz
(b) 0.25 Hz	(e) 2.5 Hz
(c) 500 kHz	(f) 3.5 Hz
7. The horizontal distance between the end points in the swing of a pendulum is 8.0 cm. What is the amplitude?
8. The tine of a tuning fork, when struck, has an amplitude of 0.13 cm. If the frequency of the fork is 200 Hz, what total distance will the tine travel in 1.00 min?

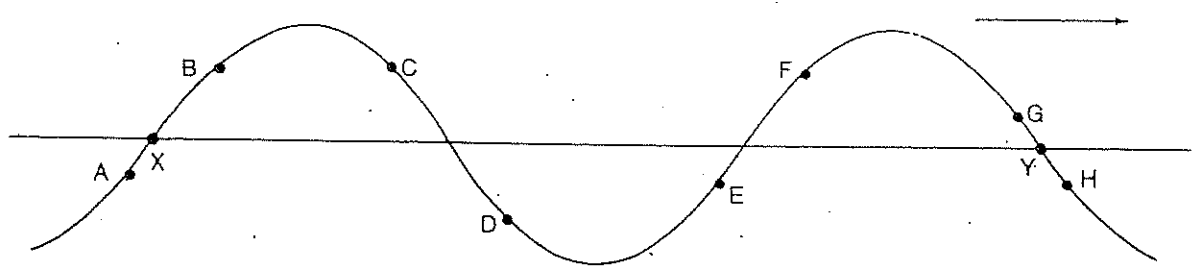
Answers are in last page

9. The diagram shows the profile of waves in a ripple tank.



- (a) By measuring, find the wavelength and the amplitude of the waves.
  - (b) If crest A takes 2.0 s to move to where crest C is now,
    - (i) What is the speed of the waves?
    - (ii) What is the frequency of the waves?
    - (iii) What is the frequency of the source?
10. The wavelength of a water wave is 8.0 m and its speed is 2.0 m/s. How many waves will pass a fixed point in the water in 1.0 min?

11.

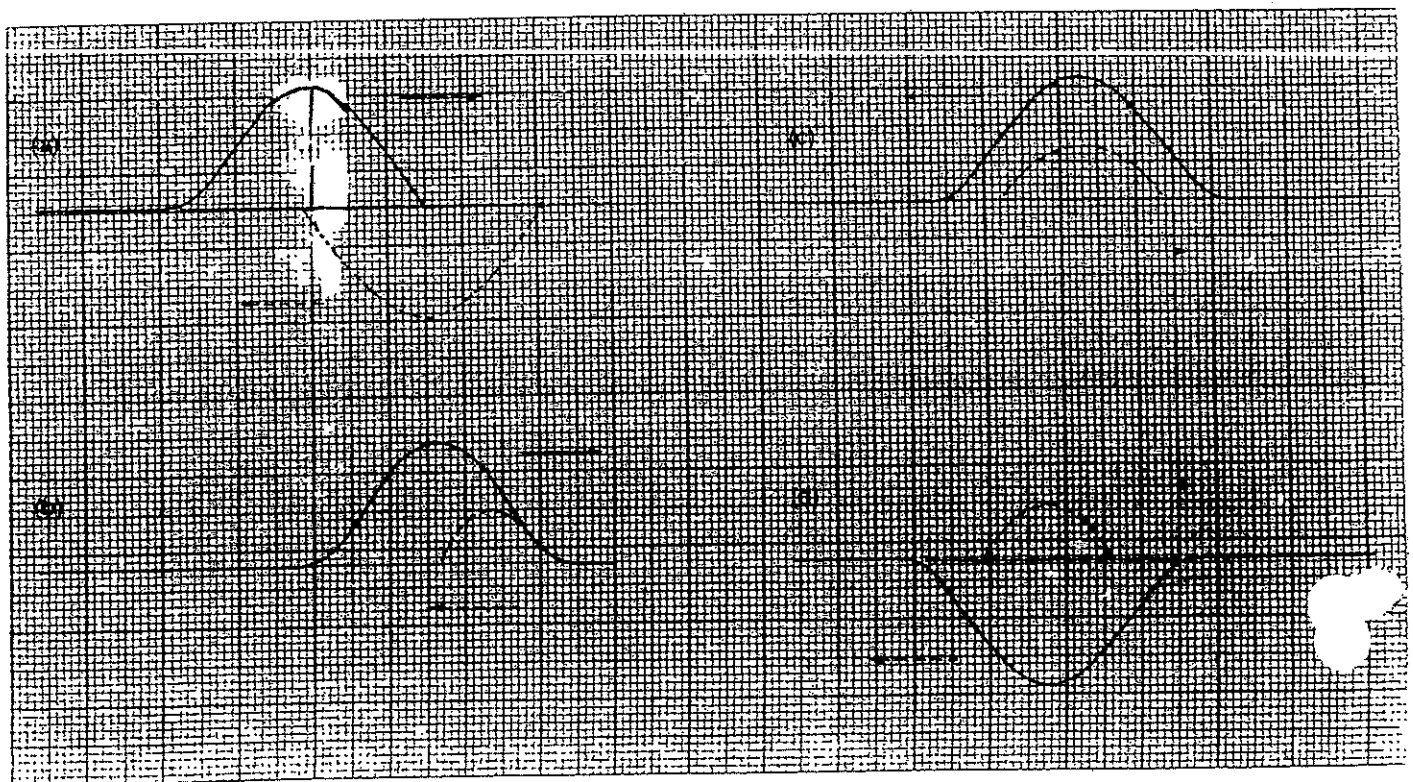


- Examine this diagram of a wave and
- (a) list all pairs of points that are in phase.
  - (b) determine the wavelength, in centimetres, by measurement.
  - (c) determine the speed of the waves, if they take 0.50 s to travel from X to Y.

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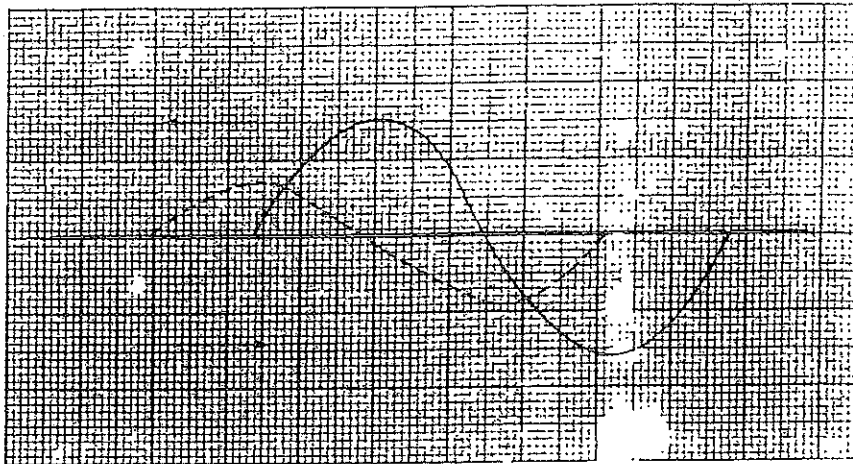
- 12. Water waves with a wavelength of 6.0 m approach a lighthouse at 5.6 m/s.
  - (a) What is the frequency of the waves?
  - (b) What is their period?
- 13. 5.0 Hz waves move along a rope with a wavelength of 40 cm. What is their speed?
- 14. The distance between successive crests in a series of water waves is 5.0 m, and the crests travel 8.6 m in 5.0 s. Calculate the frequency of a block of wood bobbing up and down in the water.
- 15. The wavelength of a water wave is 3.7 m and its period is 1.5 s. Calculate
  - (a) the speed of the wave.
  - (b) the time required for the wave to travel 100 m.
  - (c) the distance travelled by the wave in 1.00 min.
- 16. A water wave travels 60 cm in 2.0 s. If the wavelength is 5.0 cm, what is the frequency of the wave?
- 17. A boat at anchor is rocked by waves whose crests are 30 m apart and whose speed is 8.0 m/s. What is the interval of time between crests striking the boat?
- 18. What is the speed of a sound wave with a wavelength of 3.4 m and a frequency of 100 Hz?
- 19. The period of a sound wave emitted by a vibrating guitar string is  $3.0 \times 10^{-3}$  s. If the speed of the sound wave is 360 m/s, what is its wavelength?
- 20. A television station broadcasts with a frequency of 90 MHz. If the speed of the electromagnetic waves emitted by the station tower is  $3.0 \times 10^8$  m/s, what is the wavelength of the waves?
- 21. The frequency assigned to an FM (frequency modulation) station is 102 MHz. What is the wavelength of the waves if they travel at  $3.0 \times 10^8$  m/s?
- 22. Bats emit ultrasonic sound to help them locate obstacles. The waves have a frequency of  $5.5 \times 10^4$  Hz. If they travel at 350 m/s, what is their wavelength?
- 23. When a stone is dropped into water, the resulting ripples spread farther and farther out, getting smaller and smaller in amplitude until they disappear. Why does the amplitude eventually decrease to zero?

30. Trace the pulses illustrated into your notebook, and determine the resultant displacement of the particles of the medium at each instant, using the Principle of Superposition.

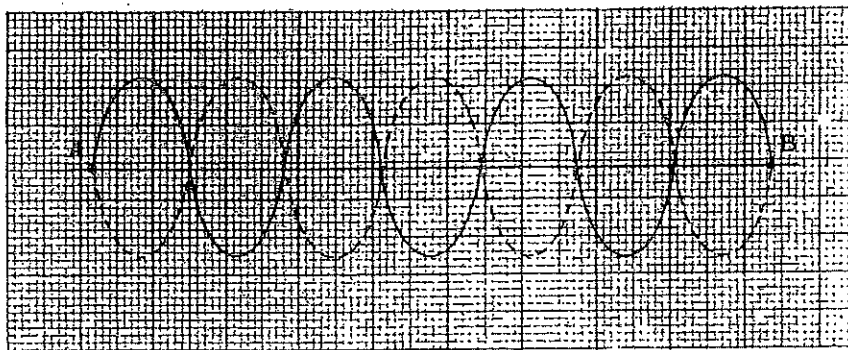


31. Trace the waves illustrated into your notebook and determine their resultant displacement.

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32.



Using measurements taken directly from this diagram of a standing wave pattern, determine each of the following.

- (a) the wavelength of the waves
  - (b) the speed of the waves, if they move between points A and B in 3.0 s
  - (c) the frequency of the waves
33. Calculate the wavelength if the distance between adjacent nodes in a vibrating medium is
- (a) 1.5 m (b) 4.0 cm (c) 48 mm
34. The distance between adjacent nodes in the standing wave pattern in a piece of string is 25.0 cm.
- (a) What is the wavelength of the wave in the string?
  - (b) If the frequency of the vibration is 200 Hz, calculate the velocity of the wave
35. Standing waves are produced in a string by sources at each end with a frequency of 10.0 Hz. The distance between the third node and the sixth node is 54 cm.
- (a) What is the wavelength of the interfering waves?
  - (b) What is their speed?
36. Standing waves are produced in a string by two waves traveling in opposite directions at 6.0 m/s. The distance between the second node and the sixth node is 80 cm. Determine the wavelength and the frequency of the original waves.
37. In the middle of a page in your notebook, mark two points 4.0 cm apart. Using a compass, draw in circular wavefronts originating at the points with 2.0 cm wavelengths. Use solid lines for crests and dotted lines for troughs. Mark all the nodes and points of maximum constructive interference.

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### Numerical Answers to Review Questions

1. 1.3 Hz, 0.75 s
2. 2.00 s
3. (a) 1.5 points/min (b) 3 escapes/min  
(c) 11.3 r/s
4. (a) 0.40 s (b)  $3.9 \times 10^{-3}$  s (c) 27.30 d
5. (a) 0.20 Hz (b)  $1.0 \times 10^3$  Hz (c) 40 Hz  
(d) 1.2 Hz (e) 0.17 Hz (f)  $4.2 \times 10^{-2}$  Hz
6. (a) 0.10 s (b) 4.0 s (c)  $2.00 \times 10^{-6}$  s (d) 10 s  
(e) 0.40 s (f) 0.29 s
7. 4.0 cm
8. 62 m
9. (a) 3.6 cm, 1.0 cm (b) (i) 3.6 cm/s (ii) 1.0 Hz  
(iii) 1.0 Hz
10. 15 waves
11. (b) 8.0 cm (c) 24 cm/s
12. (a) 0.93 Hz (b) 1.1 s
13.  $2.0 \times 10^2$  cm/s
14. 0.34 Hz
15. (a) 2.5 m/s (b) 41 s (c)  $1.5 \times 10^2$  m
16. 6.0 Hz
17. 3.8 s
18.  $3.4 \times 10^2$  m/s
19. 1.1 m
20. 3.3 m
21. 2.9 m
22.  $6.4 \times 10^{-3}$  m
- ~~26. 0.50 cm~~
- ~~27. 3.6 m~~
32. (a) 2.6 cm (b) 3.1 cm/s (c) 1.2 Hz
33. (a) 3.0 m (b) 8.0 cm (c) 96 mm
34. (a) 50 cm (b)  $1.0 \times 10^4$  cm/s
35. (a) 36 cm (b)  $3.6 \times 10^2$  cm/s
36. 40 cm, 15 Hz