Physics 11 Waves W.S.

KEY

1. $v = f\lambda$ $\therefore \lambda = \frac{v}{f} = \frac{3.00 \times 10^8 \text{ m/s}}{10\,000 \times 10^6 \text{ Hz}} = \boxed{3.00 \times 10^{-2} \text{ m}}$

$= \boxed{3.00 \text{ cm}}$

2. $\lambda = \frac{v}{f} = \frac{3.00 \times 10^8 \text{ m/s}}{108 \times 10^6 \text{ Hz}}$ $\boxed{\lambda = 2.78 \text{ m}}$

3. (a) $(4.5 \times 10^{-3} \text{ cm}) \times (10^{-2} \text{ m/cm}) \times (10^9 \text{ nm/m}) = \boxed{4.5 \times 10^4 \text{ nm}}$

(b) $(6 \times 10^{-5} \text{ km}) \times \left(1000 \frac{\text{m}}{\text{km}}\right) \times \left(10^9 \frac{\text{nm}}{\text{m}}\right) = \boxed{6 \times 10^7 \text{ nm}}$

(c) $(173 \, \mu\text{m}) \times \left(\frac{10^{-6} \text{ m}}{\mu\text{m}}\right) \times (10^9 \text{ nm/m}) = \boxed{1.73 \times 10^5 \text{ nm}}$

4. (a) $(5893 \text{ nm}) \times (10^{-9} \text{ m/nm}) = \boxed{5.893 \times 10^{-6} \text{ m}}$

(b) $(1.67 \text{ nm}) \times (10^{-9} \text{ m/nm}) = \boxed{1.67 \times 10^{-9} \text{ m}}$

(c) $(146 \, \mu\text{m}) \times (10^{-6} \text{ m/}\mu\text{m}) = \boxed{1.46 \times 10^{-4} \text{ m}}$

5. $v = f\lambda$ $f = \frac{v}{\lambda} = \frac{3.00 \times 10^8 \text{ m/s}}{500 \times 10^{-9} \text{ m}} = \boxed{6 \times 10^{14} \text{ Hz}}$

6. $\lambda = \frac{v}{f} = \frac{3.00 \times 10^8 \text{ m/s}}{750 \times 10^3 \text{ Hz}} = \boxed{4.00 \times 10^2 \text{ m}}$

Page 2

Waves WS

~~Chapter 11 Quiz~~

NAME: _____ Block ~~8~~

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?

$f = 45.0\ Hz$

$\lambda = 2 \times (0.68)$

$v = f\lambda$

$= (45)(2 \times 0.68)$

$v = 61$ ~~6~~ m/s

2. A pendulum swings through 35 complete cycles in 1.14 seconds.

(a) What is the period of the pendulum?

$T = \frac{\text{time}}{\text{cycle}} = \frac{1.14\ s}{35} = 3.26 \times 10^{-2}\ s$

(b) What is it's frequency?

$f = \frac{35}{1.14\ s} = 3.07 \times 10^{1}\ Hz$

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

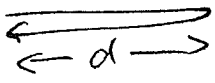
$\lambda = \frac{v}{f} = \frac{3.6\ m/s}{6.8\ Hz} = 0.53\ m$

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?

$d = v \cdot t$

$= (330)\left(\frac{1.6}{2}\right)$

$d = 2.6 \times 10^{2}\ m$



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

$f = \frac{v}{\lambda} = \frac{3.00 \times 10^{8}}{585 \times 10^{-9}}$

$f = 5.13 \times 10^{14}\ Hz$

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

12

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

(a) What is the wavelength of the wave?

$\lambda = 2(0.12) = \boxed{0.24\text{ m}}$ 2

(b) If the waves are generated with a frequency of 10.0 Hz, what is their speed? $v = f\lambda = (10)(0.24)$

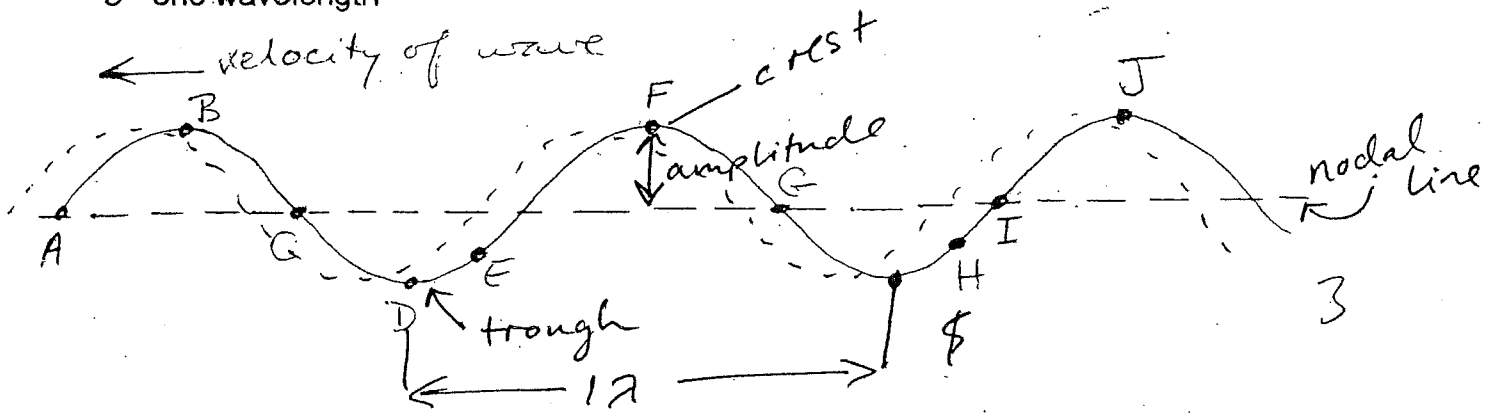
$\boxed{v = 2.4\text{ m/s}}$ 2

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



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

AI, BFJ, CG, EH 2

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

AC, BD, CI, AG, DF, DJ, GI 2

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

A: up B: down

C: down D: up

E: up F: down

G: down H: up 4

15

Physics 11

pg 4

Waves Practice worksheet

~~Chapter 14 Quiz~~

$v = f\lambda$

NAME: _____ ~~Block A~~

1. Calculate the frequency of a tuning fork that vibrates 2.4×10^3 times in 90.0 seconds.

$\#cycles = 2.4 \times 10^3$
$time = 90.0\,s$

$f = \frac{\#cycles}{t} = \frac{2.4 \times 10^3}{90.0\,s}$

$\boxed{f = 2.7 \times 10^1\,Hz}$

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 3.0×10^8 m/s?

$f = 85.0\,MHz = 85.0 \times 10^6\,Hz$
$v = 3.0 \times 10^8\,m/s$

$\lambda = \frac{v}{f} = \frac{3.0 \times 10^8\,m/s}{85.0 \times 10^6\,s^{-1}}$

$\boxed{\lambda = 3.5\,m}$

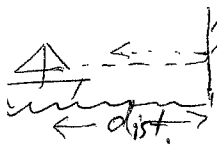
3. How many vibrations would your eardrums experience in 4.0 seconds if your walkman is emitting sound at 2800.0 Hz?

$t = 4.0\,s$
$f = 2800.0\,Hz$

$f = \frac{\#cycles}{t}$ $\quad \#cycles = f \times t = (2800.0\,s^{-1})(4.0\,s)$

$\boxed{\#cycles = 1.1 \times 10^4}$

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?



$v = 340.0\,m/s$
$t = 11.0\,s$
~~distance~~ $d = 2dist.$

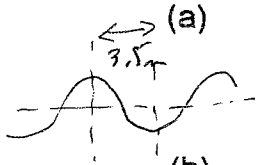
$v = \frac{d}{t} = \frac{2 \times dist}{t}$

$2 \times dist = v \cdot t$

$dist = \frac{v \cdot t}{2}$ $\rightarrow$ $dist = \frac{(340.0\,m/s)(11.0\,s)}{2}$

$\boxed{dist = 1.87 \times 10^3\,m}$

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?

$\frac{1}{2}\lambda = 3.5\,m$
$\therefore \lambda = 7.0\,m$
$v = 5.6\,m/s$

$v = f\lambda$

$f = \frac{v}{\lambda} = \frac{5.6\,m/s}{7.0\,m} = \boxed{8.0 \times 10^{-1}\,Hz}$

(b) What is the period of the waves?

$T = \frac{1}{f} = \frac{1}{0.80\,s^{-1}} = \boxed{1.2\,s}$

(c) How many waves will crash against the shore in 5.0 minutes?

$\#cycles = ?$
$time = 5.0\,min \times 60\,s/min = 300\,s$

$\#cycles = f \times t$
$= (8.0 \times 10^{-1}\,Hz)(300\,s)$

$\boxed{\#cycles = 2.4 \times 10^2\,waves}$

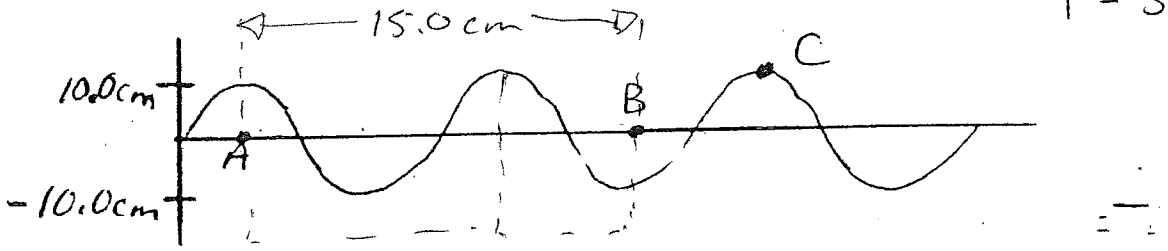
6. In seconds, what is the period of the minute hand of a clock or watch?

$t = 1h = 60min = 3600s$

$T = \frac{time}{cycle} = \boxed{3600s}$

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

$f = 35.0Hz$



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

$1.5\lambda = 15.0cm$

$\boxed{\lambda = 10.0cm}$

(b) What is the amplitude of the wave?

$\boxed{Amp = 10.0cm}$

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

(vertical - up and down)

in one cycle $d = 4 \times 10.0cm = 40.0cm$

$\#cycles = f \times t = (35.0Hz) \times (1.0s) = 35$

$dist = \#cycles \times 40.0cm$

$\boxed{dist = 1.4 \times 10^3 cm}$

$\boxed{dist = 14m}$

$v = f\lambda$

Page 6

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? $v = 325\ m/s$

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?

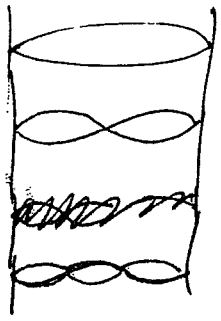
3. a) What are the wavelengths of the 4 longest waves that can produce standing waves on a string of length 30.0 cm, fixed at both ends?
   b) If the speed of the waves in the spring is 225 m/s, what are the frequencies that correspond with the wavelengths found in (a)?

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?

1.



$L = \frac{1}{2}\lambda$

$L = \lambda$

$L = \frac{3}{2}\lambda$

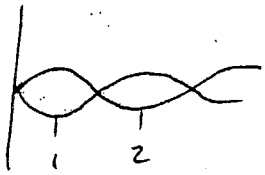
$f = \frac{v}{\lambda}$

$f_1 = \frac{325}{2(0.5)} = 325\ Hz$

$f_2 = \frac{325}{0.5} = 650\ Hz = 6.50 \times 10^2\ Hz$

$f_3 = \frac{325}{\frac{2(0.5)}{3}} = 975\ Hz$

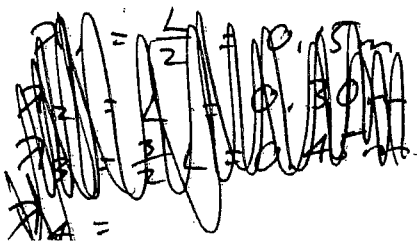
2.



① $d = \frac{1}{4}\lambda = 0.58\ m$

② $d = \frac{3}{4}\lambda = 1.7\ m$

3. (a)



$\lambda_1 = 2L = 60\ cm = 0.600\ m$

$\lambda_2 = L = 30\ cm = 0.300\ m$

$\lambda_3 = \frac{2}{3}L = 20\ cm = 0.200\ m$

$\lambda_4 = \frac{L}{2} = 15\ cm = 0.150\ m$

(b) $f = \frac{v}{\lambda} = \frac{225\ m/s}{? \ m}$

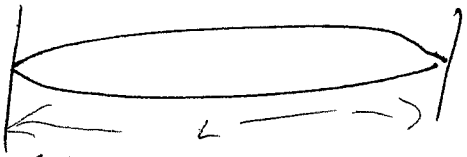
$f_1 = 375\ Hz = 375\ Hz$

$f_2 = 750\ Hz = 7.50 \times 10^2\ Hz$

$f_3 = 1125\ Hz = 1.12 \times 10^3\ Hz$

$f_4 = 1500\ Hz = 1.50 \times 10^3\ Hz$

4.



$\lambda = 2L = 1.10\,m$

~~$V = 6.95$~~

$V = f\lambda$

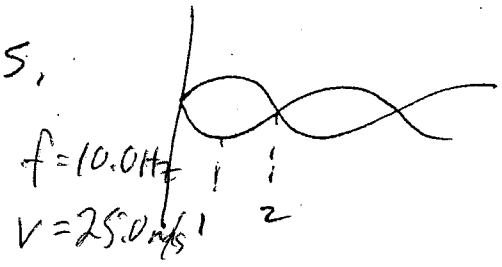
$f = \frac{V}{\lambda} = \frac{195}{1.1}$

$L = 0.55\,m$

$V = 195\,m/s$

$\boxed{f = 1.8 \times 10^2\,Hz}$

5.

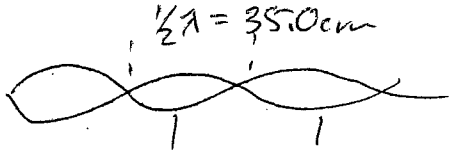


$d_1 = \frac{1}{4}\lambda = \boxed{0.625\,m}$

$d_2 = \frac{1}{2}\lambda = \boxed{1.25\,m}$

$\lambda = \frac{V}{f} = \frac{25}{10} = 2.50\,m$

6.



$\lambda = 70.0\,cm$

(a) $V = f\lambda = (350)(0.700\,m) = \boxed{245\,m/s}$

(b) $\lambda = \frac{V}{f} = \frac{245\,m/s}{150\,s^{-1}} = \boxed{1.63\,m}$

15