Waves Worksheet #6

① $\frac{v_1}{\lambda_1} = \frac{v_2}{\lambda_2}$

$\frac{18}{L} = \frac{10}{\lambda_2}$

$\lambda_2 = \frac{2(10)}{18} = \boxed{1.11 \text{ cm}}$

② a) Deep $\lambda = \frac{v}{f} = \frac{40 \text{ cm/s}}{10 \text{ Hz}} = \boxed{4 \text{ cm}}$

Shallow $\lambda = \frac{v}{f} = \frac{30}{10} = \boxed{3 \text{ cm}}$

b) $\frac{\sin\theta_1}{\sin\theta_2} = \frac{v_1}{v_2}$

$\frac{\sin 30}{\sin\theta_2} = \frac{40}{30}$

$\sin\theta_2 = \frac{30 \sin 30}{40}$

$\theta_2 = \sin^{-1}\left(\frac{30 \sin 30}{40}\right)$

$\theta_2 = \boxed{22^\circ}$

③ $\frac{\sin\theta_1}{\sin\theta_L} = \frac{V_1}{V_L}$

$\frac{\sin 30}{\sin\theta_L} = \frac{320}{384}$

$\sin\theta_L = \frac{384 \sin 30}{320}$

$\sin\theta_L = 0.6$

$\theta_L = \sin^{-1} 0.6$

$\theta_L = \boxed{36.9^\circ}$

④ $\frac{\sin\theta_1}{\sin\theta_L} = \frac{V_1}{V_L}$

$\frac{\sin 47}{\sin 27} = \frac{9}{V_L}$

$V_L = \frac{9 \sin 27}{\sin 47} = \boxed{5.6 \text{ Km/s}}$

⑤ See attachment.

⑥ $\frac{\lambda_1}{\lambda_L} = \frac{V_1}{V_L}$

$\frac{\lambda_1}{2.7} = \frac{1}{0.75}$

$\lambda_1 = \frac{2.7}{0.75} = \boxed{3.6 \text{ cm}}$

⑦ a) $\frac{\lambda_1}{\lambda_2} = \frac{\sin\theta_1}{\sin\theta_2}$

$= \frac{\sin 60}{\sin 45}$

$\frac{\lambda_1}{\lambda_2} = \boxed{1.2}$

b) $\frac{v_1}{v_2} = \frac{\lambda_1}{\lambda_2} = \boxed{1.2}$

c) The frequency does not change when moving from one medium to another.
∴ $f_1 = f_2$

So the ratio $\frac{f_1}{f_2} = \boxed{1.0}$

⑧ $f = \frac{10}{5} = 2$ Hz

3 wavefronts = 2λ

$2\lambda_1 = 24$ cm $\qquad 2\lambda_2 = 18$ cm

$\lambda_1 = 12$ cm $\qquad \lambda_2 = 9$ cm

$v_1 = f\lambda_1$ $\qquad v_2 = f\lambda_2$

$= 2(12)$ $\qquad = (2)(9)$

$v_1 = \boxed{24 \text{ cm/s}}$ $\qquad v_2 = \boxed{18 \text{ cm/s}}$

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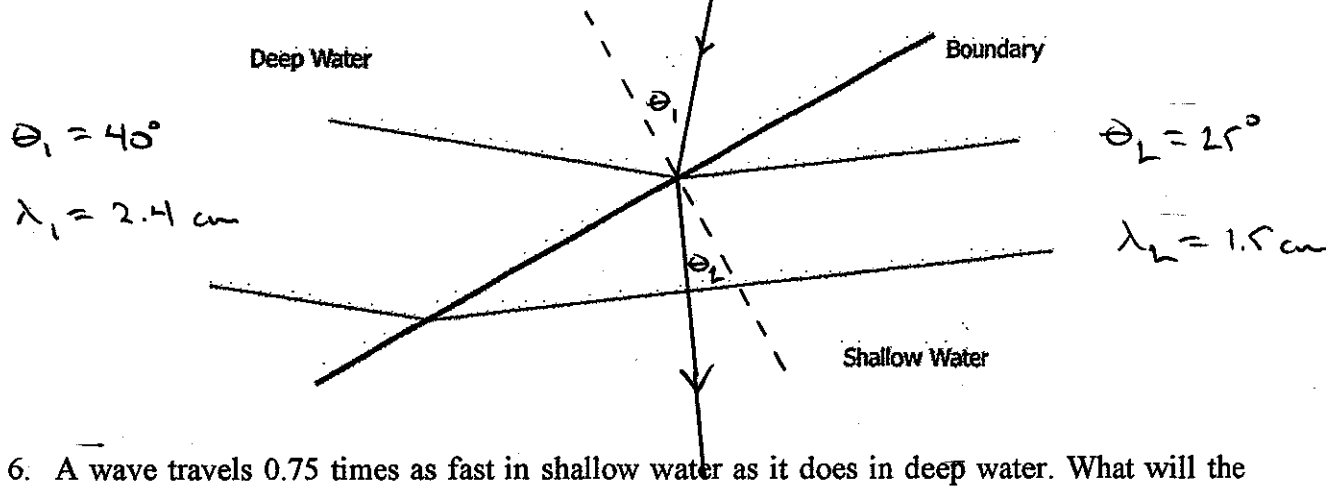
1. A water wave in deep water has a speed of 18.0 *cm / s* and a wavelength of 2.0 *cm*. In shallow water, the speed of the wave is 10.0 *cm / s*. What is the wavelength of this wave in shallow water? (1.11 *cm*)

2. A water wave of frequency 10.0 *Hz* and speed 40.0 *cm / s* is traveling in deep water. It then moves into shallow water where its speed is 30.0 *cm / s*. The angle of incidence is 30.0°. Find
   a) the wavelengths in the two media. (4.0 *cm*, 3.0 *cm*)
   b) the angle of refraction in the shallow water. (22°)

3. The velocity of a sound wave in cold air is 320 *m / s*, and in warm air 384 *m / s*. Assume that the wavefront in cold air is nearly linear. What will be the angle of refraction in the warm air if the angle of incidence is 30.0° ? (37°)

4. An earthquake P wave traveling at 9.0 *km / s* strikes a boundary within the earth between two kinds of material. If it approaches the boundary at an incident angle of 47° and the angle of refraction is 27°, what is the speed in the second medium? (5.6 *km / s*)

5. In the diagram below, draw in the following: the incident wave ray, the normal, the angle of incidence, the refracted wave ray, the angle of refraction. Measure and state the measurements of the wavelengths and the angles of incidence and refraction.



6. A wave travels 0.75 times as fast in shallow water as it does in deep water. What will the wavelength of the wave in deep water be, if the wavelength is 2.7 *cm* in shallow water? (3.6 *cm*)

7. A ripple tank wave passes from a deep to a shallow region with an angle of incidence of 60° and an angle of refraction of 45°. What are the ratios in the two media of
   a) the wavelengths? (1.2)
   b) the velocities? (1.2)
   c) the frequencies? (1.0)