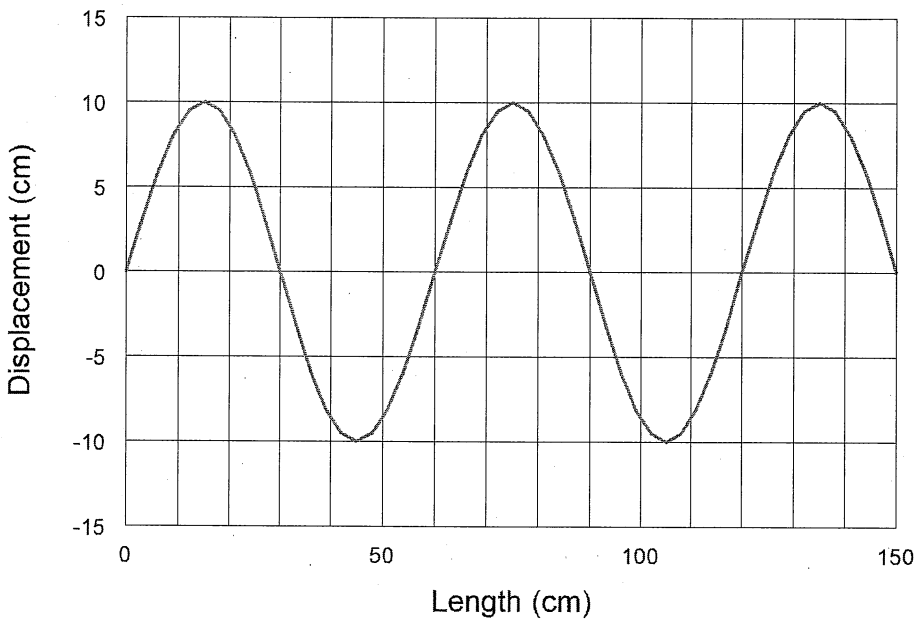
Wave Characteristics Review

1. The diagram below shows part of a rubber cord along which a wave is traveling.



(a) For this wave determine

(i) its amplitude

10 cm

(ii) its wavelength

60 cm

(b) The period of the wave is 0.20 s. What is the speed of the wave?

$v = f\lambda$ $\quad f = \frac{1}{T} = \frac{1}{.2} = 5\,Hz$

$= 5(60) = 300\ cm/s$ or $3\ m/s$

2. A wave has a frequency of 0.05 Hz. What is the period?

$T = \frac{1}{f} = \frac{1}{.05} = 20\,s$

3. A note on a piano has a frequency of 410 Hz and a wavelength of 0.80 m. What is the speed of the wave?

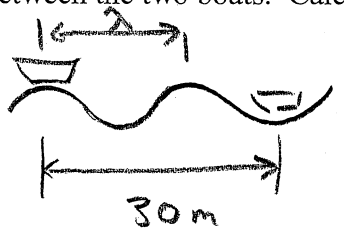
$v = f\lambda$

$= (410)(0.80)$

$= 328$ m/s

4. Two men are fishing from small boats located 30 m apart. Waves pass through the water, and each man's boat bobs up and down 15 times in 1.0 minute. At a time when one boat is on a crest, the other one is in trough, and there is one crest between the two boats. Calculate the speed of the waves.

$f = \frac{15 \text{ times}}{60 \text{ seconds}} = 0.25 \text{ Hz}$



$1\frac{1}{2}\lambda$ in 30 m

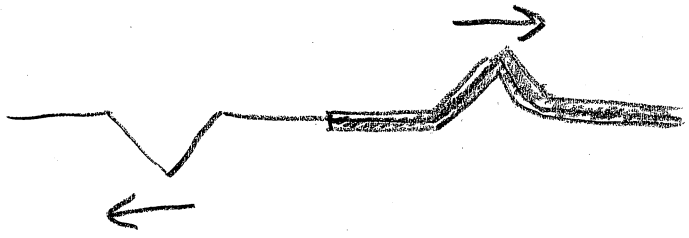
Therefore $\lambda = 20$ m

$v = f\lambda$

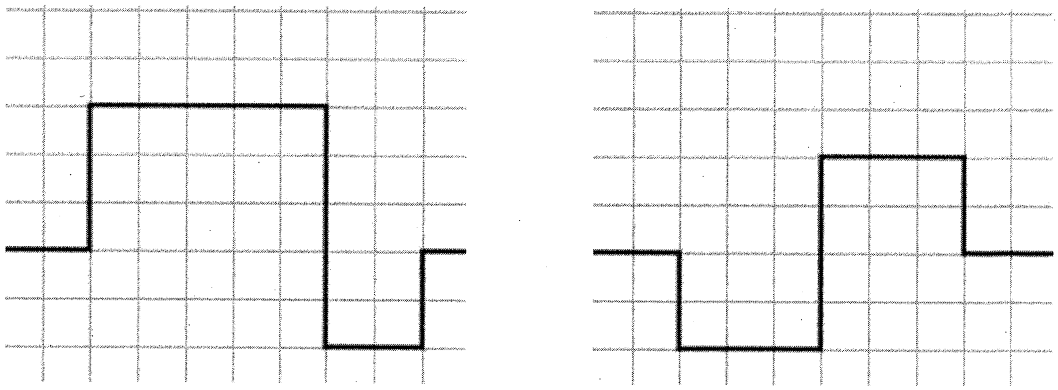
$= (0.25)(20) = 5$ m/s

5. The following diagram shows a pulse moving to the right from a thing string into a thicker string.

Sketch a diagram representing the view of the pulse after it reaches the boundary between the two different media.

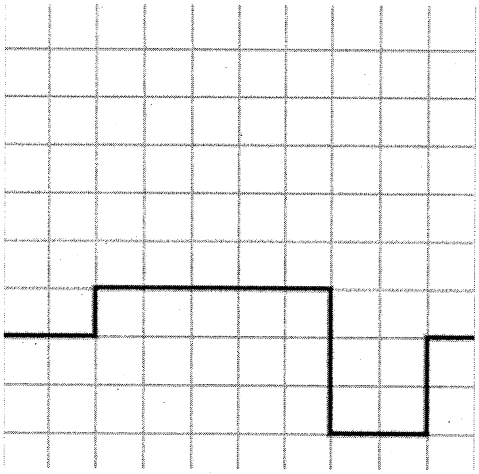


6. The two wave pulses shown below are moving toward each other.

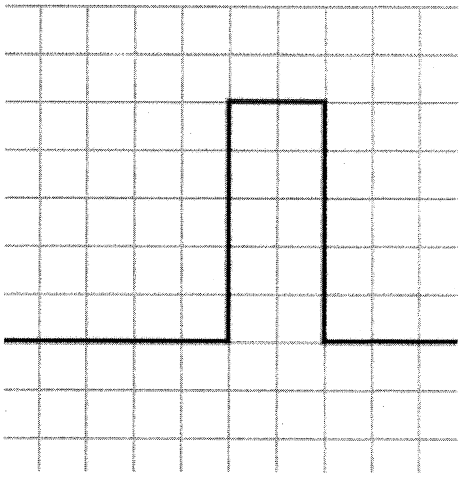


Which of the following diagrams represents the superpositon of the two wave pulses when they completely overlap?

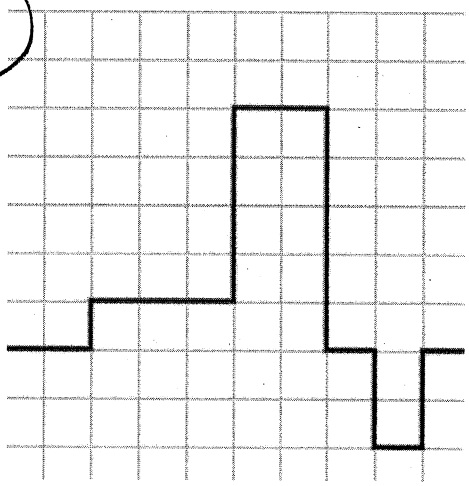
(A)



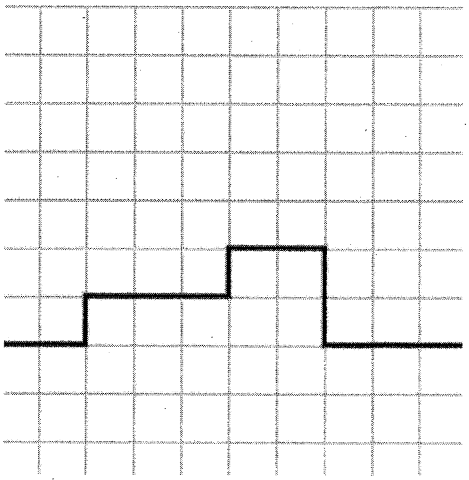
(B)



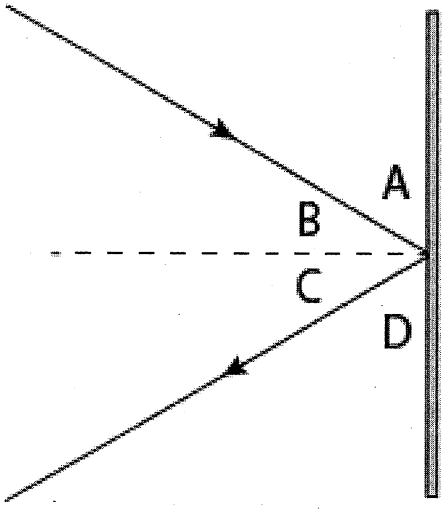
(C)



(D)



7. A wave reflects off a surface as shown below.



Which letter represents the

(a) angle of incidence

B

(b) angle of reflection

C

8. A wave strikes a flat surface at an angle of 30° from the normal. What is the angle of the reflected wave?

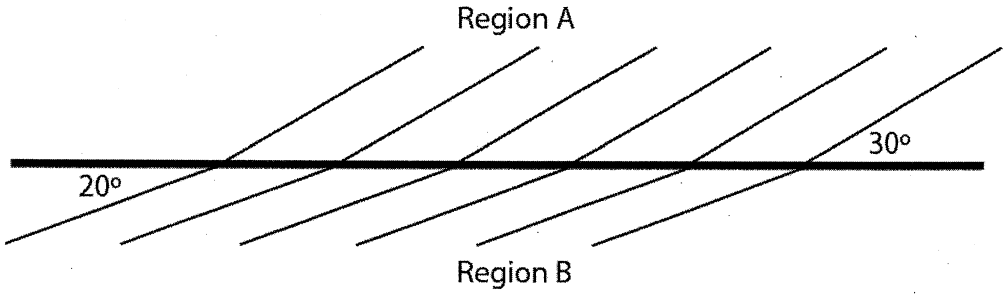
30°

9. Periodic waves of frequency 6.0 Hz, pass from a shallow section of water to a deep section of water. The angle of incidence in the shallow water is 35° and the angle of refraction in the deep water is 60°. The speed of the waves in the deep water is 30 cm/s. Calculate the speed and frequency of the waves in the shallow section.

$\frac{\sin\theta_1}{\sin\theta_2} = \frac{v_1}{v_2}$ $v = 19.9$ m/s $f = 6.0$ Hz

$\frac{\sin 35}{\sin 60} = \frac{v_1}{30}$

10. A plane wave generator with a frequency of 6.0 Hz creates a water wave with a wavelength of 2.0 cm in Region A of a ripple tank as shown (diagram is not to scale).



(a) Calculate the velocity of the waves in Region A.

$v = f\lambda$

$= 6(.02)$

$= 0.12$ m/s

(b) Calculate the velocity of the waves in Region B.

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

$\frac{\sin 30}{\sin 20} = \frac{0.12}{v_2}$

$v_2 = 0.082$ m/s

(c) Calculate the wavelength of the waves in Region B.

$v = f\lambda$

$\lambda = \frac{v}{f} = \frac{0.082}{6}$

$\lambda = 0.014$ m

OR

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

$\frac{.12}{.082} = \frac{0.02}{\lambda_2}$

$\lambda = 0.014$ m

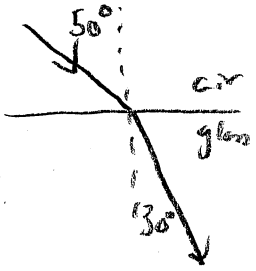
OR

$\frac{\sin\theta_1}{\sin\theta_2} = \frac{\lambda_1}{\lambda_2}$

$\frac{\sin 30}{\sin 20} = \frac{0.02}{\lambda_2}$

$\lambda = 0.014$ m

11. Light is incident (in air) on a piece of glass with an angle of 50°. The angle of refraction is 30°. Calculate the index of refraction for the glass.

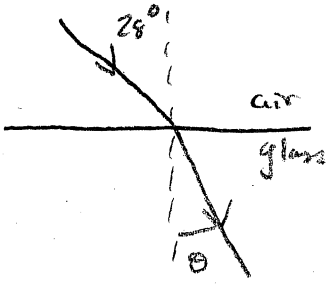


$$\frac{\sin\theta_1}{\sin\theta_2} = \frac{n_2}{n_1}$$

$$\frac{\sin 50}{\sin 30} = \frac{n_2}{1}$$

$$n = 1.53$$

12. The index of refraction of a piece of glass is 1.40. What is the angle of refraction if the incident angle (from air) is 28°?

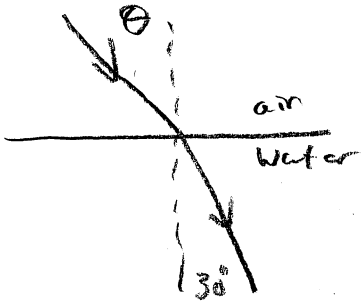


$$\frac{\sin\theta_1}{\sin\theta_2} = \frac{n_2}{n_1}$$

$$\frac{\sin 28}{\sin\theta_2} = \frac{1.40}{1}$$

$$\theta = 19.6^\circ$$

13. What is the angle of incidence in air of a ray whose angle of refraction is 30° in water (n=1.33)?

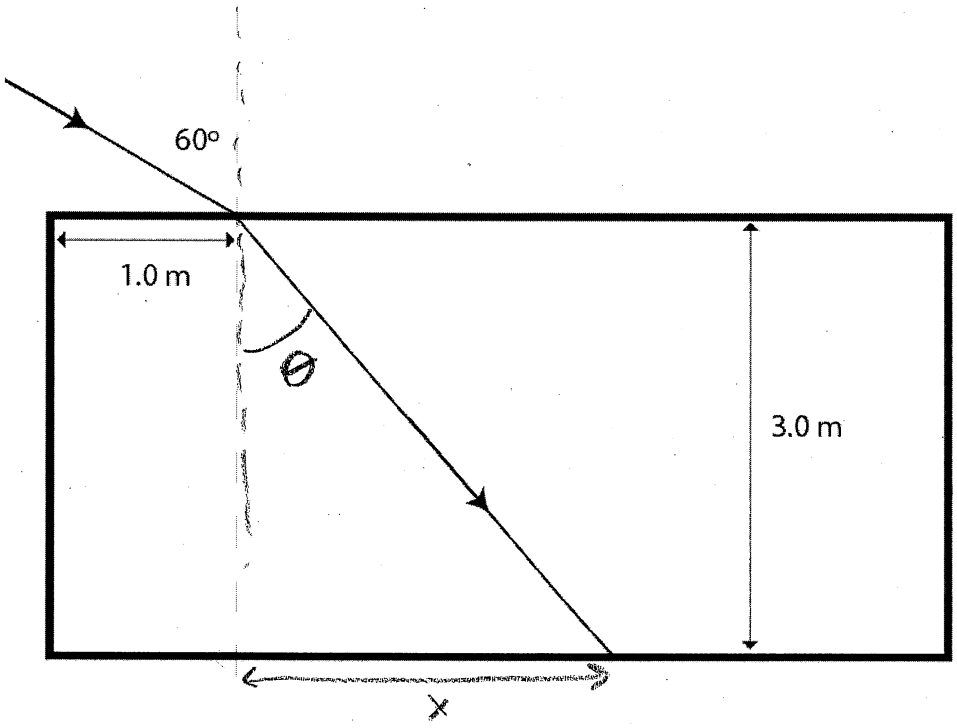


$$\frac{\sin\theta_1}{\sin\theta_2} = \frac{n_2}{n_1}$$

$$\frac{\sin\theta}{\sin 30} = \frac{1.33}{1}$$

$$\theta = 41.7^\circ$$

14. A flashlight is shone into a swimming pool (water n=1.33) as shown.



Calculate the distance from the edge where the light hits the bottom of the pool.

$\frac{\sin\theta_1}{\sin\theta_2} = \frac{n_2}{n_1}$

$\frac{\sin 60}{\sin\theta_2} = \frac{1.33}{1}$

$\theta = 40.6°$

$\tan\theta = \frac{x}{3}$

$\tan 40.6 = \frac{x}{3}$

$x = 2.57\ m$

distance from edge

$1 + x$

$3.57\ m$

15. Explain what is meant by diffraction. (A diagram may be used.)

The bending of waves when going around a barrier or passing through an opening.