Ripple Tank Lab

Purpose: Use a ripple tank to investigate wave properties of reflection, refraction and diffraction.
A ripple tank provides an ideal medium for observing the behavior of waves. The ripple tank projects images of waves in the water onto a screen below the tank. Just as you have probably observed in a swimming pool, light shining through water waves is seen as a pattern of bright lines and dark lines separated by gray areas. The water acts as a series of lenses, bending the light that passes through it. In the ripple tank, the wave crests focus light from the light source and produce bright lines on the paper. Troughs in the ripple tank waves cause the light to diverge and produce dark lines (Areas of no disturbance).

In this experiment you will investigate a number of wave properties, including reflection, refraction and diffraction. The law of reflection states that the angle of incidence equals the angle of reflection. Waves undergoing a change in speed and direction as they pass from one medium to another are demonstrating refraction. The spreading of waves around the edge of a barrier or through a narrow opening exemplifies diffraction. You will generate waves in a ripple tank and observe the effects on wave behavior of different types of 'media interfaces'.

Materials:

ripple tank	light source	dowel rod
2 paraffin blocks	protractor & ruler	a few pennies
meter stick	flat glass plate, angle cut	white paper

Procedure:
Make sure you have the white reflector sheet under the legs of the tank. Check the depth of water in your tank at all four corners, and make sure the tank is level. You want the water level to come up about 1/4" on to the 'beach' above the lower lip of the tank. Set up the light source so that it is about 50 cm above the center of the tank. CAUTION: ELECTRICITY AND WATER DO NOT MIX. DO NOT ALLOW THE LIGHT SOURCE TO TOUCH THE WATER! UNPLUG THE LIGHT SOURCE WHILE NOT IN USE!
Turn on the light. Notice that the tank is not square. Place the dowel rod along the shorter side as shown in the diagrams. Using your hand as the oscillator, roll the dowel rod back and forth about 5 cm at a rate of once per second. This rate is a frequency of 1 Hertz (1 Hz). Except where otherwise noted, use this same frequency for all experiments. Note the effect on the white sheet below. Try making small disturbances with a pencil or your finger right in the middle of the tank.

Reflection:
Place the two paraffin blocks together as in diagram A to place a barrier at the far end of the tank, as in figure 1A. Send a single incident pulse toward it so that it strikes the barrier head on (angle of incidence = 0°). Repeat several times. Record your observations in item 1 of Table 1.
Remember that the behavior of single pulses is the same as the behavior of multiple wave trains. Change the angle of the barrier with respect to the incident pulses, as in figure 1B. Generate single pulses and observe the behavior of the reflected wave, record in table 1, item 1. In the space provided in Item 2 of table 1, sketch incident (incoming) waves striking the barrier at an angle and show the reflected waves.
Remove the barrier and generate waves at 1.0 Hz. Lay a meter stick under the ripple tank and estimate the wavelength (l) in meters. From the formula v = l x f where v is velocity and f is frequency, calculate the velocity of your waves. Record in Table 1.

Refraction:
Place the glass plate in the tank as shown in Figure 2a. Support the plate with pennies so that there is only about 2mm of water over the plate. This will represent shallow water for the waves to strike.
Generate single pulses toward the glass plate. Carefully observe what happens to the direction of the wave as it passes over the shallow water. Record your observations in Table 2.

Diffraction:
Arrange 2 paraffin blocks as shown in figure 3. Generate waves at 1 Hz and observe the diffraction of the incident waves as they pass through the opening. While generating waves at a constant rate, make the opening smaller. Sketch your observations in Table 3.

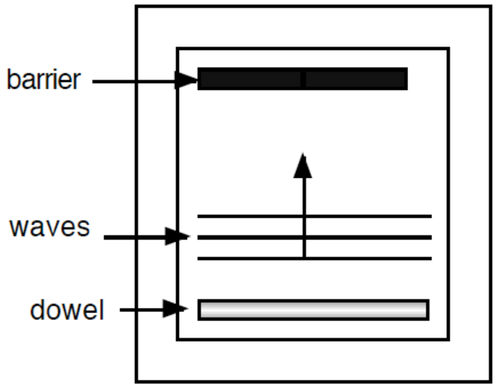

Figure 1a

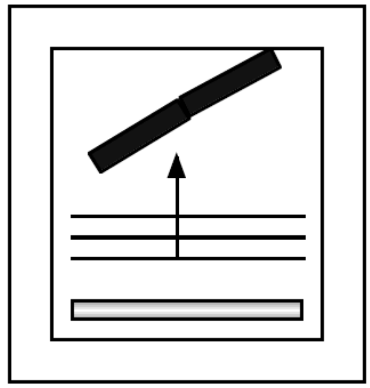
Figure 1b

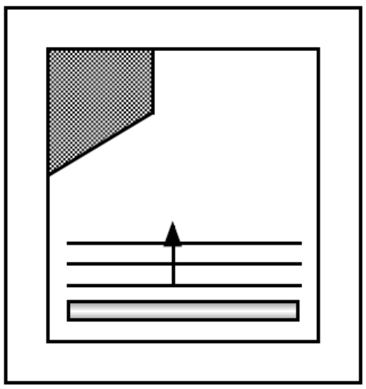
Figure 2a

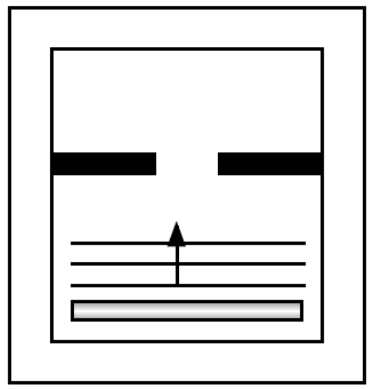
Figure 3

Observations and Data:

Table 1.

1. Observations of straight pulses striking a straight barrier at 0° and at an angle.
2. Sketch on incoming pulses and reflected pulses
3. Calculation for velocity of your waves.

Table 2.

Observations of refraction of a straight wave.

Table 3.

Observations of diffraction

Define the following terms: Wave, pulse, crest, trough, amplitude, wavelength, frequency, refraction, diffraction, reflection, oscillator, media, interface

Questions:

1. Using your observations of reflected waves, make a generalization about the angle of incidence and the angle of reflection from a straight barrier.
2. What happens to the velocity, wavelength and frequency of a water wave as it is reflected from a barrier?
3. What happens to the velocity, wavelength and frequency of a water wave as it is refracted at the boundary between the deep and shallow ater?
4. What happens to the velocity, wavelength and frequency of a water wave as it is diffracted while passing through a narrow opening?
5. How does wave diffraction change as the width of the opening is changed?
6. How do you think wind, which provides the vibration that produces ocean waves, can affect the energy level of these waves?

Application:

1. How can ocean waves help to locate underwater reefs or sandbars?
2. How can you apply the law of reflection to sports like ping-pong, racquet ball, or billiards?