Physics
Wave Behavior: Slits and Obstacles

Name: _____
Date: _____ Period: _____

Purpose: (a) To extend knowledge of wave behavior by investigating how a wave behaves when it passes through a slit or around an obstacle.
(b) To discover wave behavior which may be used to predict presently unknown behavior of light.

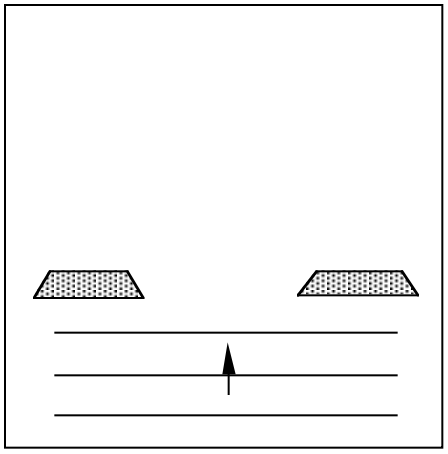
Procedure

1. Set up two long pieces of paraffin so that they form a slit with beveled edges oriented as shown in diagram 1. Make the slit width approximately 10 cm. Generate waves of low frequency and long wavelength. Observe the wave pattern and then make a drawing which shows the straight waves before arriving at the slit, as well as the wave pattern after the waves have passed through the slit. Pay particular attention to the wavelength before and after passing through the slit, and its length relative to the slit width. Idealize drawing as necessary.

2. Without changing the wave frequency, move the paraffin pieces closer together so that the slit width is 1 cm or less. Again make drawing as in step 1, but this time in diagram 2.

3. Without changing the wave frequency, replace the two long paraffin pieces with a single long paraffin obstacle, as shown in diagram 3. Observe the pattern and then make a drawing which shows the waves before they have arrived at the obstacle, as well as the effect of the obstacle on the wave pattern. Pay particular attention to the wavelength relative to the obstacle width. Idealize drawing as necessary.

4. Without changing the wave frequency, remove the paraffin obstacle and replace with a large nail standing on end. Again make drawing as in step 3, but this time in diagram 4.



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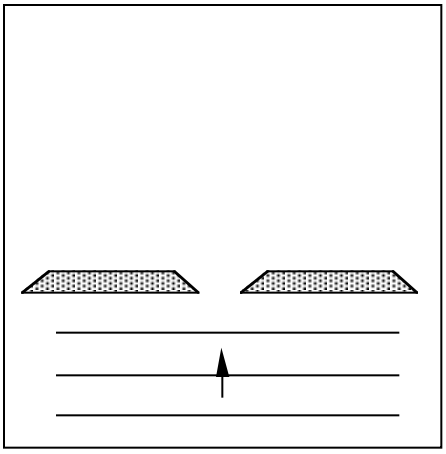

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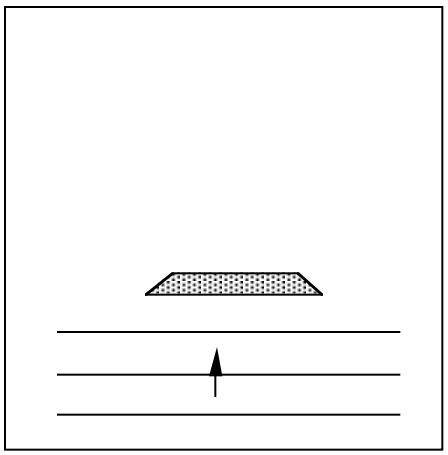

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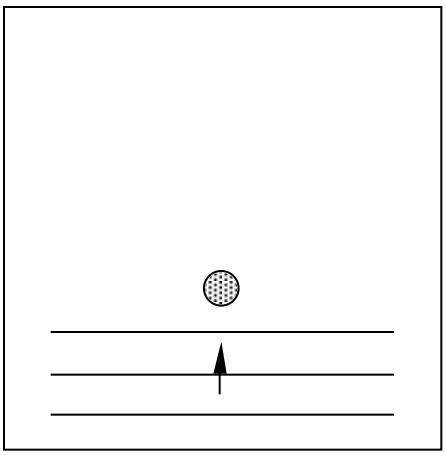

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ANALYSIS/QUESTIONS/CONCLUSION

Questions 1-5 refer to diagrams 1 and 2 in the procedure.

1. To produce curvature in waves which pass through a slit, the wavelength must be (large, small) compared to the slit width, or, alternatively, the slit width must be (large, small) compared to the wavelength. To produce more curvature with constant wavelength, the slit must be made (larger, smaller). To produce more curvature with a constant slit width, the wavelength must be made (larger, smaller). A large slit could still produce curvature in waves, provided the wavelength was VERY (large, small). Likewise, curvature could be obtained with small wavelengths, provided the slit was VERY (large, small).

2. To produce more curvature in waves passing through a slit, you can either make the (slit, wavelength) larger, and/or make the (slit, wavelength) smaller.

3. If the slit width was decreased, the wavelength would have to be (increased, decreased) to retain the initial curvature of waves passing through the slit.

4. If the FREQUENCY of the waves passing through a slit was DECREASED, the slit width would have to be (increased, decreased) to retain the initial curvature of the waves passing through the slit.

5. Normally you do not observe light exhibiting curvature as it passes through a slit, even if the slit is "small." For example, light passing through a crack in a door casts a narrow beam on a floor or wall, and does not spread way out to the side.

a. If you consider light as a wave, what inference might this lead you to draw about the wavelength of light?

b. Considering your answer to the previous question, what experimental condition might you set up to try to actually produce curvature in light passing through a slit?

Questions 6-9 refer to diagrams 3 and 4 in the procedure.

6. To produce an undisturbed area behind an obstacle, the wavelength must be (large, small) compared to the width of the obstacle, or, alternatively, the obstacle width must be (large, small) compared to the wavelength.

7. A wave in San Francisco bay hitting a piling or telephone pole is essentially like diagram (3, 4), whereas the same wave hitting a breakwater in front of a harbor mouth is like diagram (3, 4).

8. When you see a shadow of an object, you are seeing something that is essentially like diagram (3, 4).

9. Even very small objects are capable of casting shadows. What inference might this lead you to draw about the wavelength of light?