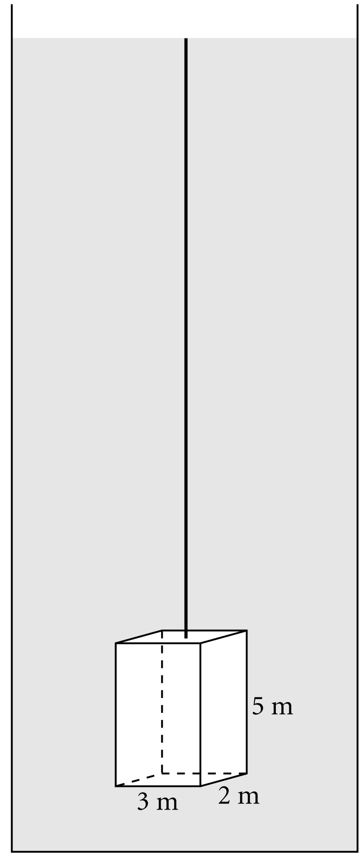
Chapter 9

HOLT PHYSICS

Mixed Review

Fluid Mechanics

1. A crate with dimensions of 2.00 m × 3.00 m × 5.00 m is immersed in sea water ($\rho = 1.025 \times 10^3$ kg/m^3) with the 3.00 × 2.00 sides as the top and bottom. The crate is held with a cable so that the top is 20.0 m below the surface of the water.



a. Calculate the hydrostatic pressure on the top of the crate and on the bottom of the crate.

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b. Find the absolute pressure at the top and at the bottom of the crate. ($P_0 = 1.01 \times 10^5$ N/m^2)

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c. Find the forces exerted on the top and on the bottom of the crate by these pressures.

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d. On the diagram at right, sketch in vectors representing the direction and magnitude of these forces.

e. What is the net force exerted by the water on the crate?

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f. The crate's weight is 2.50×10^6 N. Will it sink when the cable is cut? Explain.

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g. Calculate the volume of the crate.

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h. Use Archimedes' principle to find the buoyant force on the crate. How is it related to your answer to item e?

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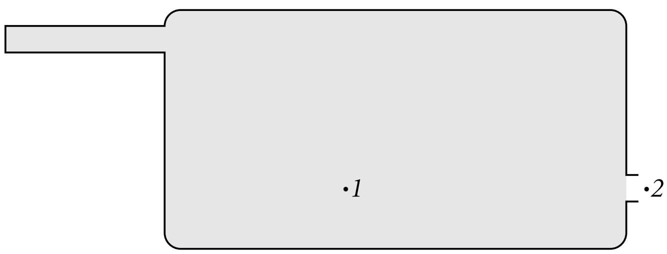
HOLT PHYSICS

Mixed Review *continued*

2. A very large boiler has a very small opening near the bottom, as shown in the diagram below. Water ($\rho = 1.00 \times 10^3$ kg/m^3) is constantly added through the top of the boiler to keep the boiler full. Pressure at the point labeled *1* is 1.00×10^6 N/m^2 above atmospheric pressure ($P_0 = 1.01 \times 10^5$ N/m^2).



a. Write the general form of Bernoulli's equation for the points labeled *1* and *2*.

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b. Explain why $h_1 = h_2$ in this case. Write the simplified form of Bernoulli's equation that results from this conclusion.

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c. Can you assume that v_1 is approximately zero? Explain.

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d. Write the reduced form of Bernoulli's equation that results from this assumption.

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e. How does P_2 compare with the atmospheric pressure P_0? How does it compare with P_1?

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f. Use this information to find the rate of flow of water out of the small opening. (Hint: solve Bernoulli's equation for v_2).

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