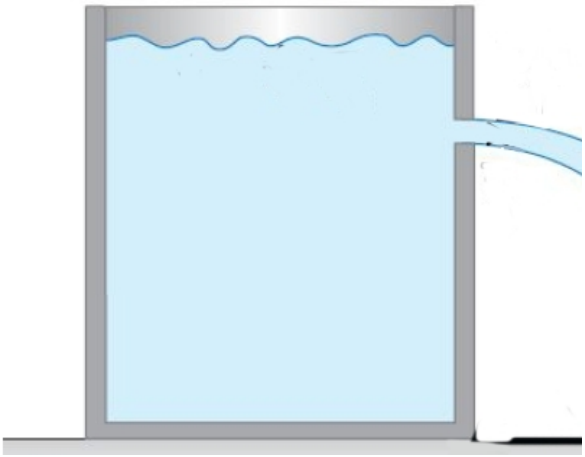
Review II

PHY250 - Fall 2021

Exercise 1

Suppose the top surface of the vessel is subjected to an external gauge pressure P2. (a) Derive a formula for the speed, v_1 , at which the liquid flows from the opening at the bottom into atmospheric pressure, P_0. Assume the velocity of the liquid surface, v_2, is approximately zero.



Exercise 2

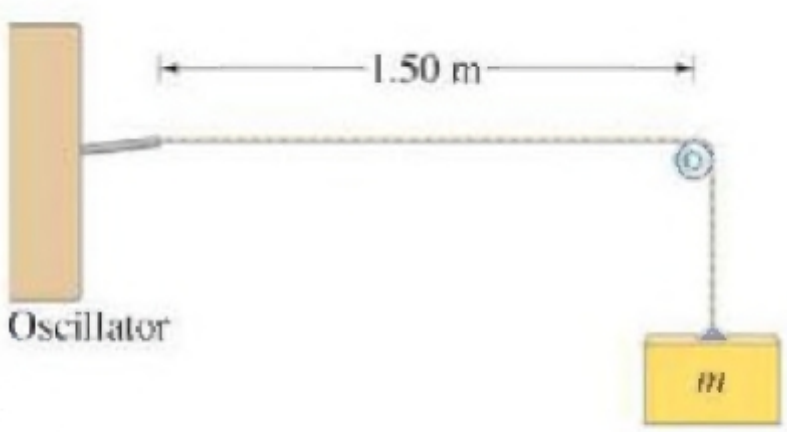
Water stands at a height h behind a vertical dam of uniform width b. (a) Use integration to show that the total force of the water on the dam is $F = \frac{1}{2}\rho g h^2 b$. (b) Show that the torque about the base of the dam due to this force can be considered to act with a lever arm equal to $h/3$. (c) For a freestanding concrete dam of uniform thickness t and height h, what minimum thickness is needed to prevent overturning? Do you need to add in atmospheric pressure for this last part? Explain.

Exercise 3

A plywood disk of radius $20.0cm$ and mass $2.20kg$ has a small hole drilled through it, $2.00cm$ from its edge. The disk is hung from the wall by means of a metal pin through the hole, and is used as a pendulum. What is the period of this pendulum? ($I_{CM} = \frac{1}{2}MR^2$).

Exercise 4

One end of a horizontal string of linear density $6.6 \times 10^{-4} kg/m$ is attached to a small-amplitude mechanical $120 - Hz$ oscillator. The string passes over a pulley, a distance $\ell = 1.50\ m$ away, and weights are hung from this end. What mass m must be hung from this end of the string to produce (a) one loop, (b) two loops, and (c) five loops of a standing wave? Assume the string at the oscillator is a node, which is



Question 1

A maintenance crew is working on a section of a three-lane highway, leaving only one lane open to traffic. The result is much slower traffic flow (a traffic jam). Do cars on a highway behave like

(i) the molecules of an incompressible fluid or
(ii) the molecules of a compressible fluid?

Question 2

Mercury is less dense at high temperatures than at low temperatures. Suppose you move a mercury barometer from the cold interior of a tightly sealed refrigerator to outdoors

on a hot summer day. You find that the column of mercury remains at the same height in the tube. Compared to the air pressure inside the refrigerator, is the air pressure outdoors

(i) higher,
(ii) lower, or
(iii) the same?

Question 3

Explain the difference between the speed of a transverse wave traveling down a cord and the speed of a tiny piece of the cord.

Question 4

If we knew that energy was being transmitted from one place to another, how might we determine whether the energy was being carried by particles (material objects) or by waves?

Question 5

When a sinusoidal wave crosses the boundary between two sections of cord, the frequency does not change (although the wavelength and velocity do change). Explain why.