PHY250 - Fall 2021: Midterm Exam

Exercise 1(25 p)

A swimming pool is 5.0 m long, 4.0 m wide, and 3.0 m deep. Compute the force exerted by the water against (a) the bottom and (b) either end. (Hint: Calculate the force on a thin, horizontal strip at a depth h, and integrate this over the end of the pool.) Do not include the force due to air pressure. Density of water: $10^3\ kg/m^3$

Exercise 2(25 p)

Take into account the speed of the top surface of the tank (Fig. 1) and show that the speed of fluid leaving the opening at the bottom is:

$$v_1 = \sqrt{\frac{2gh}{(1 - A_1^2/A_2^2)}}$$

where $h = y_2 - y_1$, and A_1 and A_2 are the areas of the opening and of the top surface, respectively. Find the distance d at which the fluid reaches the floor.

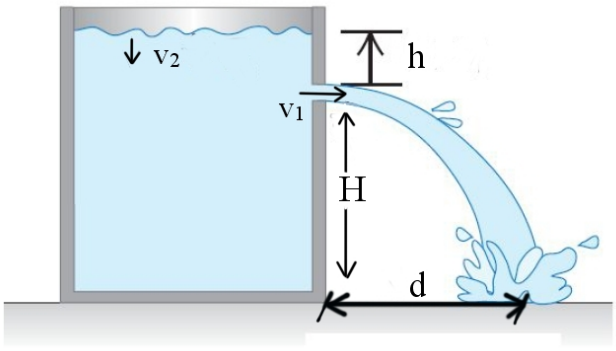

Figure 1: Find v_1 and d

Exercise 3(25 p)

A student wants to use a meter stick as a pendulum. She plans to drill a small hole through the meter stick and suspend it from a smooth pin attached to the wall (Fig. 2). Where in the meter stick should she drill the hole to obtain the shortest possible period? How short an oscillation period can she obtain with a meter stick in this way?

Inertia momentum of the stick respect to the center of mass: $\frac{1}{12}ML^2$

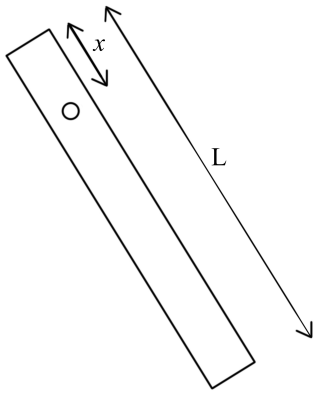

Figure 2: Find x for the shortest period.

Exercise 4(25 p)

A $65-cm$ guitar string is fixed at both ends. In the frequency range between 1.0 and $2.0kHz$, the string is found to resonate only at frequencies $1.2, 1.5$, and $1.8kHz$. What is the speed of traveling waves on this string?

EXTRA CREDIT: 5p

The velocity of waves on a string is $96m/s$. If the frequency of standing waves is $445Hz$, how far apart are the two adjacent nodes?