PHYS 1511 Discussion Section: Week 10

Connor Feltman

University of Iowa

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Review

Chapter 10: Simple Harmonic Motion (SHM) and Elasticity

- -Elastic Deformation
- -Stress, Strain and Hooke's Law

Chapter 11: Fluids

- -Density
- -Pressure & Depth
- -Archimedes Principle/Bouyant Force
- -Continuity Equation
- -Bernoulli's Equation

Relevant Equations

Chapter 10:

$$\vec{F} = kx \qquad \text{(Spring Resorting Force)} \tag{1}$$

$$\omega = \sqrt{\frac{k}{m}} \text{ or } k = \omega^2 m \qquad \text{(spring constant)} \tag{2}$$

$$W = \Delta \text{PE} = \frac{1}{2}kx^2 \qquad \text{(Work/Potential Energy done by spring)} \tag{3}$$

$$F = Y\left(\frac{\Delta L}{L_o}\right)A \qquad \text{(Stretching in 1D)} \tag{4}$$

$$F = S\left(\frac{\Delta X}{L_o}\right)A \qquad \text{(Sheer Force on surface)} \tag{5}$$

$$\Delta P = -B\left(\frac{\Delta V}{V_0}\right) \qquad \text{(Volume change by a pressure)} \tag{6}$$

*** Y,S & B are all constants that depend on the material

Chapter 11:

$$\rho = \frac{m}{V} \qquad \text{(Density)} \tag{7}$$

$$\vec{P} = \frac{\vec{F}}{A} \qquad \text{(Pressure Definition)} \tag{8}$$

$$\vec{F_b} = \rho g V \qquad \text{(Buoyant Force)} \tag{9}$$

$$A_1 v_1 = A_2 v_2 \qquad \text{(Continuity Equation)} \tag{10}$$

$$P_1 + \frac{1}{2}\rho v_1^2 + \rho g y_1 = P_2 + \frac{1}{2}\rho v_2^2 + \rho g y_2 \qquad \text{(Bernoulli's Eqn)} \tag{11}$$

Question #1

Spring Motion

In 0.75s, a 7.00kg block is pulled through a distance of 4.0m on a frictionless horizontal surface, starting from rest. The block has a constant acceleration and is pulled by means of a horizontal spring that is attached to the block. The spring constant of the spring is 415 N/m.
(1) By how much does the spring stretch?
(2) How much work is done by the spring to stretch as far as it did in (1)?

Question #2

Stretching

One end of a piano wire is wrapped around a cylindrical tuning peg and the other end is fixed in place. The tuning peg is turned so as to stretch the wire. The piano wire is made from steel ($Y = 2.0 \times 10^{11} N/m^2$). It has a radius of 0.8mm and an unstrained length of 0.76m. The radius of the tuning peg is 1.8 mm. Initially there is no tension in the wire. Find the tension in the wire when the peg is turned through two revolutions

Question #3

Pressure Treasury

United States currency is printed using intaglio presses that generate a printing pressure of 8×10^4 lbs/in^2. A \$20 bill is 6.1in by 2.6in. Calculate the magnitude (in Newtons) of force that the printing press applies to one of the sides of the bill.

(1 N $\approx$ 4.448 lbs) *Note: lb $\neq$ lbs
(1 meter = 39.3701 inches)

Question #4

Floating Physics?

Tom hanks is lost at sea in the movie "Castaway" and wants to travel with whatever belongings he has. He decides to build a raft that has dimensions 3m wide by 4m long by 0.5m tall. The raft is rectangle, made entirely of wood with density of roughly 400 kg/m^3. Answer the following:

(a) What is the mass of the raft?

(b) If the raft was put into water and it floats, what volume of water is displaced? ($\rho_w \approx 1000 kg/m^3$)

(c) How much of the raft is submerged under water? i.e. how far does the water come up on the raft's 0.5m sides?

Question #5

Heart Troubles

A patient in a hospital has been diagnosed with Aortic Stenosis (when the aortic valve does not close properly). Doctors need to know how fast blood travels through the valve when it should be closed. An echo-cardiogram was performed showing the diameter of heart before the valve to be 3 cm with velocity 0.34 m/s. The patient will become critical if the aortic velocity passes 4.0 m/s. What must be the diameter of the aortic valve if the doctors should fear the patient going critical?