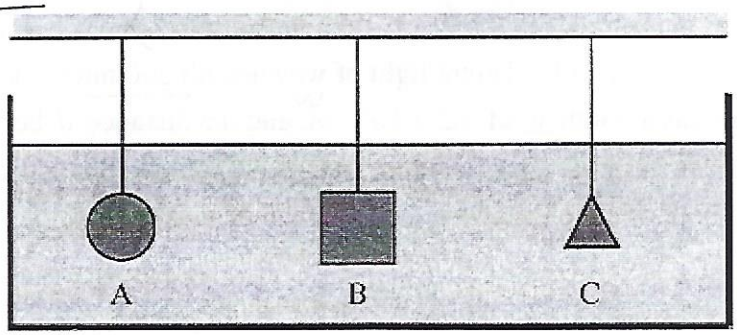
Name Key

AP Review #16



5. (10 points)

Three objects of identical mass attached to strings are suspended in a large tank of liquid, as shown above.

3 (a) Must all three strings have the same tension?

___ Yes X No (1)

Justify your answer.

$F_t + F_B = F_g$

$F_t = F_g - F_B$

The tension depends on the weight (2) + the buoyant force. The buoyant force depends on the volume of the objects, which may be different

Object A has a volume of 1.0×10^{-5} m^3 and a density of 1300 kg/m^3. The tension in the string to which object A is attached is 0.0098 N.

3 (b) Calculate the buoyant force on object A.

2 (c) Calculate the density of the liquid.

2 (d) Some of the liquid is now drained from the tank until only half of the volume of object A is submerged. Would the tension in the string to which object A is attached increase, decrease, or remain the same?

X Increase (1) ___ Decrease ___ Remain the same

Justify your answer.

b) $F_t + F_B = F_g$ (1) equilibrium

$F_B = F_g - F_t$

$= \rho V g - F_t$ (1) use V + ρ to get F_g

$= (1300 \frac{kg}{m^3})(1.0 \times 10^{-5} m^3)(9.81 m/s^2)$

$- .0098 N$

$F_B = .12 N$ (1) answer

c) $F_B = \rho_l V_l g$ $V_l = V_A$

$\rho = \frac{F_B}{V g}$ (1) sub into eqn

$= \frac{.12 N}{(1.0 \times 10^{-5} m^3)(9.81 m/s^2)} = 1200 kg/m^3$

(1) answer w/ units

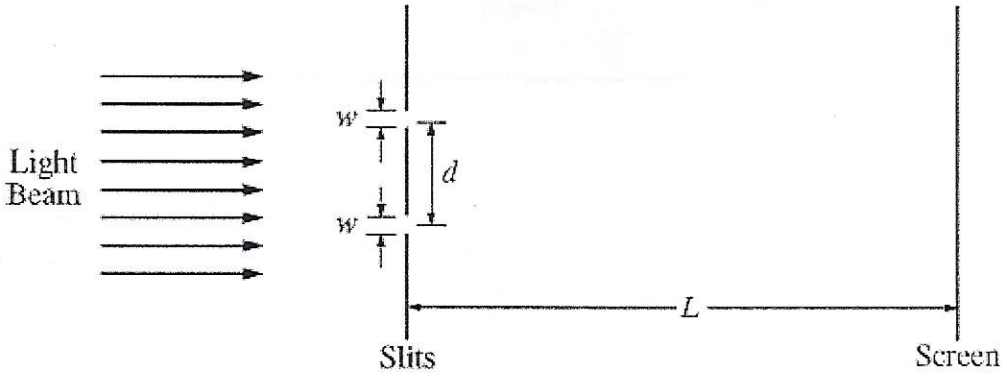
d) $F_t + F_B = F_g$

$F_t = F_g - F_B$

(1) If some of the liquid is removed the buoyant force would decrease. If the buoyant force decrease the tension would increase to compensate

6. (10 points)

In a classroom demonstration, a beam of coherent light of wavelength 550 nm is incident perpendicularly onto a pair of slits. Each slit has a width w of 1.2×10^{-6} m, and the distance d between the centers of the slits is 1.8×10^{-5} m. The class observes light and dark fringes on a screen that is a distance L of 2.2 m from the slits. Your notebook shows the following setup for the demonstration.



Note: Figure not drawn to scale.

2 (a) Calculate the frequency of the light.

3 (b) Calculate the distance between two adjacent dark fringes on the screen.

The entire apparatus is now immersed in a transparent fluid having index of refraction 1.4.

2 (c) What is the frequency of the light in the transparent fluid?

3 (d) Does the distance between the dark fringes increase, decrease, or remain the same?

_____ Increase ___X___ Decrease _____ Remain the same

Explain your reasoning.

a) $f = \frac{v}{\lambda} = \frac{3.00 \times 10^{8}\ m/s}{550 \times 10^{-9}\ m} = 5.5 \times 10^{14}\ Hz$

(1) eqn + sub (1) answer w/ units

b) $\Delta x = \frac{\Delta m \lambda L}{d} = \frac{(1)(550 \times 10^{-9}\ m)(2.2\ m)}{1.8 \times 10^{-5}\ m} = .067\ m$

(1) use Δx (1) eqn (1) sub

c) $f = 5.5 \times 10^{14}\ Hz$ (2) same f

d) $x = \frac{m \lambda L}{d}$ In the fluid $v = \frac{c}{n}$ the speed of light decreases. So then the wavelength also decreases $\lambda = v/f$. This leads to a decrease in the separation of the fringes.

(1) $\lambda \downarrow$ (1) $\Delta x \sim \lambda$