Chapter 14c Homework

Archimedes Principle & SHM of a floating object

Qu. 1 An object with a height $h$, mass, $M$, and uniform cross-sectional area, $A$, floats upright in a liquid with density, $\rho_{\text{liq}}$.

a) Calculate the vertical distance, $y_1$, from the surface of the liquid to the bottom of the floating object at equilibrium. (Ans: $y_1 = \rho_{\text{obj}} h / \rho_{\text{liq}}$).

b) A downward force with magnitude $F$ is applied to the top of the object. At the new equilibrium position, how much farther below the surface of the liquid is the bottom of the object than it was in part a) ?
(Ans: $y_2 - y_1 = -F/ A g \rho_{\text{liq}}$)

c) Your result in part b) shows that if the force, $F$, is suddenly removed, the object will oscillate up and down in SHM. Calculate the period of this motion in terms of the density of the liquid, $\rho_{\text{liq}}$, the mass of the object, $M$, and cross-sectional area, $A$, of the object. You can ignore the damping due to fluid friction. (Ans: $T = 2\pi \sqrt{(M / A g \rho_{\text{liq}})}$)