FP11

An ice cube of side a floats in a much larger glass of water.

a) (2 points) In terms of the densities of water (ρ_W) and ice (ρ_I), how far below the surface of the water is the bottom face of the cube?

The cube is now lifted distance y_0 above its equilibrium position. At time $t = 0$ the cube is released.

b) (1 point) Draw a free body diagram of the ice cube, valid at $t = 0$.

c) (4 points) Show that the vertical motion for $t > 0$ is simple harmonic. Find the frequency of the oscillations, and give a precise expression for the displacement of the cube from its equilibrium position as a function of time t. Assume that there is no damping of the oscillations.

d) (3 points) Eventually, the ice cube melts. Relative to the water level before the ice melts, where is the level after melting? Neglect any temperature variations of the density of ice and water. Justify your answer.