Oscillation with coercive force

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Solution: *a. The differential equation is,*

$$m\ddot{x} + \gamma\dot{x} + Dx = mg - V\rho_{was}g + F_0\cos\omega t \ .$$

b. The resting position of the mass in air is $x_l = \frac{mg}{D} \simeq 0.98\ m$ *and in water* $x_w = z + \frac{m - V\rho_{was}}{D}g \simeq 0.57\ m$. *This ansatz leads to the known differential equation,*

$$m\ddot{z} + \gamma\dot{z} + Dz = F_0\cos\omega t \ .$$

c. The resonance frequencies with and without friction are related by,

$$\omega_w = \sqrt{\omega_0^2 - \frac{\gamma^2}{2m^2}} \ .$$

Hence, $\gamma = m\sqrt{2\omega_0^2 - 2\omega_w^2} \simeq 154\ kg/s$.