Answer on Question #68765-Physics-Mechanics-Relativity

A test tube of mass 0.006 kg and of external dimension 0.02 m floated vertically in water by placing 0.01 kg of mercury at the bottom of the tube. The tube is depressed in a small amount then released. Determine the period of its oscillation

Solution

Total mass is

$$m = 0.006 + 0.01 = 0.016\ kg.$$

External radius is

$$r = \frac{0.02}{2} = 0.01\ m.$$

The volume of displaced water is

$$V = yA = y\pi r^2.$$

The upthrust on the tube due to the displaced water is

$$F = \rho g V = \rho g y \pi r^2.$$

For simple harmonic motion we have:

$$F = m\omega^2 y.$$

Thus,

$$\omega = \sqrt{\frac{\rho g \pi r^2}{m}}$$

The period is

$$T = \frac{2\pi}{\omega} = 2\pi\sqrt{\frac{m}{\rho g \pi r^2}} = 2\pi\sqrt{\frac{0.016}{(1000)(9.8)\pi(0.01)^2}} = 0.453\ s.$$