

NCERT-Analog: 11.14.18

EE:1205 Signals and Systems
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I. QUESTION:

A cylindrical piece of cork of density ρ , base area A and height h floats in a liquid of density ρ_1 . The cork is depressed slightly and then released. Show that the cork oscillates up and down simple harmonically with a period $T = 2\pi \sqrt{\frac{h\rho}{\rho_1 g}}$

Solution:

Parameter	Description
ρ_1	Density of Liquid
ρ	Density of cork
h	Height of cylindrical cork
x	Displacement
T	Time period
A	Base area of cylindrical cork
F_R	Restoring Force
a	Acceleration
ω	Angular Frequency
$m = \rho Ah$	Mass of cylindrical cork

TABLE 1
PARAMETER TABLE

by a depth x ,

$$\text{.....} \quad (1)$$

$$\Rightarrow a = -\frac{\rho_1 A g}{m} x \quad (2)$$

$$a = -\omega^2 x \quad (3)$$

Comparing ?? and ??,

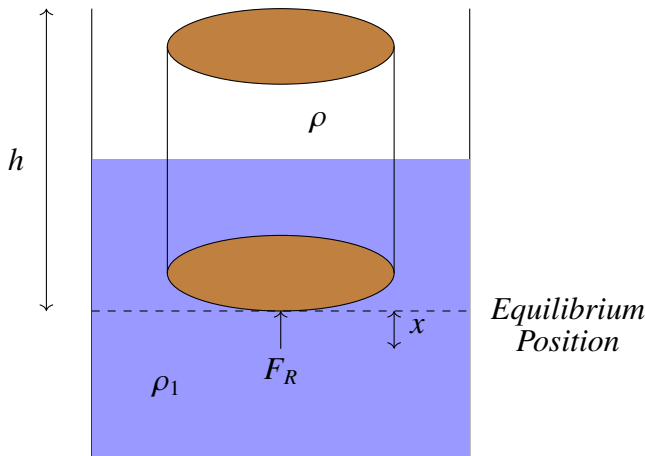
$$\omega^2 = \frac{\rho_1 A g}{m} = \frac{\rho_1 A g}{\rho A h} \quad (4)$$

$$\Rightarrow \omega = \sqrt{\frac{\rho_1 g}{\rho h}} \quad (5)$$

$$T = \frac{2\pi}{\omega} \quad (6)$$

$$\therefore T = 2\pi \sqrt{\frac{h\rho}{\rho_1 g}} \quad (7)$$

Hence Proved.



When we slightly displace cylindrical piece of cork