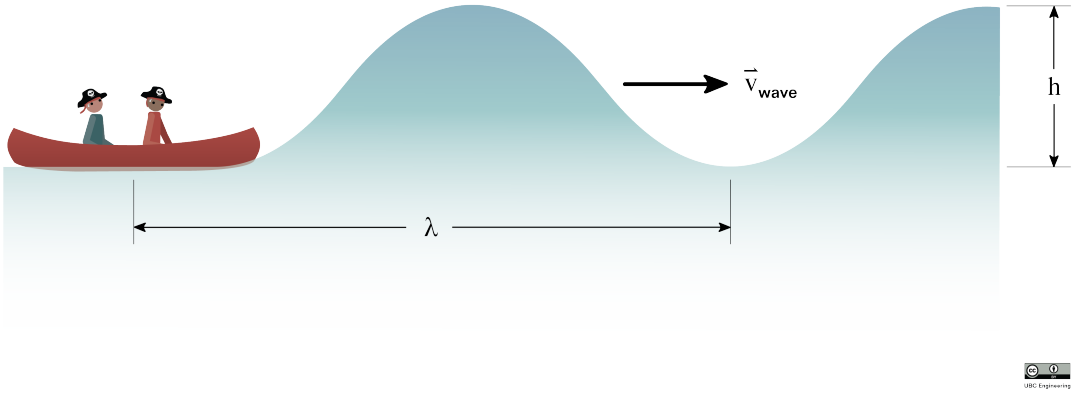
22-R-VIB-TW-45



A small toy boat sits anchored in the water, bobbing up and down with a natural frequency of $\omega_n = 5$ Hz. If the wind picks up, creating waves of wavelength $\lambda = 15$ cm, what speed, v_{wave}, will cause the vertical displacement of the boat to experience resonance?

Solution:
For resonance we require that $\omega_n = \omega_0$

$$\begin{aligned} \omega_n &= \omega_0 \\ v_w &= \lambda f \\ 2\pi v_w &= \lambda\omega_0 = \lambda\omega_n \\ v_w &= \frac{\lambda\omega_n}{2\pi} = \frac{(0.15)(5)}{2\pi} = 0.119 \text{ [m/s]} \end{aligned}$$