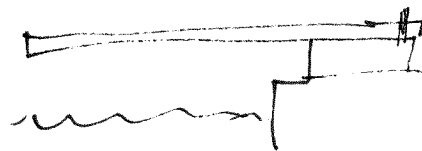


Chapter 15Problem 58

Board with nobody on it

$$f = 4.00 \text{ Hz}$$



$$m = 10.0 \text{ kg}$$

What is the frequency of simple harmonic motion with a 75.0 kg diver on the board?

Since we are dealing with simple harmonic motion

$$\omega = \sqrt{\frac{k}{m}} \quad \text{where } m \text{ is the effective mass of the board.}$$

$$f = \frac{\omega}{2\pi} \quad \text{Then } f = \frac{1}{2\pi} \sqrt{\frac{k}{m}}$$

Solving for the force constant we have

$$2\pi f = \sqrt{\frac{k}{m}} \rightarrow 4\pi^2 f^2 = \frac{k}{m} \rightarrow k = 4\pi^2 f^2 m$$

$$k = 4\pi^2 (4.00 \text{ Hz})^2 (10.0 \text{ kg}) = 6317 \text{ N/m}$$

By adding the diver, the effective mass is

$$m = 10.0 \text{ kg} + 75.0 \text{ kg} = 85.0 \text{ kg}$$

Now solve for the new frequency.

$$f = \frac{1}{2\pi} \sqrt{\frac{k}{m}} = \frac{1}{2\pi} \sqrt{\frac{(6317 \text{ N/m})}{(85.0 \text{ kg})}} = \boxed{1.37 \text{ Hz}}$$