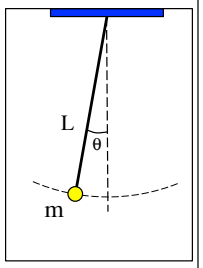
Problem 15.33

The simple pendulum system in an elevator is shown to the right.

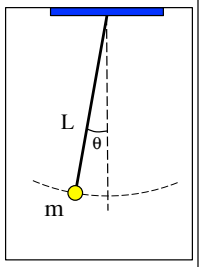


a.) If the elevator is accelerating *upward*, what is the pendulum's *period*?

The *period* of a pendulum is dependent upon the acceleration of the gravitational force acting on the body. If the elevator is accelerating upward, the effective acceleration changes and we get:

$$T = 2\pi\left(\frac{L}{g}\right)^{1/2}$$
$$= 2\pi\left(\frac{(5.00\text{ m})}{(9.80\text{ m/s}^2)+(5.00\text{ m/s}^2)}\right)^{1/2}$$
$$= 3.65\text{ s}$$

b.) If the elevator is accelerating *downward*, what is the pendulum's period?



Same story:

$$T = 2\pi\left(\frac{L}{g}\right)^{1/2}$$
$$= 2\pi\left(\frac{(5.00\text{ m})}{(9.80\text{ m/s}^2)-(5.00\text{ m/s}^2)}\right)^{1/2}$$
$$= 6.35\text{ s}$$

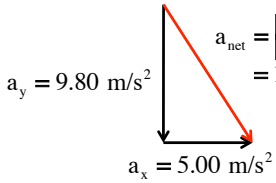
Note that this makes sense. With less acceleration acting, there will be less in the way of restoring torque and, as a consequence, should take more time to execute one cycle.

c.) If the elevator is accelerating perpendicular to the horizontal, what is the pendulum's period?

This is interesting. Because the accelerations are not along a line, we have to use vector analysis to determine the *net acceleration* acting on the bob.

c.) (con't.)

The net acceleration will be:



$$a_{net} = \left[(9.80\text{ m/s}^2)^2 + (5.00\text{ m/s}^2)^2\right]^{1/2}$$
$$= 11.0\text{ m/s}^2$$

Sooo . . .

$$T = 2\pi\left(\frac{L}{g}\right)^{1/2}$$
$$= 2\pi\left(\frac{(5.00\text{ m})}{(11.0\text{ m/s}^2)}\right)^{1/2}$$
$$= 4.24\text{ s}$$