24.7: Simple Harmonic Motion: Exercises

Exercises

1. The device pictured in this picture entertains infants while keeping them from wandering. The child bounces in a harness suspended from a doorframe by a spring. (a) If the spring stretches 0.250 m while supporting an 8.0-kg child, what is its force constant? (b) What is the time for one complete bounce of this child? (c) What is the child's maximum velocity if the amplitude of her bounce is 0.200 m?

2. A mass is placed on a frictionless, horizontal table. A spring (k = 100 N/m), which can be stretched or compressed, is placed on the table. A 5.00-kg mass is attached to one end of the spring, the other end is anchored to the wall. The equilibrium position is marked at zero. A student moves the mass out to x = 4.0 cm and releases it from rest. The mass oscillates in SHM. (a) Determine the equations of motion. (b) Find the position, velocity, and acceleration of the mass at time t = 3.00 s.

3. Assume that a pendulum used to drive a grandfather clock has a length L_0 = 1.00 m and a mass M at temperature T = 20.00°C. It can be modeled as a physical pendulum as a rod oscillating around one end. By what percentage will the period change if the temperature increases by 10°C? Assume the length of the rod changes linearly with temperature, where $L = L_0 (1 + \alpha\Delta T)$ and the rod is made of brass (α = 18 x 10−6 °C−1).*(Note: This effect was one of the reasons it took so long for navigators to reliably determine longitude at sea.)*