

30. The magnitude of the downhill component of the gravitational force acting on each ore car is

$$w_x = (10000 \text{ kg}) (9.8 \text{ m/s}^2) \sin \theta$$

where $\theta = 30^\circ$ (and it is important to have the calculator in degrees mode during this problem). We are told that a downhill pull of $3w_x$ causes the cable to stretch $x = 0.15 \text{ m}$. Since the cable is expected to obey Hooke's law, its spring constant is

$$k = \frac{3w_x}{x} = 9.8 \times 10^5 \text{ N/m} .$$

(a) Noting that the oscillating mass is that of *two* of the cars, we apply Eq. 16-12 (divided by 2π).

$$f = \frac{1}{2\pi} \sqrt{\frac{9.8 \times 10^5 \text{ N/m}}{20000 \text{ kg}}} = 1.1 \text{ Hz} .$$

(b) The difference between the equilibrium positions of the end of the cable when supporting two as opposed to three cars is

$$\Delta x = \frac{3w_x - 2w_x}{k} = 0.050 \text{ m} .$$