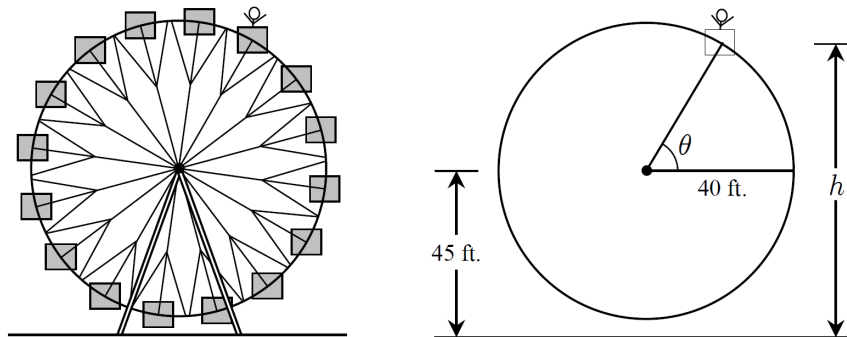


Homework 7

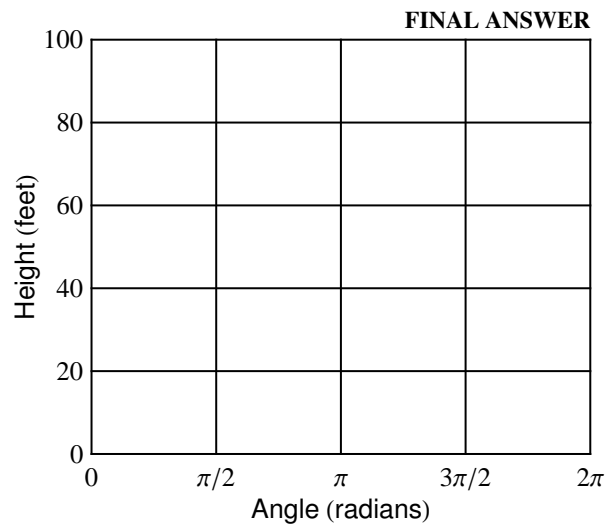
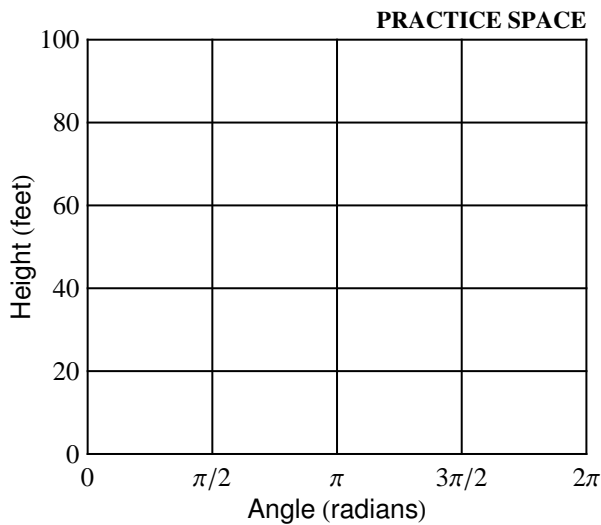
1. Little Joey is riding the Ferris wheel at the county fair:



The wheel has a radius of 40 feet, and the center of the wheel sits 45 feet above the ground. Let h be little Joey's height above the ground, and let θ be the angle shown in the picture above.

(a) Determine little Joey's height h above the ground for $\theta = 0^\circ, 90^\circ, 180^\circ,$ and 270° .

(b) Sketch a graph of h as a function of θ .



(c) Find a formula for h as a function of θ . Make sure that your formula agrees with your answers to parts (a) and (b).

(d) Use your answer to part (c) to find a formula for $\frac{dh}{dt}$ in terms of θ and $\frac{d\theta}{dt}$.

(e) Given that the Ferris wheel is rotating once every 5 minutes, find the value of $\frac{d\theta}{dt}$. Express your answer in radians per second.

(f) How quickly is little Joey ascending when $\theta = 0$?

2. The human ear is sensitive to an amazing range of sound levels. For example, the sound emitted by a jackhammer is equivalent in magnitude to about 100,000 human voices, while a single human voice is approximately as loud as 100,000 buzzing mosquitoes. In terms of power, a jackhammer emits about 1 watt of sonic energy, a human voice emits about 0.00001 watts, and a buzzing mosquito emits about 0.0000000001 (or 10^{-10}) watts.

For this reason, the “loudness” of a sound is usually described in terms of *decibels*, which are a logarithmic unit. The decibel level L of a sound is related to the power P according to the formula

$$L = 10 \log\left(\frac{P}{P_0}\right)$$

where $P_0 = 10^{-12}$ watts. (The constant P_0 represents the softest sound audible to human ears.)

- (a) Based on the information above, find the decibel levels of the sounds emitted by a jackhammer, a human voice, and a buzzing mosquito.

- (b) What is the decibel level of a sound having power P_0 ?

(c) Make a table showing the decibel levels for sounds having powers of 0.00001 watts, 0.0001 watts, 0.001 watts, 0.01 watts, 0.1 watts, 1 watt, 10 watts, and 100 watts.

(d) If the power of a sound is doubled (say, by having two jackhammers instead of one), how much does the decibel level increase?

(e) The band Disaster Area wants to make an awesome 160 decibels of sound at their next rock concert. (They want to be able to brag that they are “as loud as a jet engine”.) Unfortunately, no legally available speaker can emit more than 145 decibels of sound. How many speakers will they need?