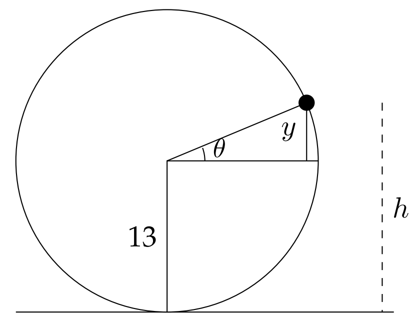
Section 3.9: Related Rates – Day 2
Section 3.10 Tangent Line Approximation Intro

1. A Ferris wheel with a radius of 13 meters is rotating at a rate of one revolution every three minutes. How fast is a rider rising when her seat is 18 meters above the ground? (Assume the wheel is tangent to the ground at the bottom.) *Hint: Label useful things in the diagram sketch.*



(a) In terms of the labels given in the picture and calculus-type language:

- What do we Know? (Hint: how many radians in one revolution?)

- What do we Want?

(b) Determine an equation that relates the variables in your Want and Know.

(c) Solve the related rates problem.
(Hint: use what you know about right-triangle trigonometry! You don't actually need to know the angle from horizontal she's at when she's 18 feet above the ground.)

2. Consider the function $f(x) = x^3$.

(a) At the point $x = 2$, what is $f(x)$? $f(2) =$ ______

(b) Let $L(x)$ be the function that is the tangent line to $f(x)$ at $x = 2$. This tangent line is sometimes called the *linearization* of $f(x)$ at $x = 2$. Finish the equation (you will need to show some work).

$L(x) =$ ______________________________.

(c) Observe that the value $x = 2.1 = 2 + \frac{1}{10}$ is very close to $x = 2$. Evaluate $L(x)$ at $x = 2.1$. Do not use a calculator until your very last step (that is you can get a decimal approximation of a fraction, but you should compute the fraction by hand).

$L(2.1)$ as a fraction __________ $L(2.1)$ as a decimal approximation. __________

(d) Use a calculator or a computer to evaluate $f(2.1)$. $f(2.1) =$ __________

(e) What is the error if you use $L(2.1)$ to approximate $f(2.1)$? (That is, what is the difference between the two quantities?) What is the percent error, calculated as (approx value - actual value)/(actual value)?

(f) Draw a rough sketch of $f(x)$ and $L(x)$, and use the picture and your computations to explain, in a sentence or two, why using $L(2.1)$ to approximate the cube of 2.1 is a reasonable thing to do.