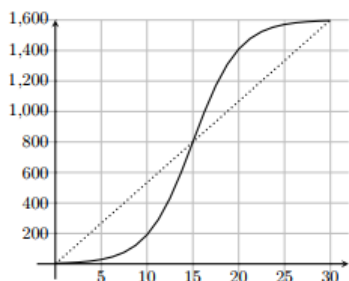
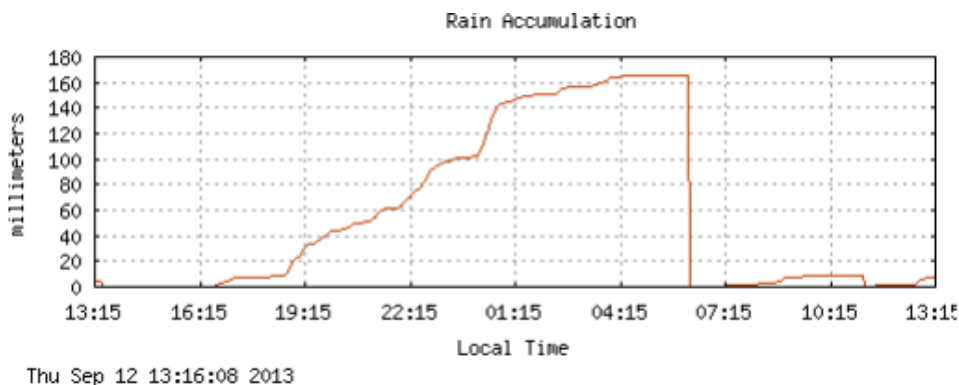


1. The solid curve in the graph below gives position s of a car along a straight roadway (measured in meters), as a function of time t (measured in seconds).



- (a) Find the slope of the dotted line in the graph above. Explain (including units), what this slope represents.
- (b) Estimate the instantaneous velocity at $t = 15$. Include units. Draw and label the line you used to estimate this.
2. Below is a plot of the rainfall accumulation from the 2013 Boulder flood taken from the Foothills Lab Weather Station. The rainfall is measured in millimeters.



- (a) Use the graph to estimate the average rainfall rate between 4:15 pm (marked as 16:15 on the graph) and 4:15 am the next morning (marked as 04:15 on the graph). Show all work and include units. Draw the line that you are finding the slope of.
- (b) When is it raining hardest? Explain how you know.
- (c) Estimate the rainfall rate at 22:15 (include units). Draw the line that you are finding the slope of.
- (d) What does the graph indicate is happening to the rainfall during the hour after 4:15 am?
- (e) Explain the precipitous drop between 04:15 and 07:15.

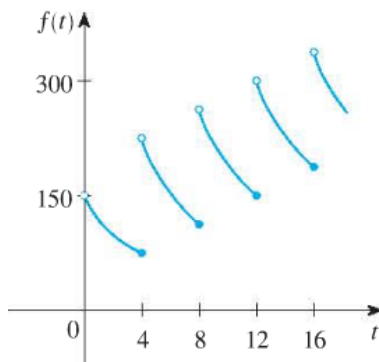
3. The point $P(0.5, 0)$ lies on the curve $y = \cos(\pi x)$.
- (a) If Q is the point $(x, \cos(\pi x))$, use your calculator to find the slope of the secant line PQ (correct to six decimal places) for the following values of x :
- 0
 - 0.4
 - 0.49
 - 0.499
 - 1
 - 0.6
 - 0.51
 - 0.501
- (b) Using the results of part (a), guess the value of the slope of the tangent line to the curve at $P(0.5, 0)$.
- (c) Using the slope from part (b), find an equation of the tangent line to the curve at $P(0.5, 0)$.
- (d) Sketch the curve, two of the secant lines, and the tangent line.
4. Sketch the graph of the function and use it to determine the value of a for which $\lim_{x \rightarrow a} f(x)$ exists.

$$f(x) = \begin{cases} 1 + \sin(x) & \text{if } x < 0 \\ \cos(x) & \text{if } 0 \leq x \leq \pi \\ \sin(x) & \text{if } x > \pi \end{cases}$$

5. A patient receives a 150-mg injection of a drug every 4 hours. The graph shows the amount $f(t)$ of the drug in the bloodstream after t hours. Find

$$\lim_{t \rightarrow 12^-} f(t) \text{ and } \lim_{t \rightarrow 12^+} f(t)$$

and explain the significance of these one-sided limits.



6. Sketch the graph of an example of a function f that satisfies all of the given conditions.

- $\lim_{x \rightarrow 0} f(x) = 1$
- $\lim_{x \rightarrow 3^-} f(x) = -2$
- $\lim_{x \rightarrow 3^+} f(x) = 2$
- $f(0) = -1$
- $f(3) = 1$

Optional Challenge Problem

Complete 5g from Project 1