Math 1110: In-Class Problems for 3.6

Problem 1  Evaluate the following expressions.

(a) $\frac{dy}{dx}$ for $y = x^{\sqrt{x}}$ with $x > 0$

(b) $\frac{d}{dx} \left[ \sin \left( \pi \left( x + \frac{1}{2} \right) \right) \right]_{x=0}$

(c) $\frac{d}{dx} \left( \sin^2 \left( \sqrt{x^2 + 1} \right) \right)$

Problem 2

A bus will hold 60 people. The number $x$ of people per trip who use the bus is related to the fare charged ($p$ dollars) by the relationship $p = [3 - (x/40)]^2$. Write an expression for the total revenue $r(x)$ per trip received by the bus company. What number of people per trip will make the marginal revenue $dr/dx$ equal to zero? What is the corresponding fare? (This fare is the one that maximizes the revenue.)
Problem 3

(a) What is the derivative of \( \sin(\sin x) \)

(b) What is the derivative of \( \sin(\sin(\sin x)) \)

(c) Now let \( g(x) \) be the compositions of \( \sin(x) \) with itself one thousand times. Generalize from your results in parts (a) and (b) to compute \( g'(0) \). Explain your intuition (i.e., your reasoning about how you solved the problem) in a sentence or two.

Problem 4 The position at time \( t \geq 0 \) or a particle moving along a coordinate line is \( s = 10 \cos(t + \pi/4) \).

(a) What is the particle’s starting position \( (t = 0) \)?

(b) What are the points farthest to the left and right of the origin reached by the particle?

(c) Find the particle’s velocity and acceleration at the points in part (b).

(d) When does the particle first reach the origin? What are it’s velocity, speed, and acceleration then?