Worksheet # 2

(Due Friday, August 23)

Problem 1. Calculate the derivatives of the following curves. There is no need to simplify.

a)

$$y = \frac{x^2 + 3x - 1}{1/x + 2}$$

b)

$$y = \sqrt[4]{x^3}(x^3 + 2)$$

c)

$$y = \frac{(x^2 + 1)(x^2 + 4x)}{\sqrt{x} + 1}$$

d)

$$y = \sqrt[5]{x}(x^5 + 5x) - x$$

Problem 2. Determine the equation of the tangent line of the following functions at the point $x = 2$:

a)

$$\frac{x - 1}{x^2 + 3x + 5}$$

b)

$$\frac{x}{(3x^2 + 5x)(x^4 + 2x)}$$

Problem 3. Is the following function differentiable at $x = 3$?

$$f(x) = \begin{cases} 3x^2 + 2x + 12, x \leq 3 \\ 5x^2, x > 3 \end{cases}$$

Problem 4. Solve the following equations for $\theta \in [0, 2\pi)$

$$\sin(2\theta) = \sin(\theta)$$

$$-\cos(\theta) = 2cos^2(\theta) - 1$$

Problem 5. Suppose we have a maize plantation that is being attacked by the maize weevil (*Sitophilus zeamais*), which feeds on the individual grains of corn. A team of agronomists analysed during two years the presence of this pest in the plantation and were able to come up with the following model that describes the density of maize weevil in the plantation during each of the months.

$$N(t) = 50 + 40\sin\left(\frac{\pi}{6}t\right)$$

where N is the number of maize weevil bugs per maize plant and t is the time in months.

a) Based on this model, what is the maximum number of maize weevil bugs that can be found in a single plant? What is the minimum?

b) How many months will it take for the weevil bug population to be the same size as the first measure (time $t = 0$)?

c) One of the recommendations of the agronomists is that you should spray pesticide three months before the maximum number of maize weevils appears. If we are at the start of the third year (i.e. $t = 36$), in how many months should you start spraying the pesticide?