Math 111 – Fall 2014
Examination 2

Please complete the following problems. All work must be shown in order to receive full credit. Answers without explanation will receive no credit. The use of books, notes, calculators, or any other external sources of information is not allowed during this examination.

1. (15 pts.) Find \( y'(x) \) for the following:
   
   a. \( y = \sqrt{4x^2 + \sec^2(3x)} \)
   
   b. \( y = \frac{4^x}{\log_4(x)} \)

   c. \( y = \cos^2(\sin^2(5x)) \)

2. (15 pts.) Find \( y'(x) \) for the following:

   a. \( y = x\arctan(x^2) \)

   b. \( y = \frac{1}{\arcsin(2x)} + \cot(2x) \)

   c. \( y = \frac{x^\pi + \pi^x}{\pi^x + x^\pi} \)

3. (10 pts.) Find \( y'(x) \) for the following:

   a. \( y = \ln(2\tan^2(3x)) \)

   b. \( y = x\sqrt{x} \)

4. (10 pts.) Find \( y'(x) \) for the following:

   a. \( y = \ln\left(\frac{x^3}{\sqrt{x^3 + 7}}\right) \)

   b. \( y = e^x + e^y + e^{xy} + e \)

5. (8 pts.) Find \( \frac{d^{250}y}{dx^{250}} \) for \( y = \ln(x) \).

6. (16 pts.) This question is about tangents and normals to curves.

   a. Find the tangent line to \( y = \tan(x)\sec(x) \) at \( x = \frac{\pi}{3} \).

   b. Find the normal line to \( y = \sqrt{x - 1} - \frac{1}{x} \) at \( x = 2 \).

7. (12 pts.) Oil spilled from a ruptured tanker spreads in a circular pattern whose area increases at a constant rate of 6 km\(^2\)/hr. How fast is the radius of the spill increasing when the area is \( 9\pi \) km\(^2\)?
8. (14 pts.) The figure below shows the velocity $v$ of a particle moving on a horizontal coordinate line.

![Velocity Graph](image)

**a.** When does the particle move forward?
**b.** When is the particle not moving?
**c.** When does the particle move backward?
**d.** When is the particle’s acceleration positive?
**e.** When is the particle’s acceleration zero?
**f.** When is the particle’s acceleration negative?
**g.** When does the particle move at its greatest speed?