MATH 21, FALL, 2009, EXAM # 2 VER. 2.0

Name:_____.

ID #_____.

Section #_____.

Instructor_____.

TA_____.

Instructions: All cellphones, calculators, computers, translating devices, and music players must be turned off.

Do all work on the test paper. ***Show all work***. You may receive no credit, even for a correct answer, if no work is shown. You may use the back if you need extra space. ***Do not*** simplify your answers, unless you are explicitly instructed to do so. This does not apply to evaluation of elementary functions at standard values or functional expressions, so that you **would** be expected to simplify $\sin(\pi/6)$ to $\frac{1}{2}$, for example. Do not write answers as decimal approximations; if $\sqrt{2}$ is the answer, leave it that way. *Except where explicitly stated otherwise, you can use the derivative rules and limit rules learned in class.*

You may **not** use a calculator, computer, the assistance of any other students, any notes, crib sheets, or texts during this exam. All cellphones must be switched off and out of sight. No music players, translators, or other electronic devices allowed

You have 60 minutes to complete this exam.

Do not turn to the next page until you are instructed to do so.

Grading:

1._____/15   5._____/10

2._____/15   6._____/10

                               6._____/10

3._____/10   7._____/20

4._____/10

Total._____/100

(1) Find the indicated derivatives. *(5 points/part)*
  (a) $(\cosh(2x+3))' =$
  (b) $\left(x^2 \ln(x)\right)' =$
  (c) $\left(\sin^{-1}(x^2)\right)' =$

(2) Find the following limits. Justify each step. *(5 points/part)*
  (a) $\lim\limits_{x \to 0} \dfrac{\tan(2x)}{\sinh(5x)} =$
  (b) $\lim\limits_{x \to \infty} x \left(e^{1/x} - 1\right) =$
  (c) $\lim\limits_{x \to 0} \dfrac{\sin(x) - x}{x^3} =$

(3) Find the points on the curve
$$x^2 + 2xy + 4y^2 = 3$$
where the curve is horizontal, that is, where $dy/dx = 0$. *(10 points)*

(4) During the early stages of a disease outbreak, the rate of increase of the number of infected people in a community is proportional to the number who are already infected. If, three weeks ago, there were 30 people on Lehigh's campus infected with the H1N1 flu, and, two weeks ago there were 100, how many people are there now who are infected with the H1N1 flu? *(10 points)*

(5) Officer Egbert is traveling due North on Route 1, moving at 60 m.p.h. He spies a motorist driving East on Route 2. When he is 0.4 miles South of the intersection with Route 2 (which heads due East and West, at a right angle to Route 1), the motorist is 0.3 miles past the intersection (East of the intersection) with Route 1, and Officer Egbert trains his radar gun on the car, which tells him that the rate of change of the distance between his squad car and the motorist is exactly 0. How fast is the motorist driving? *(10 points)*

(6)
  (a) State the Mean Value Theorem. *(5 points)*
  (b) Use the Mean Value Theorem to show that the function
$$f(x) := x^3 + 4x - 5$$
  only has a root at $x = 1$, and nowhere else. *(5 points)*

(7) Use linear approximation to find an approximate value of $(25)^{1/3}$, the cube root of 25. *(10 points)*

(8) Let $f(x) = \dfrac{x^2 - 1}{x^2 + 3}$, then
  (a) Find the domain of $f(x)$.
  (b) Find all x- and y- intercepts.
  (c) Find any horizontal or vertical asymptotes.
  (d) Find where the curve is increasing and decreasing, and find any critical points.
  (e) Find on what regions the curve is concave up, and where it is concave down, and find any points of inflection.
  (f) Then, sketch the curve, showing each of these features. *(20 points)*