# Math 111 Exam #2
## October 25, 2017

**Time:** 1 hour and 25 minutes
**Instructions:** Show all work for full credit. No outside materials or calculators allowed.
**Extra Space:** Use the backs of each sheet for extra space. Clearly label when doing so.

**Name**: _____

**ID #**: _____

**Instructor/Section:** _____

*"I pledge by my honor that I have abided by the NJIT Academic Integrity Code."*

_____ (Signature)

| Problem | Value | Score |
|---|---|---|
| 1 | 15 pts. | |
| 2 | 15 pts. | |
| 3 | 12 pts. | |
| 4 | 12 pts. | |
| 5 | 12 pts. | |
| 6 | 12 pts. | |
| 7 | 12 pts. | |
| 8 | 10 pts. | |
| **TOTAL** | 100 | |

**1.** Consider the curve $y = f(x) := \frac{4}{x} + \frac{x}{2}$.

(a) Find the tangent line to the curve at (4,3). **(5 pts.)**

(b) Find the normal line to the curve at (4,3). **(5 pts.)**

(c) Find all points where the tangent line to the curve is horizontal. **(5 pts.)**

**2.** Let a body move along the *s*-axis with its position given as $s(t) = t^3 - 6t^2 + 9t$ in meters, with *t* in seconds. Find each of the following **(5 pts. each)**:

(a) The velocity *v* and acceleration *a*. (b) *a* when $v = 0$. (c) The speed when $a = 0$.

**3.** Find the derivatives $dy/dx$ of each of the following **(6 pts. each)**:

(a) $y = 2e^{-x} + xe^{3x}$ (b) $y = \dfrac{3x + \tan 2x}{x \sec x}$

**4.** Find the derivatives $dy/dx$ for each of the following **(6 pts. each)**:

(a) $(3xy+7)^2 = 6y$ (b) $y = (\sin x)^x$

**5.** Show all work in obtaining the answers to each of the following **(6 pts. each)**:

(a) Suppose the function $y = f(x)$ is differentiable in an interval containing $x = 3$ and $f(3) = 8$ and $f'(3) = 2/5,$ so that the function has a differentiable inverse $f^{-1}$ in an interval containing $y = 8$. What is the derivative of the inverse function at $y = 8$?

(b) Find the derivative of $y = \sqrt{x}\arcsin\left(\sqrt{x}\right) = \sqrt{x}\sin^{-1}\left(\sqrt{x}\right).$

**6.** Find the derivatives of each of the following functions **(6 pts. each)**:

(a) $y = \cot^{-1}(1+3t)^{1/2} = \operatorname{arccot}(1+3t)^{1/2}$ (b) $y = \ln[(\sin\theta\cos\theta)^{1/2} / (1+2\ln\theta)]$.

**7.** A 13 ft. ladder leans against a vertical wall, with its base sliding along a horizontal floor. When the base is 5 ft. from the wall it is moving away from the wall at a rate of 2 ft./sec. along the floor. How fast is the ladder sliding down the wall at this instant? **(12 pts.)**

**8.** Sand is being poured onto a conical pile at the rate of 3 cubic meters per second. The sand pile is a right circular cone (with circular base on the ground) of height $h$ and diameter $2r$, with the height equal to twice the base diameter. At what rate is the height increasing when the pile is 6 meters high? (Recall that the volume of the cone is $V = (\pi/3)r^2h$) **(10 pts.)**