Math11 Fall 2009 **Exam #3 Friday December 4, 2009** Professor D. Benedetto

Please carefully write all of your answers in your **Blue Book**. Justify all of your answers. There are **No Calculators** allowed.

1. (5 Points) Compute $\frac{d}{dx}\left(\int_{3x}^{2} \cos t \, dt\right)$.

2. (30 Points) Compute each of the following integrals.

(a) $\int \frac{1}{x^2}\sqrt{1-\frac{1}{x}}\, dx$ **(b)** $\int \frac{we^{w^2}}{(17+e^{w^2})^3}\, dw$

(c) $\int_0^{\pi} \sin^2\left(\frac{x}{6}\right)\cos\left(\frac{x}{6}\right)\, dx$ **(d)** $\int_{-3}^{3} x|x|\, dx$

(e) $\int (e^{3x}+e^{-7x})^2\, dx$ **(f)** $\int x(x+1)^{14}\, dx$

3. (10 Points) Find all local maximum and minimum value(s) of the function $f(x) = x^4e^{-x}$.

4. (15 Points) A toolshed with a square base and a flat roof is to have volume of 800 cubic feet. If the floor costs \$6 per square foot, the roof \$2 per square foot, and the sides \$5 per square foot, determine the dimensions of the most economical shed. Remember to state the domain (or common-sense-bounds) of the function you are computing extreme values for.

5. (10 Points) Compute the area bounded by $y = 4 - x^2$, $y = x + 2$, $x = -3$, and $x = 0$. Draw a picture of the region(s). Do not worry about simplifying your fractions in the final answer.

6. (20 Points) Compute $\int_0^4 x - 1\, dx$ using each of the following three different methods:

(a) using Area interpretations of the definite integral,
(b) Fundamental Theorem of Calculus,
(c) Riemann Sums and the limit definition of the definite integral.

7. (10 Points) Jack throws a baseball straight downward from the top of a tall building. The initial speed of the ball is 25 feet per second. It hits the ground with a speed of 153 feet per second. How tall is the building?

TURN PAPER OVER FOR THE BONUS PROBLEMS PLEASE!!

REMEMBER: ALL OF YOUR WORK GOES IN THE BLUE ANSWER BOOK

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BONUS PROBLEMS: THESE ARE OPTIONAL!

Feel free to attempt either of the following two bonus problems, but ONLY if you are completely done with the original part of the exam, problems 1-7.

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Bonus 1: Suppose f is continuous on $[-a, a]$, PROVE each of the following two statements:

(a). If f is even, then $\int_{-a}^{a} f(x)\ dx = 2\int_{0}^{a} f(x)\ dx$

(b). If f is odd, then $\int_{-a}^{a} f(x)\ dx = 0$

Bonus 2: Consider a cone such that the height is 6 inches high and its base has diameter 6 in. Inside this cone we inscribe a cylinder whose base lies on the base of the cone and whose top intersects the cone in a circle. What is the maximum volume of the cylinder? Remember to state the domain (or common-sense-bounds) of the function you are computing extreme values for.