MAT 202 Writing Project #1 Name _____
100 Points Covers Parts of Chapters 5 and 6

This Project is due Thursday, February 3rd.

**If you submit this work in hard-copy form, staple this page, with your name on it, as a cover sheet for your project.** Write on only one side of each page. I will not award (or deduct) points for anything on the backs of pages. The following instructions apply equally to traditional paper-and-pencil submissions and electronic uploads directly to Assignments on D2L Course Shell.

For early feedback, make a black-and-white, multi-page PDF and upload it to the D2L drop-box for Writing Project #1. Otherwise, mail your neat, clear, black-and-white, one-side-of-each-page work to me at:

Harry Mills
EDBH 134K
Aims Community College
5401 West 20th Street
Greeley, CO 80634

Alternatively, you may just slide it under my office door in Ed Beaty by or before the deadline: EDBH 134K

**Mail, E-Mail, or drop off your Writing Project 2 by or before Thursday, February 3rd. Late work accepted as late as Monday, February 7th, at a 10% discount.**

1. Do your own work. Show all your work
2. Use plain white paper (or RocketBook) without lines (8 ½ x 11-inch A4 copier paper works just fine). 20% deduction for ruled paper.
3. Staple or paper-clip the top left corner of your project, if you submit hard copy. Do NOT staple over problem numbers or any of your work. If I can't see it, you didn't do it.
4. Leave margins. "MAT 202" in big letters in top left corner of every page solves most problems with margins.
5. Write DARK. I don't mind if you use pen. Just strike through mistakes. Pencil's OK, but make sure you're getting it DARK against a white background. Do not use red ink.
6. Leave ROOM between problems and between steps on your work. I have bad eyes, and I need to make comments on your work, so being stingy with space and paper is a mistake on Writing Projects.
7. **Don't do work in 2 columns!**

Begin Exercises:

1. Use the method of cylindrical shells to find the volume generated by rotating the region bounded by the given curves about the specified axis. Give exact answers in terms of $\pi$, for instance $V = \frac{11\pi}{7}$.

   a. (5 pts) $y = x^3,\ y = 8,\ x = 0;$ about $x = 3$.

   b. (5 pts) $x = 2y^2,\ x = y^2 + 1;$ about $y = -2$.

2. Suppose that 2 J of work is needed to stretch a spring from its natural length of 30 cm to a length of 42 cm.

   a. (5 pts) How much work is needed to stretch the spring from 35 cm to 40 cm? WARNING: Make sure you're using the correct units, unlike your professor in class, who seemed to think centimeters and meters were the same thing! (This all has to be done in meters!)

   b. (5 pts) How far beyond its natural length will a force of 30 N keep the spring stretched?

3. (5 pts) Prove the Mean Value Theorem for Integrals by applying the Mean Value Theorem for derivatives to the function $F(x)=\int_a^x f(t)\,dt$. Recall MVT for Integrals:

**The Mean Value Theorem for Integrals** If $f$ is continuous on $[a, b]$, then there exists a number $c$ in $[a, b]$ such that

$$f(c) = f_{\text{ave}} = \frac{1}{b-a}\int_a^b f(x)\,dx$$

that is,

$$\int_a^b f(x)\,dx = f(c)(b-a)$$

4. The function $f(x)=x^2+5x+11$ is 1-to-1 on the restricted domain $D=\left[-\frac{5}{2},\infty\right)$.

   a. (5 pts) Find the inverse function $f^{-1}(x)$. State its domain and range.

   b. (5 pts) Find $\left(f^{-1}\right)'(5)$, directly, by differentiating your answer for part a.

   c. (5 pts) Find $\left(f^{-1}\right)'(5)$ by applying a theorem regarding derivatives of inverse functions.

5. Find the derivative with respect to $x$. All "-1" powers refer to function inverses, not reciprocals.

   a. (5 pts) $y=7\cdot 5^{x^2-3x}$

   b. (5 pts) $y=\ln\left(\frac{\sqrt[5]{x^2-3x}}{(3x^5+5x)^3}\right)$

   c. (5 pts) $y=\log_5\left(x^2-3x\right)$

   d. (5 pts) $y=[\cos(x)]^{x^2-3x}$

   e. (5 pts) $y=\sin(x)\cdot\cosh^{-1}\left(5x^3-7x\right)$

6. Evaluate the integrals

   a. (5 pts) $\int \sin(x)\cdot e^{\cos(x)}\,dx$

   b. (5 pts) $\int \frac{dx}{\sqrt{x^2+25}}$

7. Simplify the following.

   a. (5 pts) $\sec\left(\cot^{-1}\left(\sqrt{9-x^2}\right)\right)$

   b. (5 pts) $\cot^{-1}\left(\cot\left(\frac{7\pi}{6}\right)\right)$. I *think* you're OK on the domains, after class talk.

8. (5 pts) The half-life of Millsium is 75 years. How old is a Mills skeleton from a burial mound if there is 17% of its natural radioactive Millsium remaining?

9. Evaluate the following limits:

   a. (5 pts) $\lim_{x\to\infty}\left(x^{1/x}\right)$

b. (5 pts) $\lim_{x\to 5} \dfrac{x^2-7x+10}{x^2-2x-15}$

c. (5 pts) $\lim_{x\to 0} \dfrac{e^x-1-x}{x^2}$