MATH 141

MIDTERM EXAM II

April 3rd, 2000

- **No calculators are allowed on this exam.**

- **Please show all your work. You may not receive full credit for a correct answer if there is no work shown.**

- **Please put your final answer in the boxes when provided**

1. **(13pts)** Use the **definition of the derivative** (i.e. as the limit of difference quotients) to find the derivative of $f(x) = (3x + 1)^2$ at $x = 1$, that is $f'(1)$.

2. **(12pts)**

   (a) If $y = \dfrac{3x^2 + 1}{\sqrt{x}}$, find $\dfrac{dy}{dx}$.

   (b) If $s = \dfrac{t^2}{t + 3}$, find $\dfrac{ds}{dt}$.

   (c) If $y = 3^x$, find $y'(x)$.

3. **(9pts)** Suppose you have the following information about the functions f and g:

$f(2) = 2$	$g(2) = 8$
$f'(2) = 3$	$g'(2) = -1$
$f(6) = 2$	$g(6) = 2$
$f'(6) = -\frac{1}{2}$	$g'(6) = -4$

Use this information to find:

(a) $(fg)'(6)$

(b) $(f - g)'(2)$

(c) $(f \circ g)'(6)$

4. **(16pts)** Suppose the position of a car along a certain road is given by

$$s(t) = \frac{2}{3}t^3 - 6t^2 + 16t$$

where time is measured in seconds.

(a) Find $v(t)$, the velocity of the car as a function of t.

(b) Find $a(t)$, the acceleration of the car as a function of t.

(c) When is the first time the car is at rest?

(d) After 3.5 seconds, is the car speeding up or slowing down? Justify your answer.

5. **(20pts)** For each of the following, find $\frac{dy}{dx}$:

(a) $y = x^2 \sin x$

(b) $\dfrac{\sin x}{\cos x}$

(c) $y = e^{\sqrt{2}}$

(d) $y = \cos(xe^x)$

6. **(5pts)** Find the limits:

$$\lim_{x \to 0} \frac{2\sin(3x)}{x}$$

7. **(10pts)** What is the equation of the tangent line to the curve $y = \dfrac{1}{1+x^2}$ at the point on the curve when $x = 1$?

8. **(15pts)**

   (a) Find the second derivative of $y = (x^2 + 2)^3$ at $x = 0$.

   (b) If $\sin y = x$, find $\dfrac{dy}{dx}$