

**Math 1A—Calculus, Fall 2010—Haiman**  
**Midterm Exam 2**

1. (15 pts) Differentiate

$$f(x) = \frac{Ax + B}{Cx + D},$$

where  $A, B, C, D$  are constants. Simplify your answer.

2. (15 pts) Differentiate  $x^{(\tan^{-1} x)}$ .

3. (15 pts) The pressure,  $P$ , and volume,  $V$ , of gas in a piston are related by  $PV = 500 \text{ N cm}$  (N cm stands for Newton centimeters). What is the rate of change of  $P$  when  $V = 20 \text{ cm}^3$  and  $dV/dt = -5 \text{ cm}^3 / \text{s}$ ?

4. (15 pts) Find the absolute maximum and minimum values of the function  $f(x) = (\ln x)/x$  on the interval  $[1, 5]$ . You may find it useful to know that  $(\ln 5)/5 \approx 0.322$  and  $1/e \approx 0.368$ .

5. (a) (10 pts) Find the linear approximation to the function  $f(x) = x^3$  at  $a = 1$ .

(b) (5 pts) Find the estimated value of  $(1.05)^3$  given by the linear approximation in part (a). Is the estimated value larger than the actual value, or smaller?

6. For the function

$$f(x) = e^{-x^2/2}$$

(a) (10 pts) Find the intervals on which  $f$  is increasing or decreasing.

(b) (10 pts) Find the intervals on which the graph of  $f$  is concave upwards or concave downwards.

(c) (5 pts) Find the inflection points on the graph of  $f$ .