

1. (4pt.)

- (a) State the Mean Value Theorem.  
(b) Use the Mean Value Theorem to prove that

$$|\tan x - \tan y| \geq |x - y|$$

for all  $x, y \in (-\pi/2, \pi/2)$

2. (9 pt.) Let  $f(x) = x^3 + \frac{3}{x}$

- (a) Find the intervals on which  $f(x)$  is increasing or decreasing, and find local extrema, if any.  
(b) Find intervals on which the graph of  $f(x)$  is concave upward or downward, and find the points of inflection, if any.  
(c) Find vertical and horizontal asymptotes for the graph of  $f(x)$ , if any.  
(d) Sketch the graph of  $f(x)$ .

3. (4 pt.) Find the area of the largest rectangle that can be inscribed in a circle with radius 10.

4. (4 pt.) Compute the following integrals

$$(a) \int \sin 2x \sec^4 2x \, dx, \quad (b) \int (\cos x + 2)^2 \, dx.$$

5. (4 pt.) Compute

$$(a) \int_0^3 (x + \sqrt{9 - x^2}) \, dx \quad (b) \int_{-4}^0 |x + 3| \, dx.$$