

Answer all of the following questions. Each question counts 10 points.

Calculators are not allowed

1. (a) Let  $f$  be given by:

$$f(x) = \begin{cases} \frac{5}{2-x} + B & , \text{if } x < 0 \\ A & , \text{if } x = 0 \\ \frac{1 - \cos x}{x^2} & , \text{if } x > 0 \end{cases}$$

Find the values of  $A$  and  $B$  so that  $f$  is continuous for every  $x \in \mathbb{R}$ .

(b) If  $f(x) = \sqrt{x-2}$ ; for  $x > 2$ . Use the definition of the derivative to find  $f'(6)$ .

2. (a) Find the derivative of the function

$$f(x) = \sin^4(1 + \tan x)^2$$

(b) Find the horizontal and the vertical asymptotes (if any) for the function

$$f(x) = \frac{|x+1|}{x-5}$$

3. (a) Find an equation for the normal line (lines) to the graph of

$$xy + \tan x + y^2 = 9, \text{ at the points on the graph where } x = 0.$$

(b) Use differentials to find an approximate value for  $\sqrt{(2.99)^3 - 2}$ .

4. (a) Gas is escaping from a spherical balloon at the rate of  $2 \text{ ft}^3/\text{min}$ . At what rate is the surface area decreasing when the radius is 1 ft.

(b) State the Mean Value Theorem and show that:

$$|\sin(2b) - \sin(2a)| \leq 2|b - a|, \text{ for any real numbers } a \text{ and } b.$$

Good Luck