

Answer all questions. Calculators and Mobile Phones are not allowed.

Q1. [(6 + 6)pts.] Evaluate the following limits, if they exist,

$$(a) \lim_{x \rightarrow 2} (x-2) \sqrt{1 + \frac{1}{(x-2)^2}} \quad (b) \lim_{x \rightarrow 0} \frac{x}{2x \cos x - \sin^2 x}$$

Q2. [(6 + 7)pts.]

(a) Use the definition of the derivative to find  $f'(x)$ , where

$$f(x) = x^2 + \sin x.$$

(b) Find the vertical and horizontal asymptotes (if any), for the graph of

$$f(x) = \frac{4x^2|x-2|}{x^3-8}$$

Q3. [(6 + 7)pts.]

(a) Find  $\frac{dy}{dx}$ , where  $y(x) = \sin^3\left(\frac{x^2+1}{x+1}\right) + \sec\sqrt{x^4+1}$ .

(b) Find the values of the constants  $A$  and  $B$  so that  $f$  is continuous on  $\mathbb{R}$ , where

$$f(x) = \begin{cases} \frac{2x^3 - x \cos x}{x^2} & \text{if } x < 0 \\ 2Ax + B & \text{if } 0 \leq x \leq 1 \\ \frac{x^2 - 1}{x - 1} & \text{if } x > 1. \end{cases}$$

Q4. [(4 + 4 + 4)pts.] Find the points on the graph of  $f$  (if any), where

$$f(x) = x^{\frac{1}{3}}(x-1)^{\frac{1}{3}}$$

at which the graph has :

- (a) A horizontal tangent line.
- (b) A cusp.
- (c) A vertical tangent line.

(Good Luck)