

PRINT NAME: \_\_\_\_\_

STUDENT ID NUMBER: \_\_\_\_\_

- (1) No books, notes and calculators are allowed.
- (2) Show your work in details.

Problem	Points	Score
1	20	
2	20	
3	20	
4	20	
5	20	
Total	100	

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(1) (20 points) Let

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

Find where  $f(x)$  is continuous and where  $f(x)$  is differentiable.  
Justify your answer.

- (2) (20 points) Use Intermediate Value Theorem to show that the equation  $x^5 + x + 2006 = 0$  has at least one solution.

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- (3) (20 points) Suppose that  $\sin x + \sin y = 1$ . Find  $dy/dx$  using implicit differentiation.

(4) (20 points) Find the following limits if they exist.

(a)  $\lim_{x \rightarrow 2^-} \frac{x^3 - 8}{x^2 - 5x + 6}$

(b)  $\lim_{x \rightarrow 0} \frac{x - \sin(3x)}{\tan(x)}$

(c)  $\lim_{x \rightarrow 0^+} x \sin\left(\frac{1+x}{x}\right)$

(d)  $\lim_{x \rightarrow (-1)^+} \frac{x+1}{|x^2-1|}$

(5) (20 points) Find the derivatives of the following functions.

(a)  $f(x) = \frac{\sqrt{x} - 1}{\sqrt{x} + 1}$

(b)  $f(x) = \sqrt{x\sqrt{x}}$

(c)  $f(x) = \cos(x \sin x)$

(d)  $f(x) = x \cos\left(\frac{1}{x}\right)$