

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

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

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

Problem	Points	Score
1	20	
2	10	
3	10	
4	20	
5	20	
6	20	
Total	100	

(1) (20 points)

(a) Let  $f(x) = |\cos(x)|$  for  $-\pi < x < \pi$ . Find where  $f(x)$  is continuous and where  $f(x)$  is differentiable. Briefly state your reason.

(b) Let  $f(x) = \cos|x|$  for  $-\pi < x < \pi$ . Find where  $f(x)$  is continuous and where  $f(x)$  is differentiable. Briefly state your reason.

(2) (10 points) Use Intermediate Value Theorem to show that the equation  $x^5 - x + 2004 = 0$  has at least one solution.

(3) (10 points) Use the definition of derivative to compute the tangent line of the curve  $y = x^2 + 2x$  at the point  $(1, 3)$ .

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(4) (20 points) A table of values for  $f$ ,  $g$ ,  $f'$ ,  $g'$  is given as follows.

$x$	$f(x)$	$g(x)$	$f'(x)$	$g'(x)$
1	3	2	4	6
2	1	8	5	7
3	7	2	7	9

(a) If  $h(x) = f(3f(x) - 3g(x))$ , find  $h'(1)$ .

(b) If  $H(x) = g(3f(x) - 3g(x))$ , find  $H'(1)$ .

(5) (20 points) Find the following limits if they exist.

(a)  $\lim_{x \rightarrow 2} \frac{x^2 - 3x + 2}{x^2 - 4}$

(b)  $\lim_{x \rightarrow 4^-} \left( \frac{1}{x - 4} + \frac{1}{|x - 4|} \right)$

(c)  $\lim_{x \rightarrow 0} \frac{\tan(3x)}{\sin(2x) \cos(x)}$

(d)  $\lim_{x \rightarrow 0} x^2 \sin \left( 1 - \frac{1}{x} \right)$

(6) (20 points) Find the derivatives of the following functions.

(a)  $f(t) = \frac{t^2 + 2t - 1}{\sqrt{t}}$

(b)  $f(x) = \frac{x^2 + 1}{x^2 - 1}$

(c)  $f(x) = x^2 \sin(x^3)$

(d)  $f(x) = \tan(x \sin x)$