

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

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

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

Problem	Score	Problem	Score
1 (30)		2 (20)	
3 (20)		4 (20)	
5 (20)		6 (20)	
7 (20)		8 (30)	
9 (20)			
Total (200)			

(1) (30 points) Compute the following limits.

(a)  $\lim_{x \rightarrow \infty} (\sqrt{x^2 + 1} - \sqrt{x^2 - 1})$

(b)  $\lim_{x \rightarrow 1} \frac{x^3 - x}{x^3 - 1}$

(c)  $\lim_{x \rightarrow -\infty} \frac{6x^2 + 5x}{(1 - x)(2x - 3)}$

$$(d) \lim_{x \rightarrow 0} \frac{\sqrt{1-x} - \sqrt{1+x}}{x}$$

$$(e) \lim_{t \rightarrow 2} \frac{t^{-1} - 2^{-1}}{t - 2}$$

$$(f) \lim_{x \rightarrow 0} \frac{\sin(4x)}{\tan(3x)}$$

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(2) (20 points) Find the derivative of each of the following functions.

(a)  $f(x) = x \tan(x) + \cos(x^2)$

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

(c)  $f(t) = \frac{6}{\sqrt[3]{t^5}}$

(d)  $f(x) = \sqrt{\cos(\sin(x))}$

- (3) (20 points) Find local and absolute maxima and minima of the function  $f(x) = x^3 - 3x$  on the interval  $[-2, 2]$ .

- (4) (20 points) A spotlight on the ground shines on a wall 12 m away. If a man 2 m tall walks from the spotlight toward the building at a speed of 1.6 m/s, how fast is his shadow on the building decreasing when he is 4 m from the building?

- (5) (20 points) A rectangular storage container with an open top is to have a volume of  $10 \text{ m}^3$ . The length of its base is twice the width. Material for the base cost \$10 per square meter. Material for the sides costs \$6 per square meter. Find the cost of materials for the cheapest such container.

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- (6) (20 points) A poster is to have an area of  $180 \text{ in}^2$  with 1-inch margins at the bottom and sides and a 2-inch margin at the top. What dimensions will give the largest printed area?

- (7) (20 points) Two cars start moving from the same point. One travels south at 60 mph and the other travels west at 25 mph. At what rate is the distance between the cars increasing two hours later?

- (8) (30 points) Sketch the graphs of each of the following functions. You must follow the steps A-H as in Sec. 4.5: (A) Domain (B) Intercepts (C) Symmetry (D) Asymptotes (E) Intervals of Increases and Decreases (F) Local maximum and minimum (G) Concavity and points of inflection (H) Sketch the curve.
- (a)  $f(x) = 8x^2 - x^4$

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

(9) (20 points) Evaluate the following integrals.

(a)  $\int_0^1 (x^2 - x) dx$

(b)  $\int_0^{\pi/2} (\sin(x) - \cos(x)) dx$

(c)  $\int \sqrt[2002]{1 + 3x} dx$

(d)  $\int \frac{x^2}{(x^3 + 1)^2} dx$