

PRINT NAME: _____

STUDENT ID NUMBER: _____

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

Problem	Score	Problem	Score
1 (20)		2 (15)	
3 (30)		4 (20)	
5 (15)		6 (20)	
7 (30)		8 (25)	
9 (25)			
Total (200)			

(1) (20 pts) Compute the following limits if they exist.

(a) $\lim_{h \rightarrow 0} \frac{(h-1)^3 + 1}{h}$

(b) $\lim_{x \rightarrow \infty} x \sin\left(\frac{2}{x}\right)$

(c) $\lim_{x \rightarrow \infty} \frac{3x^4 + x - 5}{6x^4 - 2x^2 + 1}$

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

(2) (15 pts)

(a) (10 pts) Find the points on the curve

$$x^2 + xy + y^2 = 12$$

where the tangent lines are horizontal.

(b) (5 pts) Find the highest and lowest points on the above curve.

(3) (30 pts)

(a) (20 pts) Show that the equation $x^3 + x + 1 = 0$ has exactly one real root and this root is negative.

(b) (10 pts) Use Newton's method with initial approximation $x_1 = -1$ to find x_3 , the third approximation to the root of the equation $x^3 + x + 1 = 0$.

(4) (20 pts) Sketch the graph of the function

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

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.

(5) (15 pts) Compute the following integrals.

(a) $\int_1^9 \frac{\sqrt{x} - 2x^2}{x} dx$

(b) $\int_0^1 (\sqrt[4]{x} + 1)^2 dx$

(c) $\int_0^4 \frac{x}{\sqrt{1+2x}} dx$

- (6) (20 pts) A cylindrical can without a top is made to contain V cm^3 of liquid. Find the dimensions that will minimize the cost of the metal to make the can.

(7) (30 pts) Consider the integral

$$\int_1^3 (x^2 + x) dx$$

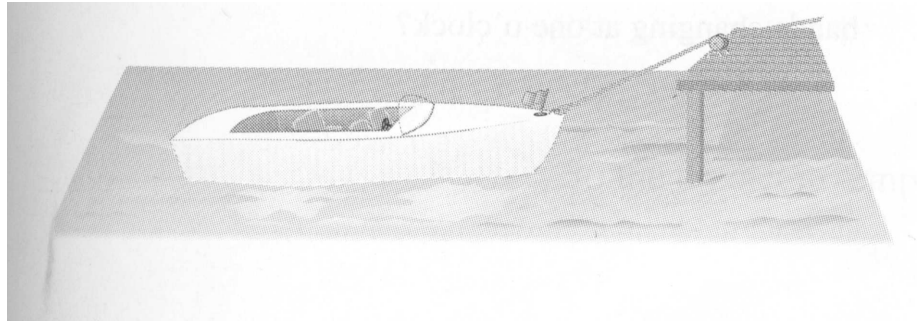
(a) Write the above integral as a limit of Riemann sums.

(b) Compute the limit you obtained in part (a). You may need the following formulas:

$$\sum_{k=1}^n k = \frac{n(n+1)}{2} \quad \text{and} \quad \sum_{k=1}^n k^2 = \frac{n(n+1)(2n+1)}{6}$$

(c) Verify your answer by computing the integral using Fundamental Theorem of Calculus.

- (8) (25 pts) A boat is pulled into a dock by a rope attached to the bow of the boat and passing through a pulley on the dock that is 1 m higher than the bow of the boat. If the rope is pulled in at a rate of 1 m/s, how fast is the boat approaching the dock when it is 8 m from the dock?



- (9) (25 pts) A steel pipe is being carried down a hallway 9 ft wide. At the end of the hall there is a right-angled turn into a narrower hallway 6 ft wide. What is the length of the longest pipe that can be carried horizontally around the corner?

