First Name: ___________________________ Last Name: ___________________________

Student-No: ___________________________ Section: ___________________________

Grade: 

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Indefinite Integrals

1. [9 marks] Each part is worth 3 marks. Please write your answers in the boxes.

   (a) Calculate the indefinite integral \( \int \frac{\sin(x)}{\sqrt{\cos(x)}} \, dx \) for \( 0 < x < \pi/2 \).

   Answer:

   (b) Calculate the indefinite integral \( \int \frac{x+1}{x^2+3x} \, dx \) for \( x > 0 \).

   Answer:
(c) (A Little Harder): Calculate the indefinite integral $\int x^2e^{-x} \, dx$.

Answer:
Definite Integrals

2. [12 marks] Each part is worth 4 marks. Please write your answers in the boxes.

(a) Calculate \( \int_{0}^{\pi/2} \cos^3(x) \, dx \).

Answer:

(b) Calculate \( \int_{0}^{3} \frac{9x^2}{x^2 + 9} \, dx \).

Answer:
(c) (A Little Harder): Calculate $\int_{1}^{e^2} \frac{\ln x}{x^2} \, dx$.

Answer:
Riemann Sum, FTC, and Volumes

3. [12 marks] Each part is worth 4 marks. Please write your answers in the boxes.

(a) Calculate the infinite sum
\[
\lim_{n \to \infty} \sum_{i=1}^{n} \frac{4i^2}{n^3} \sqrt{1 + \frac{i^3}{n^3}}
\]
by first writing it as a definite integral. Then, evaluate this integral.

Answer:

(b) For \( x \geq 0 \) define \( F(x) \) and \( g(x) \) by \( F(x) = \int_0^x \cos^2(t) \, dt \) and \( g(x) = xF(x^2) \). Calculate \( g'(\sqrt{\pi}) \).

Answer:
(c) Write a definite integral, with specified limits of integration, for the volume obtained by revolving the bounded region between \( x = -y^2 \) and \( x = -4+y^2 \) about the vertical line \( x = 2 \). **Do not evaluate the integral.**

Answer:
4. (a) [4 marks] Write a definite integral with specific limits of integration that determines the finite area enclosed by \( y^2 = x \) and \( x = 8 - 2y \).

(b) [2 marks] Evaluate the integral and so compute the area enclosed.
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5. A solid has as its base the region in the \( xy \)-plane between \( y = 1 - \frac{x^2}{9} \) and the \( x \)-axis. The cross-sections of the solid perpendicular to the \( x \)-axis are semi-circles with the diameter of the semi-circle in the base.

(a) \[4\text{ marks}\] Write a definite integral that determines the volume of the solid.

(b) \[2\text{ marks}\] Evaluate the integral to find the volume of the solid.
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