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 $\int x^2\sqrt{8 - x^3} \, dx$ for $x < 2$.
   
   Answer:

   (b) Calculate the indefinite integral $\int x\sqrt{x - 1} \, dx$ for $x > 1$.

   Answer:
(c) (A Little Harder): Calculate the indefinite integral \( \int \ln (1 + x^2) \, dx \).

Answer:
Definite Integrals

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

(a) Calculate \( \int_0^\pi \sin^3(x) \, dx \).

Answer:

(b) Calculate \( \int_{-1}^1 \left( x^2 e^{-x^3} + x^5 \cos(x) \right) \, dx \).

Answer:
(c) (A Little Harder): Calculate $\int_1^e (\ln x)^2 \, dx$.

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

\[ \lim_{n \to \infty} \sum_{i=1}^{n} \frac{4i}{n^2 (4 + i^2/n^2)} \]

by first writing it as a definite integral. Then, evaluate this integral.

Answer:

(b) Define \( F(x) \) and \( g(x) \) by \( F(x) = \int_{1}^{x} \ln t \, dt \) and \( g(x) = x \, F(x^2) \) for \( x > 1 \). Calculate \( g'(e) \).

Answer:
(c) Write a definite integral, with specified limits of integration, for the volume obtained by revolving the bounded region between \( y = x^2 \) and \( y = 6x - 5 \) about the horizontal line \( y = -2 \). 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 $y^2 = 6 + x$ and $2y = x - 2$.

(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 $y = 1 - x^2/16$ and the $x$-axis. The cross-sections of the solid perpendicular to the $x$-axis are isosceles right triangles (i.e. $45 - 45 - 90$ triangles) with the longest side (i.e. the hypotenuse) in the base.

(a) 4 marks Write a definite integral that determines the volume of the solid.

(b) 2 marks Evaluate the integral to find the volume of the solid.
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