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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 \( \int \sin^3(x) \, dx \).

   Answer:

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

   Answer:
(c) (A Little Harder): Calculate the indefinite integral \( \int \frac{\sqrt{x^2 - 25}}{x} \, dx \) for \( x > 5 \).

Answer:
Definite Integrals

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

(a) Calculate \( \int_{0}^{\pi/8} \tan^5(2x) \sec^2(2x) \, dx \).

Answer:

(b) Calculate \( \int_{-2}^{-1} \frac{1}{(x+2)^2+1} \, dx \).

Answer:
(c) (A Little Harder): Calculate \( \int_{0}^{1} x^3 \sqrt{1 - x^2} \, dx \).

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

\[
\lim_{n \to \infty} \sum_{i=1}^{n} \frac{2i}{n^2} e^{-i^2/n^2}
\]

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

Answer:

(b) Define \( F(x) \) and \( g(x) \) by \( F(x) = \int_{0}^{x} e^{-t} \, dt \) and \( g(x) = \sqrt{F(x^2)} \). Calculate \( g'(2) \).

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

Answer:
4. (a) 2 marks Plot the finite area enclosed by $4y^2 = 8 - x$ and $y = x/4$.

(b) 4 marks Write a definite integral with specific limits of integration that determines this area. **Do not evaluate the integral.**

Answer:
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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.

Answer:

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

Answer:
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