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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 $\int \frac{3x}{x+4} \, dx$.

   Answer:

   (b) Calculate the indefinite integral $\int \arctan(x) \, dx$.

   Answer:
(c) (A Little Harder): Calculate the indefinite integral $\int \frac{1}{x\sqrt{x^2-1}} \, dx$ for $x > 1$.

Answer:
Definite Integrals

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

(a) Calculate \( \int_{0}^{\pi/4} \tan^2(x) \, dx \)

Answer:

(b) Calculate \( \int_{-\pi}^{\pi} (1 + x^3) \cos^2(x) \, dx \).

Answer:
(c) (A Little Harder): Calculate $\int_{0}^{\infty} e^{-x} \cos(x) \, dx$. 

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

   \[ \lim_{n \to \infty} \sum_{i=1}^{n} \frac{6i}{n^2} \sqrt{1 + \frac{4i^2}{n^2}} \]

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

   Answer:

   (b) Define \( F(x) \) and \( g(x) \) by \( F(x) = \int_{0}^{x} \cos^2(t) \, dt \) and \( g(x) = x \, F(x^2) \). 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 $y = x^2$ and $y = 9x$ 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 \( y^2 = 10 - x \) and \( x = (y - 2)^2 \).

(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 semi-circles with the diameter of the semi-circle 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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