1. (5 points each) Evaluate each of the following integrals
   
   (a) \( \int_{-3}^{3} \frac{t|t|}{t^4 + 2} \, dt \)  
   (b) \( \int t^3 \sqrt{t - 4} \, dt \)  
   (c) \( \int_{0}^{3\pi/2} |\sin x| \, dx \)  
   (d) \( \int \cos^3 \theta \sin \theta \, d\theta \)

2. (20 points) The profit \( P \) (in thousands of dollars) for a company spending an amount \( s \) (in thousands of dollars) on advertising is \( P = -\frac{1}{10} s^3 + 6s^2 + 400 \). Find the amount of money the company should spend on advertising in order to yield a maximum profit.

3. (a) (6 points) Write the integral which gives the area of the region between \( x = 0 \) and \( x = 1 \), above the \( x \)-axis, and below the curve \( y = x - x^2 \).
   
   (b) (8 points) Evaluate your integral exactly to find the area.
   
   (c) (6 points) Find all \( c \) between \( x = 0 \) and \( x = 1 \) so that \( f(c) = f_{avg} \).

4. (20 points) Using the definition for area using right hand endpoints,
   
   \[ A = \lim_{n \to \infty} R_n = \lim_{n \to \infty} \left[ f(x_1) \Delta x + f(x_2) \Delta x + f(x_3) \Delta x + \ldots + f(x_n) \Delta x \right] \]

   find an expression for the area under the curve \( y = x^3 \) from 0 to 1 as a limit.

5. (5 points each) Let the function \( f \) be defined by \( f(x) = \int_1^x \frac{1}{t} \, dt \) for \( x > 0 \).
   
   (a) What is \( f(1) \)? What is \( f'(x) \)? What is \( f'(1) \)?
   
   (b) \( f \) is differentiable. Why?
   
   (c) Show that \( \frac{d}{dx} \left( f \left( \frac{1}{x} \right) \right) = -f'(x) \).
   
   (d) Using the definition of \( f \), show that \( f(x + h) - f(x) = \int_x^{x+h} \frac{1}{t} \, dt \).

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