University of California, San Diego
Department of Mathematics

Instructions

1. Write your *Name*, *PID*, *Section Number* and the *Version* of your exam on the front of your Blue Book.
2. No calculators or other electronic devices are allowed during this exam.
3. You may use one page of notes, but no books or other assistance during this exam.
4. Read each question carefully, and answer each question completely.
5. Write your solutions clearly in your Blue Book
   (a) Carefully indicate the number and letter of each question.
   (b) Present your answers in the same order they appear in the exam.
   (c) Start each question on a new page.
6. Show all of your work; no credit will be given for unsupported answers.

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0. (1 point) Carefully read and complete the instructions at the top of this exam sheet and any additional instructions written on the chalkboard during the exam.

1. Evaluate the following indefinite integrals:

   (a) (7 points) $\displaystyle \int \left(e^{-x} - \sin x + \frac{1}{x} \right) dx =$

   (b) (7 points) $\displaystyle \int \frac{x^4 - 2x^2 + 4}{x^2} \, dx =$

2. Let $f(x)$ be an *odd* function with $\int_0^2 f(x)\, dx = 5$ and let $g(x)$ be an *even* function with $\int_0^2 g(x)\, dx = -1$. Let F be an antiderivative of f such that $F(0) = 1$. Evaluate the following:

   (a) (4 points) $\displaystyle \int_{-2}^2 (f(x) + 3g(x))\, dx =$

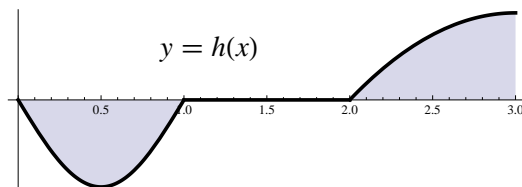   (b) (3 points) $F(2) =$

   (c) (3 points) $F(-2) =$

3. A car, traveling in a straight line, accelerates with velocity $v(t)$ measured at 2 second intervals, shown in the table below.

time (seconds)	0	2	4	6
$v(t)$ (m/s)	0	3	6	10

   (a) (3 points) Using a *left-hand sum* with $n = 3$ intervals, compute a lower estimate on the car's total displacement on the time interval $0 \le t \le 6$.

   (b) (3 points) Using a *right-hand sum* with $n = 3$ intervals, compute an upper estimate on the cars total displacement on the time interval $0 \le t \le 6$.

   (c) (2 points) Suppose the function $F(t)$ has $F(0) = 5$ and $F(6) = 47$. Based on your answers to (a) and (b), could $F(t)$ represent the total displacement of the car? Explain your reasoning.

4. Let $h(x)$ be given by the following graph:

$$y = h(x)$$

Assume that the area of the shaded region is $\frac{9}{2}$ and $\int_2^3 h(x)\, dx = \frac{5}{2}$.

(a) (3 points) What is $\int_0^1 h(x)\, dx$?

(b) (3 points) What is the average value of $h(x)$ on $0 \le x \le 3$?

(c) (3 points) Suppose $H'(x) = h(x)$. If $H(1) = 5$, compute $H(0)$, $H(2)$, and $H(3)$.

5. (a) (6 points) Solve the initial value problem:

$$\frac{dy}{dt} = 4\sin(t) + t, \quad \text{with } y(0) = 5.$$

(b) (2 points) Is the function $y(t)$ increasing or decreasing when $t > 4$? Explain your reasoning.

(This exam is worth 50 points.)