HONOR STATEMENT

"I affirm that my work upholds the highest standards of honesty and academic integrity at the University of Washington, and that I have neither given nor received any unauthorized assistance on this exam."

SIGNATURE:________________________

• Do not open the test until instructed to do so. Please turn your cell phone OFF now.
• This exam consists of this cover sheet followed by six problems on four pages. 
  When the test starts, check that you have a complete exam.
• This exam is closed book. You may use one double-sided, handwritten $8\frac{1}{2} \times 11$ page of notes, a ruler, and a non-graphing calculator. Put everything else away. You may not share notes.
• Unless otherwise indicated, you must show your work and justify your answers. The correct answer with incomplete or missing supporting work may result in no credit.
• Place your final answer in the indicated spaces.
• Unless otherwise specified, you may round your final answer to two digits after the decimal.
• If you need more room, use the backs of the pages and indicate to the grader that you have done so. Raise your hand if you have a question. GOOD LUCK!

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<thead>
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<th>Problem</th>
<th>Total Points</th>
<th>Score</th>
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1. (8 points) Differentiate the following functions. BOX your final answer. No need to simplify.

(a) \( y = x \ln(x) + 10e^{x-x^5} \).

\[
\frac{dy}{dx} = 
\]

(b) \( g(t) = \left[1 + (\ln(t))^2\right]^{\frac{1}{2}} \)

\( g'(t) = 
\)

2. (8 points) Based on the graph of \( f(x) \) shown below, identify which of the points A through G marked on the graph satisfy each of the following conditions.

(List all that apply, no need to justify your answers.)

(a) Critical point(s) for \( f(x) \): ____________

(b) Inflection point(s) for \( f(x) \): ____________

(c) Point(s) where \( f'(x) > 0 \) and \( f''(x) > 0 \): ____________

(d) Point(s) where \( f'(x) = 0 \) and \( f''(x) = 0 \): ____________
3. (8 points) Evaluate the following integrals. Simplify and BOX your final answer.

(a) $\int \left( \frac{3}{x} - \frac{5}{\sqrt{x}} + 2e^{5x} \right) \, dx =$

(b) $\int_1^2 12(t - 3)^2 \, dt =$
4. (8 points) A company is selling items. The marginal revenue, in $/Item, at $q$ hundred items is $MR(q) = 29 - 2q$, the marginal cost is $MC(q) = 5$, and the fixed costs are $FC = 3$ hundred $.

(a) What number of items results in a maximal profit?

ANSWER: $q = \underline{\text{hundred Items}}$

(b) What is the maximum profit?

ANSWER: $\underline{\text{hundred dollars.}}$

5. (6 points) The graph of a function $f(x)$ is shown below.

(a) Compute the value of the following integral.

$$\int_{5}^{9} f(x) dx = \underline{\text{}}$$

(b) Define a new function $A(m) = \int_{0}^{m} f(x) dx$, where $f(x)$ is the function in the graph above.

i. Compute $A(1) = \underline{\text{}}$

ii. At what value(s) of $m$ does $A(m)$ have a local minimum? $m = \underline{\text{}}$

iii. At what value of $m$ in the interval from $m = 0$ to $m = 10$ is $A(m)$ largest? $m = \underline{\text{}}$
6. (12 points) You run a business selling lollipops. Your profit, in dollars, from selling \( q \) thousand lollipops is given by the function:

\[
P(q) = q^4 - 32q^3 + 270q^2 - 200.
\]

Use the methods of this class and show all your work.

(a) Find all the critical values of the profit function.

ANSWER: (list all) \( q = \) thousand lollipops.

(b) Find the minimum and the maximum profit you can make if you sell between 1 thousand and 10 thousand lollipops.

ANSWER: Min Profit is $ ______ at \( q = \) thousand lollipops.

Max Profit is $ ______ at \( q = \) thousand lollipops.

(c) Find the longest interval on which the profit function is concave down.

ANSWER: From \( q = \) to \( q = \) thousand lollipops.