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STUDENT ID: $\qquad$

Math 112 Midterm 2
Winter 2016

## 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 five problems on five 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!

| Problem | Total Points | Score |
| :---: | :---: | :---: |
| 1 | 10 |  |
| 2 | 14 |  |
| 3 | 9 |  |
| 4 | 9 |  |
| 5 | 8 |  |
| Total | 50 |  |

1. (10 points)
(a) (6 points) Differentiate the following function. BOX your final answer. No need to simplify.

$$
y=\frac{\ln \left(x^{2}-3 x\right)}{e^{5 x}+e^{2}}
$$

$\frac{d y}{d x}=$
(b) (4 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 points that apply, no need to justify your answers)
i. Critical point(s) for $f(x)$ :
ii. Inflection point(s) for $f(x)$ :
iii. Point(s) where $f^{\prime}(x)=0$ and $f^{\prime \prime}(x)=0$ : $\qquad$
iv. Point(s) where $f^{\prime}(x)>0$ and $f^{\prime \prime}(x)=0$ : $\qquad$
2. (14 points) The total revenue, in thousands of dollars, for selling $q$ thousand Items is given by:

$$
T R(q)=\frac{1}{6} q^{4}-\frac{16}{3} q^{3}+48 q^{2}+100 q .
$$

(a) Compute the following derivatives:
$T R^{\prime}(q)=$
$T R^{\prime \prime}(q)=$
$T R^{\prime \prime \prime}(q)=$
(b) Find all the critical values of the marginal revenue function.

ANSWER: (list all) $q=$ $\qquad$ thousand Items.
(c) At each of the quantities you found in part (b), use either the First or the Second Derivative Test to determine whether the graph of marginal revenue has a local maximum, a local minimum, or neither. Make sure to specify which test you use and show your work.

ANSWER: Local MAX at $q=$ $\qquad$ , Local min at $q=$ $\qquad$
(d) Find the longest interval on which the total revenue function $T R(q)$ is concave down. Justify.

ANSWER: From $q=$ $\qquad$ to $q=$ $\qquad$ thousand Items
(e) Does the total revenue function have a local maximum at $q=10$ thousand Items? Justify.
$\qquad$
3. (9 points) Evaluate the following integrals. Simplify and BOX your final answer.
(a) $\int\left[\left(1+x^{2}\right)\left(\frac{1}{x}+2 x\right)+e^{0.5 x}\right] d x=$
(b) $\int_{1}^{4}\left(9 x^{2}-\frac{2}{\sqrt{x}}\right) d x=$
4. (9 points) A company is selling Things. Suppose that the marginal revenue and marginal cost, in dollars per Thing, at $q$ Things are:

$$
\begin{aligned}
& M R(q)=1200 \\
& M C(q)=60 \sqrt{q+4}
\end{aligned}
$$

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


ANSWER: $q=$ $\qquad$ Things
(b) What is the maximum profit, assuming that the fixed costs are $\$ 1000$ ? Show all work.
$\qquad$ dollars.
5. (8 points) The graph below respresents the RATE of ASCENT $r(t)$ for a balloon. In this problem, you need not show work.

(a) List all times at which the altitude graph of this balloon has horizontal tangents:

$$
t=
$$

$\qquad$
(b) At what time is the balloon at its lowest altitude? At $t=$ $\qquad$
(c) Give the longest time interval over which the balloon is rising and getting slower.

From $t=$ $\qquad$ to $t=$ $\qquad$
(d) Define a new function $A(m)=\int_{0}^{m} r(t) d t$, where $r(t)$ is the function in the graph above.
i. Estimate $A(2)=$ $\qquad$
ii. At what value(s) of $m$ does $A(m)$ have a local minimum? $m=$ $\qquad$
iii. Which of the following does the function $A(m)$ represent? Circle all the correct answers.

The altitude of the balloon at time $t=m$.

The change in altitude of the balloon from its initial position.
The velocity of the balloon at time $t=m$.

The change in the velocity of the balloon from its initial velocity

An antiderivative of $r(t)$
A derivative of $r(t)$

