MATH 160 **Fall 2015**

EXAMINATION 3

RULES

- No books or notes or calculators allowed.
- No bathroom breaks until after you have completed and turned in your exam.
- Out of consideration for your classmates, do not make disturbing noises during the exam.
- **Phones must be turned off.**

Cheating will not be tolerated. If there are any indications that a student gave or received unauthorized aid on this test, the case will be referred to the ISU Office of Judicial Affairs.

When you finish the exam, please sign the following statement acknowledging that you understand this policy:

"On my honor as a student I, _____, have neither given nor received aid on this exam." (carefully print full name)

Signature: _____ Date: 2015/12/01

page	problems	max	score
1	1–2	20	
2	3–5	20	
3	6	12	
4	7	10	
5	8	8	
total		70	

1. (8pts) Find the horizontal and vertical asymptotes of the graph of the function. If an answer does not exist, write DNE. (You must show your work and justify your answer, but you need not sketch the graph.)

$$g(x) = \frac{x^3}{x^2 - 3}$$

horizontal asymptote(s): _____

vertical asymptote(s): _____

2. (12pts) Find the absolute maximum value and the absolute minimum value, if any, of the function. (If an answer does not exist, enter DNE.)

$$f(x) = 10x - \frac{3}{x} \quad \text{on } [1, 3]$$

maximum value: $f(x_{\max}) =$ _____

minimum value: $f(x_{\min}) =$ _____

score: _____

3. (5pts) Determine whether the statement is true or false and check the box next to the correct statement explaining why it's true or false. (You need not show your work for this problem.)

   If $f''(x) < 0$ on (a, b) and $f'(c) = 0$ where $a < c < b$, then $f(c)$ is the absolute *maximum* value of f on $[a, b]$.

   ☐ True. $f''(x) < 0$ on (a, b) says that the graph of f is concave downward on (a, b). $f'(c) = 0$ means that the graph is not continuous at c, that it goes toward infinity. Therefore, $f(c) = \infty$ is the absolute maximum value.

   ☐ True. $f''(x) < 0$ says that the graph is concave downward on (a, b). Therefore, the relative maximum value at $x = c$ must, in fact, be the absolute maximum value.

   ☐ False. If b is an inflection point where $f''(x) = 0$, then the function satisfies the given conditions but has absolute maximum value at b, not c.

   ☐ False. Under the given conditions, $f(c)$ is the absolute *minimum* value of f on $[a, b]$.

   ☐ False. $f'(c) = 0$ means that the graph is not continuous at c, and that the function tends to infinity. Therefore, it has no absolute maximum value at c.

4. (7pts) Use logarithms to solve the equation for t.

   $6e^{t-5} = 6$

   Answer: $t =$ _____

5. (8pts) Find the derivative of the function

   $f(x) = 6x^2 \ln(9x)$.

   Answer: $f'(x) =$ _____

score: _____

6. (12pts) Postal regulations specify that a parcel sent by Priority Mail may have a combined length and girth of no more than 228 inches. For a rectangular box with square cross section that may be sent by Priority Mail, what are the dimensions that give the **maximum volume**? [*Hints:* Recall the formula for volume: (area of base)×height or (area of side)×length. Let ℓ denote length and let w denote width; then the girth is $4w$.]

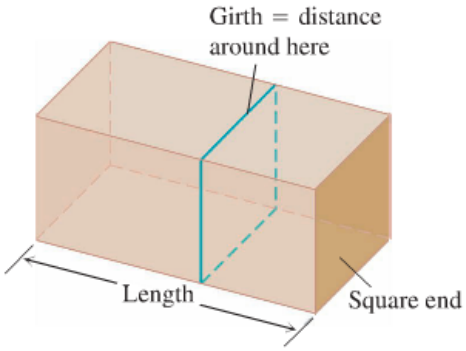

Figure 1: Let length + girth $= \ell + 4w = 228$

Answer: length: $\ell =$ _____ width: $w =$ _____

score: _____

7. (10pts) Find the intervals where $f(x) = x^2e^{-x}$ is increasing and where it is decreasing. Show your work. Mark your answers by checking the appropriate boxes below. Select all that apply.

$f(x)$ is **increasing** on:

- ☐ $(-\infty, 0) \cup (2, \infty)$
- ☐ $(0, \infty)$
- ☐ $(-\infty, 0)$
- ☐ $(0, 2)$

$f(x)$ is **decreasing** on:

- ☐ $(0, \infty)$
- ☐ $(-\infty, 0) \cup (2, \infty)$
- ☐ $(0, 2)$
- ☐ $(-\infty, 0)$

score: _____

Solve ONE of either **a.** OR **b.** then CIRCLE the letter of the part you want graded.

If nothing circled, **a.** will be graded.

8. (8pts)

a. Compute the following integrals. (Be sure to give *all* correct antiderivatives by including an arbitrary constant C in your answers.)

$$\int 3\,dx =$$

$$\int x\,dx =$$

b. Sr-90, a radioactive isotope of strontium, is present in the fallout resulting from nuclear explosions. It is especially hazardous to animal life because, upon ingestion of contaminated food, it is absorbed into the bone structure. Its half-life is 24 years. If the amount of Sr-90 in a certain area is found to be four times the safe level, find how much time must elapse before the safe level is reached.

Answer: _____ years

score: _____