No books, no notes, no calculators, no cell phones, no pagers, no electronic devices of any kind.

For problems 1-8: Put your answer in the box provided if there is a box. Show every step of your solution. Erase or mark out anything false in your work. Simplify your answers as much as you can. It may not be sufficient to have a right answer to get full credit. Some graders may be stricter than others.

Detach pages 10-15 from your exam and take them with you. Hand in only pages 0-9. Put your answers to problems 9-15 on page 9. There is no partial credit for these problems and no work need be shown. Do not hand in your scratch paper.

Exam and answers will be posted shortly after the exam: www.math.wisc.edu/~miller

Name____________________________________

Circle the number (321-333) of your discussion section and hand in to your TA:

```
321    7:45    TR    B329 VAN VLECK  Kumar, Rohini
322    8:50    TR    6322 SOC SCI    Kumar, Rohini
323    9:55    TR    348 BIRGE       Mantilla Soler, Guillermo Arturo
324   11:00    TR    1333 Sterling   Wang, Bing
325   12:05p   TR    348 BIRGE       Wang, Bing
326   12:05p   TR    B337 VAN VLECK  Potluri, Vijaya Kranthi
327    1:20p   TR    B135 VAN VLECK  Mantilla Soler, Guillermo Arturo
328    1:20p   TR    B123 VAN VLECK  Umarji, Pallavi Anand
329    2:25p   TR    B211 VAN VLECK  Yin, Weidong
330    2:25p   TR    B115 VAN VLECK  Umarji, Pallavi Anand
331    3:30p   TR    B135 VAN VLECK  Yin, Weidong
332    2:25p   TR    223 INGRAHAM    Christodoulopoulou, Konstantina
333    3:30p   TR    B115 VAN VLECK  Christodoulopoulou, Konstantina
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Page	Points	Score
1	8	
2	8	
3	8	
4	8	
5	8	
6	8	
7	8	
8	8	
9-15	36	
Total	100	

1. (8 pts)

A fisherman is reeling in a fish he has caught at that rate of 3 feet of fishing line per second. Assume that the fish is being pulled along the surface of the water and the tip of the fishing pole is exactly 5 feet above the surface of the water. How fast is the fish moving along the surface when the distance from the tip of the pole and the fish is 13 feet? (You should assume that the fish has enough drag to keep the line straight.)

Put your answer

in the box.

Show work below.

2. (8 pts)
Sketch the graph of

$$f(x) = x^3 - 3x^2 + 2$$

over the real line. Label local extreme points and inflection points.

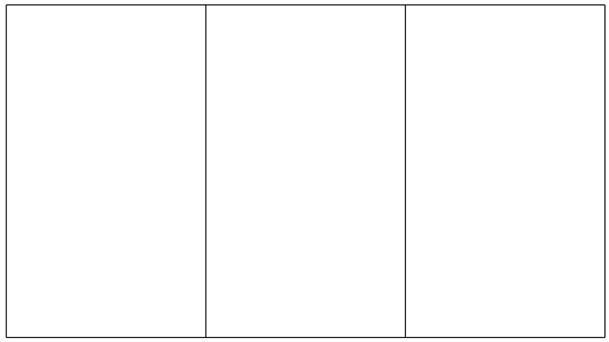

Figure 1: Kennel

3. (8 pts)

A kennel owner has 80 feet of fencing and wants to fence off a rectangular area which is divided into 3 adjacent identical rectangular subsections, as shown in Figure 1. What dimensions will maximize the area?

Put your answer

in the box.

Show work below.

4. (8 pts) Find

$$\int \sqrt{2x-4}\ \ dx$$

Put your answer
in the box.
Show work below.

5. (8 pts) Find

$$\int \frac{x-5}{(x-2)(x+1)} \; dx$$

Put your answer
in the box.
Show work below.

6. (8 pts)

The demand curve is $D(q) = \frac{36}{q+1}$ and the supply curve is $S(q) = q + 1$ for a certain commodity. For each the price p is written as a function of the quantity q. Find the consumer surplus.

Put your answer

in the box.

Show work below.

7. (8 pts)

Find the nominal annual interest rate, assuming interest is compounded continuously, that must be paid by a bank so that an initial deposit doubles in 9 years.

Put your answer

in the box.

Show work below.

8. (8 pts)
Find the unique solution to the initial value problem:

$$\frac{dy}{dx} = \frac{xe^x}{2y}, \qquad y(0) = 1$$

Put your answer
in the box.
Show work below.

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Problem	Circle the best answer
9	(a) 1 2 3 4 5 (b) 1 2 3 4 5 (c) 1 2 3 4 5 (d) 1 2 3 4 5 (e) 1 2 3 4 5
10	(a) True False (b) True False (c) True False (d) True False (e) True False
11	(m) a b c d e (M) a b c d e
12	(a) 1 2 3 4 5 (b) 1 2 3 4 5 (c) 1 2 3 4 5 (d) 1 2 3 4 5 (e) 1 2 3 4 5
13	a b c d e
14	a b c d e
15	a b c d e

Problems 9-15 are 5 points each except 11 which is 6 points.

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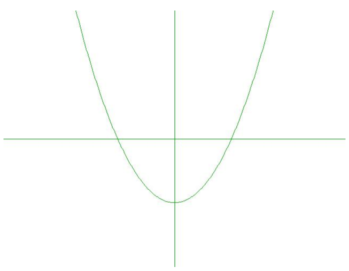
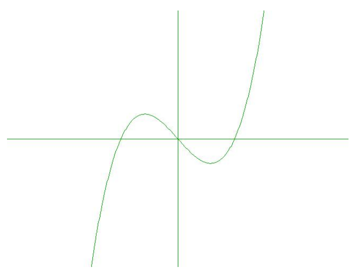
9. (5 pts)

Each of the graphs below is a differentiable function. For each graph choose one of the conditions:

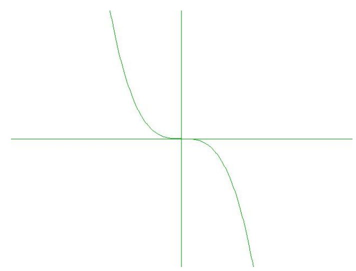
(1) $f'(x) > 0$ for all x in the interval $(-\infty, 0)$ and $f'(x) > 0$ for all x in the interval $(0, \infty)$.
(2) $f'(x) > 0$ for all x in the interval $(-\infty, 0)$ and $f'(x) < 0$ for all x in the interval $(0, \infty)$.
(3) $f'(x) < 0$ for all x in the interval $(-\infty, 0)$ and $f'(x) > 0$ for all x in the interval $(0, \infty)$.
(4) $f'(x) < 0$ for all x in the interval $(-\infty, 0)$ and $f'(x) < 0$ for all x in the interval $(0, \infty)$.
(5) None of above.



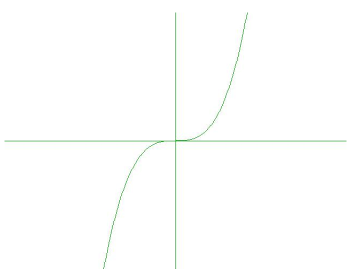
(a) 1 2 3 4 5



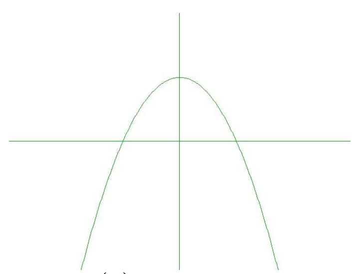
(b) 1 2 3 4 5



(c) 1 2 3 4 5



(d) 1 2 3 4 5



(e) 1 2 3 4 5

10. (5 pts)

Suppose $f(x)$ is a differentiable function on an open interval (a, b). Suppose that for some point c with $a < c < b$ we have that $f'(c) = 0$. Answer the following questions True or False:

(a) If $f''(c) > 0$, then $f(c)$ is a local minimum of f.

(b) If $f''(c) < 0$, then $f(c)$ is a local maximum of f.

(c) If $f''(c) = 0$, then $f(c)$ can be neither a local maximum nor a local minimum of f.

(d) If $f''(c) = 0$, then $f(c)$ can be a local maximum, a local minimum, or neither.

(e) If c is the only critical point of f in the interval (a, b) and $f(c)$ is a local minimum of f, then $f(c)$ must be the global minimum of f in (a, b).

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11. (6 pts) Find the global minimum m and global maximum M of the variable y, where

$$y = x + \frac{1}{x}$$

and x is in the interval $[2, 4]$.

(a) $m = 1$

(b) $m = 2$

(c) $m = 2\frac{1}{2}$

(d) m is none of above.

(e) There is no global minimum.

(a) $M = 2$

(b) $M = 4$

(c) $M = 4\frac{1}{4}$

(d) M is none of above

(e) There is no global maximum.

12. (5 pts) Match the function $f(x)$ with one of its antiderivatives $F(x)$

(a) $f(x) = -\frac{1}{x^2}$	(1) $F(x) = (.5)x^2 - 1$
(b) $f(x) = \frac{1}{x}$	(2) $F(x) = \frac{1}{x}$
(c) $f(x) = x$	(3) $F(x) = e^x + 2$
(d) $f(x) = e^x$	(4) $F(x) = \ln(x)$
(e) $f(x) = e^{x^2}$	(5) None of above.

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13. (5 pts) The continuous function $f(x)$ has the properties that

$$\int_1^5 f(x)\,dx = 10$$

and

$$\int_3^5 f(x)\,dx = 6.$$

What is $\int_1^3 f(x)\,dx$?

(a) 2

(b) 4

(c) -4

(d) None of above.

(e) The value of the integral cannot be determined from the given information.

14. (5 pts)
Find the area A between the graph of

$$f(x) = \frac{x}{x+2}$$

for $-1 \le x \le 1$ and the $x - axis$.

(a) $A = \int_{-1}^{1} \frac{x}{x+2}\,dx$

(b) $A = \int_{-1}^{1} -\frac{x}{x+2}\,dx$

(c) $A = \int_{-1}^{0} -\frac{x}{x+2}\,dx + \int_0^1 \frac{x}{x+2}\,dx$

(d) $A = \int_{-1}^{0} \frac{x}{x+2}\,dx + \int_0^1 -\frac{x}{x+2}\,dx$

(e) A is none of above.

15. (5 pts)
Find the average value A of $f(t) = t^2$ over the interval $0 \le t \le 2$.

(a) $A < 0$

(b) $0 \le A < 1$

(c) $1 \le A < 2$

(d) $2 \le A < 3$

(e) $3 \le A$

Answers

1. 13/4
2. local max at $(0, 2)$, local min at $(2, -2)$, and inflection point at $(1, 0)$.
3. 10 by 20
4. $\frac{1}{3}(2x-4)^{\frac{3}{2}} + C$
5. $2\ln|x+1| - \ln|x-2| + C$
6. $36\ln 6 - 30$
7. $\frac{1}{9}\ln(2)$
8. $y = \sqrt{xe^x - e^x + 2}$
9. a3,b5,c4,d1,e2
10. TTFTT
11. cc
12. a2, b4, c1, d3, e5
13. b
14. c
15. c