

No Calculators.  
 Show all your work.  
 Write clearly and carefully.  
 Hand in your exam to your TA.

Name\_\_\_\_\_

Circle your TA section:

|             |                 |       |    |      |           |
|-------------|-----------------|-------|----|------|-----------|
| 211 002 321 | Lang, Mike      | 7:45  | TR | B333 | Van Vleck |
| 211 002 322 | Lang, Mike      | 8:50  | TR | 202  | Bascom    |
| 211 002 324 | Rhee, Kyoungwon | 9:55  | TR | 301  | Educ Sci  |
| 211 002 326 | Rhee, Kyoungwon | 11:00 | TR | 3331 | Sterling  |
| 211 002 327 | Hartwig, Brian  | 12:05 | TR | 346  | Birge     |
| 211 002 328 | Lee, Byungyoon  | 12:05 | TR | 341  | Van Vleck |
| 211 002 329 | Lee, Byungyoon  | 1:20  | TR | 341  | Van Vleck |
| 211 002 331 | Hartwig, Brian  | 2:25  | TR | 114  | Ingraham  |
| 211 002 332 | Kethireddypally | 2:25  | TR | 223  | Ingraham  |
| 211 002 334 | Kethireddypally | 3:30  | TR | B325 | Van Vleck |

| Problem | Points | Score |
|---------|--------|-------|
| 1       | 4      |       |
| 2       | 4      |       |
| 3       | 4      |       |
| 4       | 4      |       |
| 5       | 4      |       |
| 6       | 4      |       |
| 7       | 4      |       |
| 8       | 4      |       |
| 9       | 4      |       |
| 10      | 4      |       |
| Total   | 40     |       |

1. (4 pts) Hay production in the United States increased from 12 million bales in 1991 to 19 million bales in 1994. Assuming production of hay to follow a linear equation, find the production level predicted by these data for the year 1999.

2. (4 pts) Find the indicated limits:

(a)  $\lim_{x \rightarrow 0} \frac{(2+x)^2 - 4}{x}$

(b)  $\lim_{x \rightarrow 3^+} \frac{x^2 - 4x - 3}{x - 3}$

3. (4 pts) Find the derivative of the given function:

(a)  $f(x) = \sqrt{9 + x^2}$

(b)  $f(x) = (1 - x^2)^3(x^2 + 9)^4$

4. (4 pts)

The revenue function  $R(x)$  is defined by

$$R(x) = \begin{cases} 4x & 0 < x < 10 \\ 140 - (x - 20)^2 & 10 \leq x < 20 \\ 160 - x & 20 \leq x < 160 \end{cases}$$

At which points is  $R(x)$  continuous? differentiable? What is the marginal revenue function,  $MR(x)$ ?

5. (4 pts) The cost of operating a small aircraft is calculated to be \$400 per hour plus the cost of fuel. Fuel costs are  $\frac{s}{100}$  dollars per kilometer, where  $s$  represents speed in kilometers per hour. Find the speed that minimizes the cost per kilometer.

6. (4 pts)

$$f(x) = \frac{x}{x^2 + 1}$$

Find the intervals on which  $f$  is increasing or decreasing.

7. (4 pts) Find a value of  $c$  that satisfies the Mean Value Theorem for the given function and interval.

$$f(x) = x^3 - 2x + 4, \quad \text{for } x \text{ in } [0, 2]$$

8. (4 pts) A publisher currently sells 2000 subscriptions annually for a professional journal at a rate of \$40 per year. Its marketing department predicts that for each \$1 reduction in subscription price an additional 50 subscriptions can be sold. Under this assumption what subscription rate maximizes revenue?

9. (4 pts) Find the value of the derivative  $\frac{dy}{dx}$  at the indicated point.

$$(y - x)^2 = x \text{ at } (9, 12)$$

10. (4 pts) A policeman 300 yards away from a straight highway has a radar gun pointed at your car on the highway. He finds that when your car is 500 yards away from him that the distance between him and your car is increasing at the rate of 60 miles per hour. How fast is your car traveling?

## Answers

1.  $30\frac{2}{3}$  million bales.

2. (a) 4

(b)  $-\infty$

3. (a)  $\frac{x}{\sqrt{9+x^2}}$

(b)  $3(1-x^2)(-2x)(x^2+9)^4 + (1-x^2)^3(x^2+9)^3(8x)$

4.  $R(x)$  is continuous in the interval where it is defined,  $(0, 160)$  and differentiable in the same interval except at  $x = 10$  and  $x = 20$ .

$$MR(x) = \begin{cases} 4 & 0 < x < 10 \\ -2(x-20) & 10 < x < 20 \\ -1 & 20 < x < 160 \\ \text{undefined} & x = 10, 20 \end{cases}$$

5. 200 kph.

6. increasing on  $(-1, 1)$ , decreasing on  $(-\infty, -1)$  and  $(1, \infty)$ .

7.  $\frac{2}{\sqrt{3}}$

8. \$40

9.  $1\frac{1}{6}$

10. 75 mph.