

Name _____ ID # _____ Section # _____

There are 10 multiple choice questions, 5 True/False questions, and 4 partial credit questions.

THE USE OF CALCULATORS IS NOT PERMITTED IN THIS EXAMINATION.

THERE ARE 15 PROBLEMS ON 11 PAGES, INCLUDING THIS ONE. CHECK YOUR BOOKLET NOW.

The box below is for the instructor's use.

MC(50)
T/F(10)
12(6)
13(10)
14(12)
15.....(12)
Total (_____)

1. (5 pts.) The slope of the normal line, at the point $(-1, 1)$, of the graph given by $x^2 + y^2 = 2$ is

- a) -1
- b) 0
- c) 1
- d) 2
- e) The normal line does not exist at the point.

2. (5 pts.) Suppose $x = \sin y$, find $\frac{dy}{dx}$.

- a) 0
- b) $\frac{1}{x}$
- c) $\frac{1}{\sqrt{1-x^2}}$
- d) $\frac{1}{1+x^2}$
- e) $x^2 - 1$

3. (5 pts.) Suppose $f(x) = x + \frac{1}{x}$. Find all critical points of $f(x)$.

- a) $x = 0$
- b) $x = 1$
- c) $x = 0, 1$
- d) $x = 0, 1, -1$
- e) $x = 1, -1$

4. (5 pts.) Suppose $f'(x) = x(x - 2)^2(x - 4)$. How many local maximum does $f(x)$ have?

- a) 0
- b) 1
- c) 2
- d) 3
- e) 4

5. (5 pts.) Find the value of $x = c$ that satisfies the conclusion of the Mean Value Theorem for the function $f(x) = \sqrt{2x - 1}$ on the interval $[5, 13]$.

- a) 4
- b) $\frac{11}{2}$
- c) 6
- d) $\frac{17}{2}$
- e) 12

6. (5 pts.) Suppose $f''(x) = \frac{x^2 - 4}{x}$. Find all points of inflection of $y = f(x)$.

- a) $x = 0$
- b) $x = 2$
- c) $x = 0, 2$
- d) $x = 2, -2$
- e) $x = 0, 2, -2$

7. (5 pts.) If a, b, c, d, e, f , and g are positive constants, then $\lim_{x \rightarrow \infty} \frac{2(ax + b)(cx + d)}{ex^2 + fx + g} =$

- a) 0
- b) $\frac{2}{e}$
- c) $\frac{2a}{e}$
- d) $\frac{2ac}{e}$
- e) ∞

8. (5 pts.) What are the horizontal (H.A.) and the vertical (V.A.) asymptotes of the function $f(x) = \frac{x + 1}{x^2 - 2x - 3}$?

- a) H.A. $y = 0$, V.A. $x = 3$
- b) H.A. $y = 1$, V.A. $x = 3$
- c) H.A. $y = 0$, V.A. $x = -1$ and $x = 3$
- d) no H.A., V.A. $x = -1$ and $x = 3$
- e) There are no asymptotes.

9. (5 pts.) Suppose x and y are 2 positive numbers whose sum is 10. What is the maximum value of the product x^2y ?

- a) 0
- b) $\frac{4000}{27}$
- c) $\frac{200}{9}$
- d) 125
- e) 25

10. (5 pts.) Suppose $f(1) = 3$ and $f'(1) = -1$. Then the linear approximation $L(1.5)$ of $f(x)$ at $x = 1.5$ is

- a) 1.5
- b) 2
- c) 2.5
- d) 3
- e) 3.5

11. (10 pts.) True or False

- a) The function $f(x) = x^3 + 3x + 10$ has no critical points. T F
- b) If $f'(c)$ does not exist, then $x = c$ cannot be a local maximum or a local minimum point of $f(x)$. T F
- c) If two functions have the same derivative, then they must be the same function. T F
- d) Any differentiable function $f(x)$ defined on the interval (a, b) have (at least) one absolute maximum and one absolute minimum on (a, b) . T F
- e) If $f''(c) = 0$, then $x = c$ might be a point of inflection of $y = f(x)$. T F

12. (6 pts.) On an interval I , suppose $f(x)$ and $g(x)$ are two differentiable functions that are both negative, increasing, and concave down. Then on I , their product $f(x)g(x)$ must be (choose 1 each)

a) Positive Negative

b) Increasing Decreasing

c) Concave up concave down

13. (10 pts.) Car A is traveling west at 30 miles per hour and car B is traveling north at 50 miles per hour. Both cars are headed for the intersection of the two roads. At what rate is the distance between them changing when car A is 4 miles and car B is 3 miles from the intersection?

14. (12 pts.) For the function $f(x) = x^3 - 6x^2 + 3$

a) Find all critical points of $f(x)$.

b) Determine if each critical point is a local maximum or a local minimum.

c) Find the absolute maximum and the absolute minimum points of $f(x)$ on the interval $[-1, 3]$.

15. (12 pts.) A can in the shape of a circular cylinder has a volume of 32π cubic inches. The material used for the top and bottom of the can costs twice as much as the material used for the side of the can. Find the radius of the can that minimizes the cost of the can.