Exam III - Math 141 Fall 2016

Name: ____________________________ **Exam Version A**

This exam is multiple choice. Each problem is worth five points, for a maximum possible total of 105 points (5 possible bonus points). Fill in your name, student ID number, section number, and the exam version on the scantron answer sheet. You may use the exam to work out the problems. Make sure you fill in your answers on the scantron answer sheet provided and circle the answers on the exam. You must hand in this exam as well as the scantron answer sheet. To hand in your exam, be prepared to show your picture ID. This is a closed book, closed notes exam. Calculators are allowed but must be equivalent to a TI-83/84; no TI-89s or equivalent are allowed. No cell phones are permitted outside of your bag at anytime during the test.

GOOD LUCK!

1. Sound Software estimates that it will sell N units of a program after spending a thousand dollars on advertising, where

$$N(a) = -a^2 + 300a + 6, \quad 0 \leq a \leq 300.$$

Find the maximum number of units of the program that can be sold.

(a) 150,000

(b) 22,506

(c) 6,000

(d) 300,000

2. An apple farm yields an average of 40 bushels of apples per tree when 10 trees are planted on an acre of ground. Each time 1 more tree is planted per acre, the yield decreases by 2 bushels per tree as a result of crowding. What total number of trees planted on an acre will maximize the yield?

(a) There is no maximum yield.

(b) 5

(c) 15

3. Find $\dfrac{dy}{dx}$ if $x^2 + 2xy = 3y^2$. Note: y is a function of x.

(a) $\dfrac{dy}{dx} = \dfrac{x+y}{3y-x}$

(b) $\dfrac{dy}{dx} = \dfrac{x-3y}{-x-y}$

4. What is the slope of the curve $2x^3y^2 = -18$ at the point $(-1, 3)$? Note: y is a function of x.

(a) 4.5

(b) -4.5

(c) 0.5

5. Suppose that total revenue is $R(x) = 50x - 0.5x^2$ and total cost is $C(x) = 10x + 3$ (both given in dollars), where x represents the number of units of a product that are produced and sold. Find the rate of change of the profit with respect to time when $x = 10$ units and $dx/dt = 5$ units per day.

   (a) \$200 per day
   (b) \$150 per day
   (c) \$80 per day
   (d) \$50 per day

6. Two cars start from the same point at the same time. One travels north at 25 mph, and the other travels east at 60 mph. How fast is the distance between them increasing at the end of 2 hours? (Remember: $x^2 + y^2 = z^2$.)

   (a) 60 mph
   (b) 25 mph
   (c) 130 mph
   (d) 65 mph

7. A ladder 25 ft long leans against a vertical wall. If the lower end is being moved away from the wall at a rate of 6 ft/s, how fast is the height of the top changing (the answer will be a negative rate) when the lower end is 7 ft from the wall?

   (a) -6 ft/s
   (b) 1.75 ft/s
   (c) -1.75 ft/s
   (d) -2.083 ft/s

8. Which of the following is **true**?
   (a) $e = \lim_{n\to\infty}\left(1+\frac{1}{n}\right)^n$
   (b) $e^0 = 1$
   (c) $e^1 = e$
   (d) All of the above

9. For $f(x) = e^x$, which of the following statements is **false**?
   (a) f' is negative for all x.
   (b) $f''(x)$ is positive for all x.
   (c) The graph of f has no points of inflection.
   (d) The graph of f is increasing.

10. Which of the following statements is **false**?
   (a) $\ln(AB) = \ln(A) + \ln(B)$
   (b) $\ln(A/B) = \ln(A) - \ln(B)$
   (c) $e^{\ln(x)} = x$
   (d) $\ln(x^r) = r\ln(x^{r-1})$

11. For $g(x) = \ln(x)$, which of the following statements is **false**?
   (a) The graph of g is concave down.
   (b) $g''(x)$ is positive for all x in the domain of g.
   (c) The graph of g has no relative extrema.
   (d) The domain of g is $(0, \infty)$.

12. If $y = e^2$, then dy/dx is
   (a) $2e$
   (b) 0
   (c) 2.718
   (d) None of the above.

13. If $y = \ln(3)$, then dy/dx is
   (a) 1/3
   (b) 1.10
   (c) 0
   (d) None of the above.

14. Find $f'(x)$ for $f(x) = \frac{1}{15}e^{2x^2+10} + \ln(3)$.

(a) $\frac{1}{15}e^{2x^2+10}(4x)$

(b) $\frac{1}{15}e^{2x^2+10}(2x^2+10)$

(c) $\frac{1}{15}e^{2x^2+10}$

(d) $\frac{1}{15}e^{2x^2+9}(2x^2+10)$

15. Find $g'(x)$ for $g(x) = xe^{-3x}$.

(a) $e^{-3x}(-3)$

(b) $e^{-3x} - 3xe^{-3x}$

(c) $e^{-3x} + x(-3x)e^{-3x-1}$

(d) $e^{-3x} + xe^{-3x}$

16. Differentiate $y = (\ln x)^{13} + e^{\ln x}$.

(a) $\frac{1}{x^{13}} + 1$

(b) $13(\ln x)^{12}\frac{1}{x} + 1$

(c) $13(\ln x)^{12}\frac{1}{x} + e^{\ln x}$

(d) $13(\ln x)^{12} + x$

17. Differentiate $y = \ln\left(\frac{x^7+8}{x^{10}}\right)$.

(a) $\frac{1}{\frac{x^7+8}{x^{10}}}$

(b) $\ln(x^7+8) - 10\ln x$

(c) $\frac{7x^6}{x^7+8} - \frac{10}{x}$

18. Find the approximate annual interest rate r compounded continuously so that an investment of \$500 will yield \$10,000 in ten years.

    (a) 30%
    (b) 2%
    (c) 20%
    (d) 3%

19. The concentration C, in parts per million, of a medication in the body t hours after ingestion is given by the function $C(t) = 10t^2e^{-t}$, where $t \geq 0$. Find the maximum value of the concentration and the time at which it occurs.

    (a) 5.4 ppm at $t = 2$ hr
    (b) 4.61 ppm at $t = 0.59$ hr
    (c) 2 ppm at $t = 5.4$ hr
    (d) There is no maximum concentration.

Use the following information to answer questions 20 and 21.

Suppose that $\mathbf{P_0} = \$1,000$ is invested in the Mandelbrot Bond Fund for which interest is compounded continuously at 5.9% per year. That is, the balance P grows at the rate given by

$$\frac{\mathbf{dP}}{\mathbf{dt}} = \mathbf{0.059P}.$$

20. What is the balance after 2 years?

    (a) \$1,125.24
    (b) \$1,060.78
    (c) \$2,121.56

21. In about how many years will an investment of \$1,000 double itself?

    (a) 1.22 years
    (b) 3.52 years
    (c) 11.75 years