Department of Mathematics and Statistics
Lake shore campus | 1032 W. Sheridan Road | Chicago, Illinois 60660
Phone 773.508.3558 | Fax 773.508.2123 | www.math.luc.edu

Math 117 - Fall 2021 - Common Final Exam, version A

Print name:_____

Did you have another exam 5:30 - 7:30 today (December 15)? Circle one: **Yes No**

Circle your class section below.

001 MWF 9:30-10:20 Law	002 MWF 10:50-11:40 Bourque	003 MWF 1:30-2:20 Bourque
004 MWF 4:10-5:00 Bourque		005 TTh 8:00 - 9:15 Sow
006 TTh 9:45-11:00 AM Sow	007 TTh 1:15-2:30 Varghese	008 TTh 3:00-4:15 Varghese
009 TTh 5:30-6:45 Siadat		010 MW 5:30-6:45 London

Directions:

- This exam has 16 questions. Please check that your exam is complete, but otherwise keep this page closed until the start of the exam is called.

- Fill in your name, schedule survey question, and section above.

- It will be graded out of 120 points. Your instructor may choose to scale this score appropriately to match the point value for the final exam on your section's syllabus and ground rules.

- Show your work. Answers (even correct ones) without the corresponding work will receive no credit.

- You may use a calculator. The use of any notes or electronic devices other than a calculator is prohibited.

Good luck!

Question:	1	2	3	4	5	6	7	8	9
Points:	9	9	6	7	5	6	7	8	7
Score:									

Question:	10	11	12	13	14	15	16		Total
Points:	10	4	10	8	4	10	10		120
Score:									

1. The graph below shows P, the population of a region in thousands of people, as a function of t, years since 2000.

(a) (3 points) Estimate the average rate of change $\frac{\Delta P}{\Delta t}$ over the interval $0 \leq t \leq 10$.

(b) (2 points) Give an interval of t values over which the average rate of change $\frac{\Delta P}{\Delta t}$ is negative.

(b) _____

(c) (2 points) Circle the interval below over which $\frac{\Delta P}{\Delta t}$ is **greatest**.

$$0 \leq t \leq 10 \qquad 6 \leq t \leq 10 \qquad 8 \leq t \leq 10$$

(d) (2 points) Circle any intervals below over which the graph of P is concave up.

$$2 \leq t \leq 4 \qquad 7 \leq t \leq 9 \qquad 12 \leq t \leq 14$$

2. A metal casting is being heat-treated in an industrial oven. The table below gives values for $h(t)$, the temperature of the casting t minutes after it is placed in the oven.

t (minutes)	0	8	16	24
$h(t)$ (° F)	1200	800	600	500

(a) (3 points) Find the average rate of change $\frac{\Delta h}{\Delta t}$ over the interval $0 \le t \le 8$. Give correct units and explain the meaning of this quantity in a sentence.

(b) (3 points) Does h appear to be an increasing or decreasing function? Explain your answer in a sentence.

(c) (3 points) Does h appear to be a concave up or concave down function? Explain your answer in a sentence with some work to back it up.

3. (6 points) Write an expression for the quadratic function whose graph is given below.
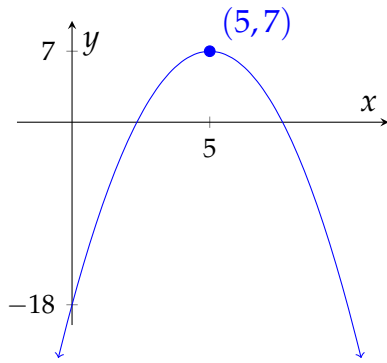
4. Suppose that $C = g(t)$ is the concentration (in parts per billion or ppb) of nitrogen dioxide in a residential kitchen t minutes after igniting a natural gas cooktop.

   (a) (2 points) If you were to graph C as a function of t, which variable would appear on the horizontal axis?

   (a) _____

   (b) (3 points) In a sentence, express the practical meaning of $g(15) = 200$.

   _____

   _____

   _____

   _____

   (c) (2 points) What are the units of the average rate of change $\frac{\Delta C}{\Delta t}$?

   _____

5. (5 points) Find the slope and intercept of the line represented by $2x + 4y = 3(x - 8)$, and write them in the spaces provided below.

(a) The slope is _____.

(b) The intercept is _____.

6. The cost, in dollars, for producing x cuckoo clocks is $C(x) = 1200 + 45x$.

(a) (3 points) Find a formula for the inverse $C^{-1}(y)$.

(b) (3 points) Explain in a sentence the meaning of the quantity $C^{-1}(6150)$.

7. In 2000, the North Bay fishing industry brought in 550 tons of fish. The annual catch in North Bay is decreasing linearly by 20 tons per year.

   (a) (3 points) Write an expression for $g(t)$, the quantity of fish caught by the North Bay fishing industry (in tons) t years after 2000.

   (b) (4 points) How long will it take for the quantity to decrease to 0? Show work to support your answer.

8. The graph of $y = f(x)$ passes through the points $(2, 4)$ and $(6, 108)$.

   (a) (4 points) Find an expression for $f(x)$ if f is a linear function of the form $f(x) = mx + b$.

   (b) (4 points) Find an expression for $f(x)$ if f is a power function of the form $f(x) = kx^p$.

9. Below is the graph of $y = f(x)$ (solid line) and the graph of $y = g(x)$ which is obtained by some transformations of f.
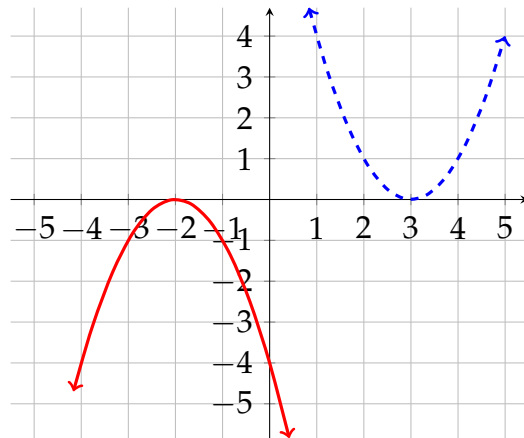
(a) (4 points) Describe the transformations in words.

_____

_____

_____

_____

(b) (3 points) Write a formula for $g(x)$ in terms of $f(x)$.

10. Ellen was hired at the start of 2018. Her contract states that her hourly pay will be $f(t)$ dollars t months after she was hired.

(a) (3 points) Louie is hired 6 months after Ellen, and is paid according to the same pay scale as Ellen. Write an expression in terms of f for Louies pay t months after the start of 2018.

(b) (3 points) Sara was hired at the same time as Ellen, and the pay for her position is twice as much as Ellen's position for the same amount of seniority. Write an expression in terms of f for Sara's pay t months after the start of 2018.

(c) (4 points) Suppose $f(8) = 12$. Fill in the blanks with values you can infer from this.

  ● _____ months after the start of 2018, Ellen's pay is _____ dollars per hour.

  ● _____ months after the start of 2018, Sara's pay is _____ dollars per hour.

11. (4 points) The point $(-3, 8)$ is on the graph of $y = f(x)$. Give the coordinates of one point on the graph of $y = -f(\frac{1}{2}(x+1))$.

12. A researcher has discovered a revolutionary new material with the property that its electrical resistance (measured in Ohms) is proportional to the square root of its temperature (measured in degrees Celsius).

   (a) (4 points) Find an expression for the material's resistance R as a function of its temperature T. Your answer will contain a constant k.

   (b) (3 points) The researcher determines that when the material's temperature is $64°C$, its resistance is 280 Ohms. Find k and rewrite your answer from part a) using it.

   (c) (3 points) At what temperature does the material have a resistance of 105 Ohms?
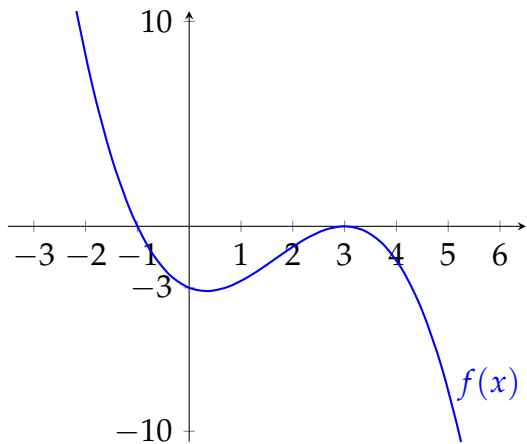
13. Consider the polynomial function $y = (x^2 - 16)(x^2 + 2x - 3)$.

    (a) (2 points) Find the leading term.

    (b) (2 points) Find the degree.

    (c) (4 points) Find all zeros.

14. (4 points) Find an expression of minimum degree for the polynomial graphed below.

15. Suppose that the rabbit population on Mr. Jenkins' farm follow the formula

$$p(t) = \frac{3000t + 200}{t + 1}$$

where $t \geq 0$ is the time (in years) since he started farming.

(a) (3 points) What is the population of rabbits when Mr. Jenkins starts farming?

(b) (4 points) Fill in the following limit statement, and then write a sentence to explain what happens to the rabbit population in the long run?

$$\lim_{t \to \infty} \frac{3000t + 200}{t + 1} = \underline{\hspace{2cm}}$$

(c) (3 points) How long does it take for the rabbit population to reach 1000?

16. Let $f(x) = \frac{(x - 1)(x - 2)(x + 5)}{(x + 7)(2x + 9)(x + 5)}$.

(a) (2 points) Find the x coordinates of the holes (if any) in the graph of $y = f(x)$.

(b) (2 points) Find the equation for each vertical asymptote, if any.

(c) (2 points) Find the equation for each horizontal asymptote, if any.

(d) (2 points) Find the x-intercepts, if any.

(e) (2 points) Find the y-intercept, if any.