LOYOLA UNIVERSITY CHICAGO
1870 AD · MAJOREM · DEI · GLORIAM

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Math 110 - Fall 2025 - Common Final Exam

Print name:_____

Section number:_____ **Instructor's name:**_____

Directions:

- **Do not open your exam until you are instructed to do so by your instructor.**
- Fill in your name, your instructor's name, and section number. If you don't know your section number, write the day and time that your class normally meets (example: MWF 8:15-9:05).
- This exam has 14 questions. Once the exam has begun, please check to make sure that your exam is complete.
- It will be graded out of 100 points.
- Show your work. Answers (even correct ones) without the corresponding work will receive no credit.
- A formula sheet has been provided with this exam. You may not refer to any other notes during the exam.
- You may use a calculator which does not allow internet access. The use of any notes or electronic devices other than a calculator is prohibited. Please remove any earbuds/headphones that you are wearing.
- **Unless otherwise stated, round any constants to two decimal places if necessary.**

Good luck!

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

Question:	9	10	11	12	13	14		Total
Points:	8	6	9	8	10	3		100
Score:								

1. (8 points) Consider the function $f(x) = 2x^2 + 10x - 48$.
   (a) Find the zeros of $f(x)$

   (b) Is $f(x)$ concave up, concave down, or neither? State why.

2. (8 points) For each part of this problem, circle **all** of the expressions which could be formulas for the function described. There could be more than one answer for each part.
   (a) The function $f(x)$ has a domain of all real numbers
      1. $3x + 5$
      2. $4x^2$
      3. $\ln(x - 3)$
      4. e^{3x}
      5. $8x^5 - 4x^3 + 2x - 9$
      6. $\sqrt{2x - 4}$
      7. $\dfrac{3}{x - 5}$
      8. None of these

   (b) The function $g(x)$ has a range of all real numbers
      1. $3x + 5$
      2. $4x^2$
      3. $\ln(x - 3)$
      4. e^{3x}
      5. $8x^5 - 4x^3 + 2x - 9$
      6. $\sqrt{2x - 4}$
      7. $\dfrac{3}{x - 5}$
      8. None of these

3. (6 points) The point $(3, -5)$ is on the graph of $f(x)$. What point must be on the graph of...
   (a) $g(x) = f(x-2)+4$

   (b) $h(x) = f(x+9)-2$

4. (8 points) The tuition for Fred University is dependent on the number of credit hours a student is taking in a given semester. If a student is taking less than 12 credit hours, the student must pay \$800 per credit hour along with an additional fee of \$5000. If a student is taking 12 or more credit hours, they must pay 600 per credit hour with along with an additional fee of \$4000. The university will not allow any student to take more than 24 credit hours in a semester, and a student must take at least one credit hour.
   (a) Find a piece-wise formula for the tuition, T, for a student taking C credit hours.

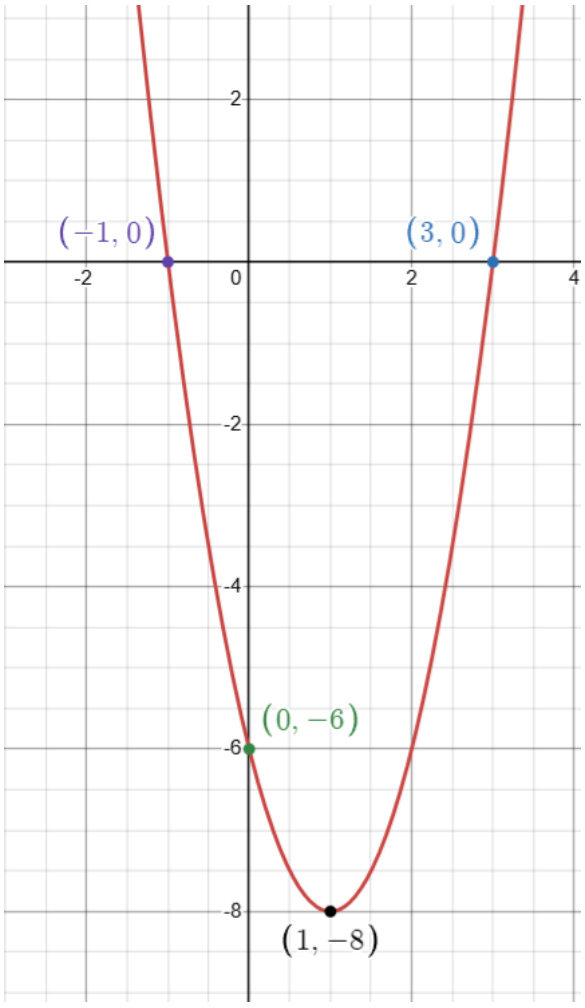
   (b) What is the domain of this function?

5. (6 points) The profits of a new company are directly proportional to the cube root of the amount of money that it spends on advertising. The profit of the company will be \$300 if they spend \$1000 on advertising.

   (a) Write a formula for the profit, P, as a function of the amount spent on advertising, A.

   (b) Find the profit if \$125,000 is spent on advertising.

6. (6 points) Find the formula for the quadratic function $f(x)$ graphed below.



7. (9 points) The population of a town is $70,000$ in the year 2025. Recall that a linear function has a general form of $P = mt + b$ and an exponential function has a general form of $P = a \cdot b^t$.

   (a) If the population of the town is decreasing by 800 per year, find a formula for the function $P(t)$, the population t years after 2025.

   (b) If the population is instead increasing by 3% per year, find a formula for the function $P(t)$, the population t years after 2025.

   (c) Using your formula from part b, find the year the population will hit $150,000$. Round to the nearest whole number.

8. (5 points) Dariya starts a new marketing firm. The profits of her business are increasing at a rate of 1.82% per year. Find the time it takes, in years, for her profits to double.

9. (8 points) Determine if each function below is linear, exponential, or neither. Then, find a formula for the function or explain why it cannot be done.

(a)

x	1	3	5	7
$f(x)$	18	2	$\frac{2}{9}$	$\frac{2}{81}$

(b)

x	1	3	5	7
$f(x)$	4	12	-5	42

10. (6 points) Jolena opens a bank account with an initial deposit of $\$4,000$. It earns interest at a nominal rate of 7% per year.

    (a) Find the balance of their account after 6 years if interest is compounded as follows. Round each answer to the nearest dollar.

    (i) Annually (once per year).

    (ii) Daily (365 times per year).

11. (9 points) Let $f(x) = 8x - 2$, $g(x) = -4x + 3$ and $h(x) = e^x$. Find the following, and simplify your answers completely:

    (a) $g(f(5))$

    (b) $h(f(x))$

    (c) $f^{-1}(x)$

12. (8 points) Consider the exponential function $Q = 10e^{-0.28t}$. Let t be measured in years.

    (a) Determine if this function displays exponential growth or decay.
    Circle one: **exponential growth** or **exponential decay**. Explain your answer in a sentence.

    (b) Give the initial value for this function.

    (c) Give the continuous growth rate for this function. Write your answer as a percentage.

    (d) Write the given function in the form $Q = ab^t$.

    (e) Find the percentage the function increases/decreases by per year. If the quantity is decreasing, write your percentage as a negative percentage.

13. (10 points) Assume $R = f(t) = 1200(1.82)^t$ is the revenue, in thousands of dollars, of a business t years after 2025.

(a) Evaluate $f(6)$. Round to the nearest whole number.

(b) Describe in words what the quantity you calculated in part (a) represents. Write your answer in a complete sentence with units.

(c) Find a formula for $f^{-1}(R)$ in terms of R. Give an exact answer.

(d) Evaluate $f^{-1}(20000)$. Round to the nearest whole number.

(e) Describe in words what the quantity you found in part (d) represents. Write your answer in a complete sentence with units.

14. (3 points) Give an example of something that you learned in your course that will be useful in your future career and/or everyday life.

Average rate of change: $\dfrac{f(b)-f(a)}{b-a}$

Slope-intercept form: $y = b + mx$

Point-slope form: $y - y_0 = m(x - x_0)$

Standard form: $Ax + By = C$

Quadratic function: $y = ax^2 + bx + c$

Factored form: $y = a(x - r)(x - s)$

Quadratic formula: $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Vertex form: $y = a(x - h)^2 + k$

Power function: $y = kx^p$

Directly proportional: $y = kx$

Inversely proportional: $y = \dfrac{k}{x}$

Factored form of a polynomial: $p(x) = c(x - a_1)(x - a_2) \cdots (x - a_n)$

Exponential Function: $Q(t) = a \cdot b^t$

Continuous Exponential Function: $Q(t) = a \cdot e^{kt}$

Simple Interest: $B = P(1 + r)^t$

Compound Interest: $B = P\left(1 + \dfrac{r}{n}\right)^{nt}$

Common Logarithm $y = \log(x) \longleftrightarrow 10^y = x$ for $x > 0$

Natural Logarithm $y = \ln(x) \longleftrightarrow e^y = x$ for $x > 0$