# Math 101, Final Exam
May 2, 2017

Name: _____     UNL Student ID Number: _____

Indicate your section/instructor.

| Question | Points | Score |
|----------|--------|-------|
| 1 | 18 | |
| 2 | 15 | |
| 3 | 17 | |
| 4 | 10 | |
| 5 | 17 | |
| 6 | 14 | |
| 7 | 16 | |
| 8 | 15 | |
| 9 | 10 | |
| 10 | 18 | |
| Total: | 150 | |

☐  Section 001   Nir         ☐  Section 002   Hong

☐  Section 003   Egging      ☐  Section 004   Funk

☐  Section 005   Wakefield   ☐  Section 006   Holmes

☐  Section 007   Martin      ☐  Section 008   DeClerk

☐  Section 009   Miller      ☐  Section 010   Reichenbach

☐  Section 011   Longo       ☐  Section 101   Huben

☐  Section 171   Bills

Answer the questions in the spaces provided on the question sheets. Show an appropriate amount of work (including appropriate explanation) for each problem, so that graders can see not only your answer but also how you obtained it. Include units in your answer when possible. You may receive 0 points for a problem where you show no work.

**Instructions:**

1. Do not open this exam until told to do so.

2. <u>No</u> books or notes may be used on the exam.

3. Credit or partial credit will be given <u>only</u> when the appropriate explanation and/or algebra is shown.

4. Make sure your answer is clearly marked.

5. Read and follow directions carefully.

6. This exam has 10 questions, for a total of 150 points. There are 8 pages. Make sure you have them all.

7. You will have <u>90 minutes</u> to complete the exam.

8. All cell phones and electronic devices (other than calculators) must be turned off during the exam.

9. Do not separate the pages of this exam. If they do become separated, write your name on every page and point this out to your instructor when you hand in the exam.

10. You may only use an *approved* calculator on the exam. No calculators with a CAS or QWERTY keyboards are allowed.

11. If you use graphs or tables to find an answer, be sure to include an explanation and sketch of the graph, and to write out the entries of the table that you use.

1. [18 points] A floor refinishing company charges \$1.83 per square foot to sand and refinish a hard-wood floor. In addition to the cost per square foot, they charge \$400 for equipment use and waste disposal.

   (a) Write an equation $C(x)$ representing the cost of refinishing a floor that is $x$ square feet.

   (b) Evaluate **and** interpret $C(400)$. *Write your interpretation in a complete sentence with units.*

   (c) Sam didn't measure his kitchen before having the refinishing company come and refinish his hard-wood floor. However, he knows that the total bill was \$1223.50. How many square feet is his kitchen? *Show all work.*

2. [15 points] Use the graphs below to evaluate $f(x)$ and $g(x)$.
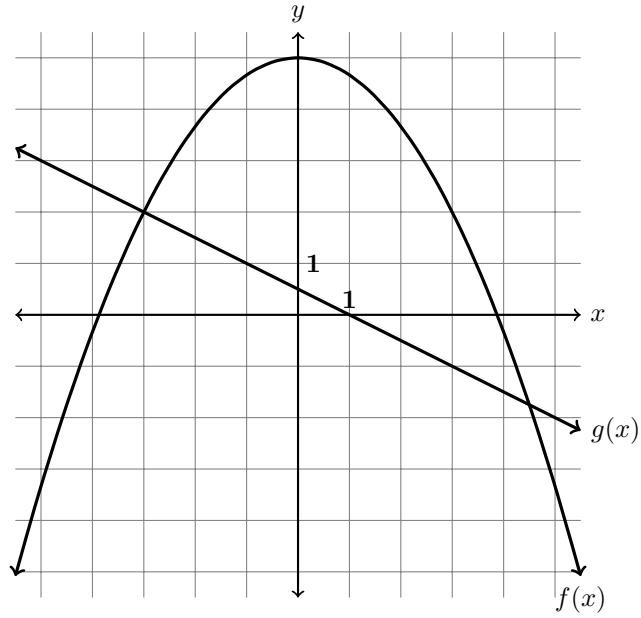


Calculate the following. *Show all work.*

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

(b) $f(0) - g(0)$

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

(d) $g(f(3))$

3. [17 points] The population of elk in a national park $t$ years after 2015 is given by the equation

$$P = f(t) = 400(1.1)^t.$$

(a) Evaluate **and** interpret $f(2)$. *Write your interpretation in a complete sentence with units.*

(b) Write an equation for $f^{-1}(P)$.

(c) Evaluate **and** interpret $f^{-1}(510)$. *Write your interpretation in a complete sentence with units.*

4. [10 points] Write an equation for the quadratic function whose graph has a $y$-intercept at $y = 40$ and $x$-intercepts at $x = 5$ and $x = -4$.

5. [17 points] The department of wildlife has been studying the population of catfish and bluegill in Waterford lake since 2012. The following table reports their findings. *Note: Catfish and bluegill are species of fish found in Nebraska lakes.*

| Year | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|
| Catfish | 25 | 28 | 31 | 34 | 37 |
| Bluegill | 500 | 550 | 605 | 665 | 732 |

(a) Is the population of catfish modeled better by a linear, exponential, or polynomial function? Write an equation for this function in terms of $t$, the number of years since 2012. *Be sure to use methods we have learned in this course to explain why this function gives the best model. Write your explanation in a complete sentence.*

(b) Is the population of bluegill modeled better by a linear, exponential, or polynomial function? Write a formula for this function in terms of $t$, the number of years since 2012. *Be sure to use methods we have learned in this course to explain why this function gives the best model. Write your explanation in a complete sentence.*

(c) If this trend continues, how many catfish should the state expect to find in Waterford lake in 2017?

6. [14 points] Solve the following equations for $x$ using only common log, natural log, or exponentials. *Give an exact answer, not an approximation.*

(a) $3^x = 12$

(b) $\log(x + 2) = 3$

(c) $144 = 12(1.3)^{3t}$

7. [16 points] The graph of $y = f(x)$ contains the point $(6, -3)$. What point must lie on the following graphs? *Show all work.*

(a) $f(x + 2)$

(b) $-f(x)$

(c) $2f(-x)$

(d) $3(f(x) - 1)$

(e) $f(2x + 4)$

8. [15 points] An astronaut throws a rock while on another planet. The height, in feet, of the rock $t$ seconds after it was thrown can be modeled by the equation

$$h(t) = -2(t-2)^2 + 18.$$

(a) When does the rock reach its maximum height? *Write your answer in a complete sentence with units.*

(b) What is the rock's maximum height? *Write your answer in a complete sentence with units.*

(c) When does the rock hit the surface of the planet? *Show all work. Write your answer in a complete sentence with units.*

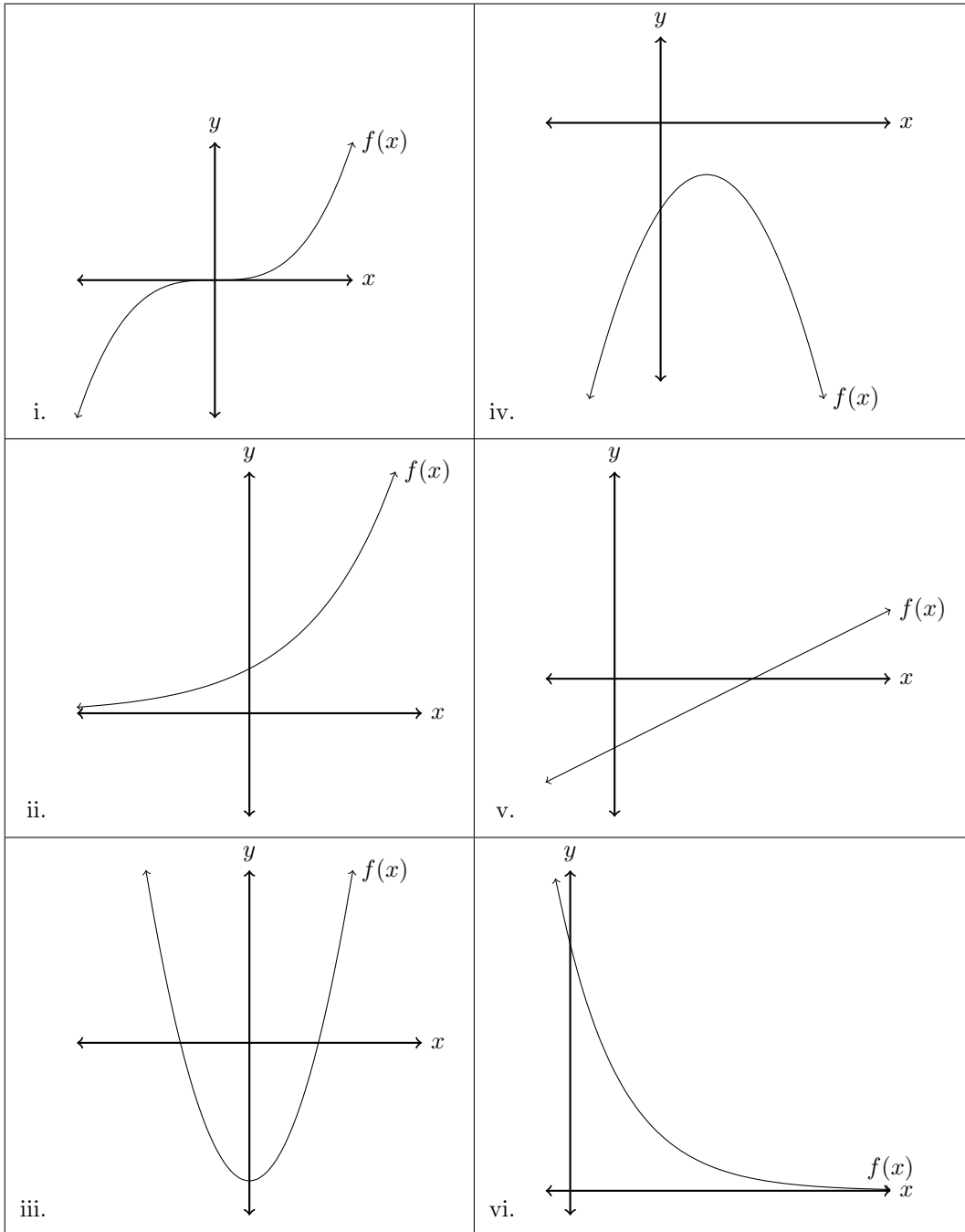9. [10 points] Match each of the equations below with its graph.

(a) $y = (x+2)(x-2)$ _____

(d) $y = \frac{1}{4}x^3$ _____

(b) $y = 100\left(1 - \frac{0.04}{12}\right)^{12x}$ _____

(e) $y = -\frac{1}{2}(x-2)^2 - 3$ _____

(c) $y = \frac{1}{2}x - 2$ _____

i.

iv.

ii.

v.

iii.

vi.

10. [18 points]

(a) For each of the functions below, determine the long-run behavior, horizontal asymptotes, vertical asymptotes, zeros, and holes. *If the function does not have any vertical asymptotes, horizontal asymptotes, zeros, and/or holes, write "None".*

$$f(x) = \frac{x-2}{(x-3)(x-2)}$$

- Long-run behavior:

  As $x \to \infty$, $f(x) \to$ _____

  As $x \to -\infty$, $f(x) \to$ _____

- Horizontal Asymptotes: _____

- Vertical Asymptotes: _____

- Zeros: _____

- Holes: _____

$$g(x) = \frac{(x-1)(x+1)}{(x+1)(x-4)}$$

- Long-run behavior:

  As $x \to \infty$, $g(x) \to$ _____

  As $x \to -\infty$, $g(x) \to$ _____

- Horizontal Asymptotes: _____

- Vertical Asymptotes: _____

- Zeros: _____

- Holes: _____

(b) Sketch a graph of $f(x)$.