

Math 120 - Autumn 2016
Final Exam
December 10, 2016

Name: _____

Student ID no. : _____

Signature: _____

Section: _____

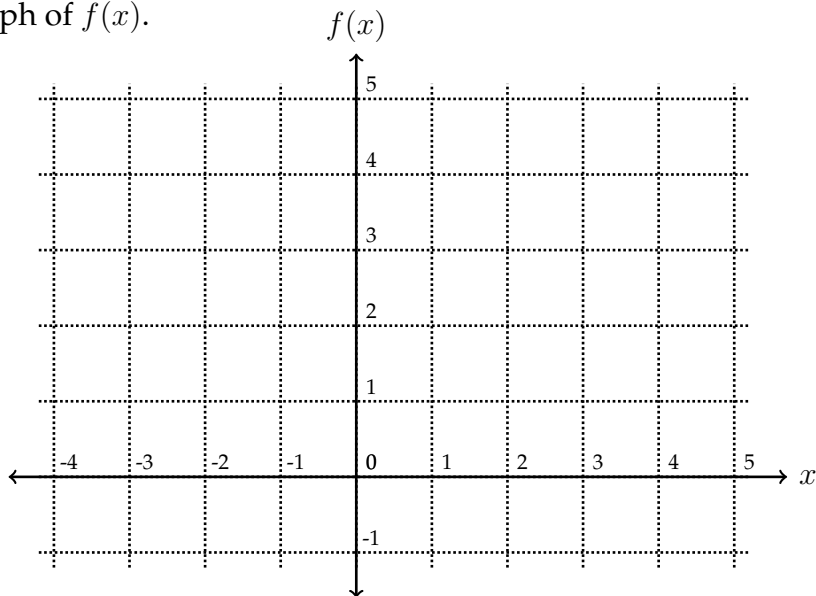
| | | |
|-------|-----|--|
| 1 | 15 | |
| 2 | 16 | |
| 3 | 14 | |
| 4 | 14 | |
| 5 | 15 | |
| 6 | 14 | |
| 7 | 12 | |
| Total | 100 | |

- This exam consists of SEVEN problems on EIGHT pages, including this cover sheet.
- Show all work for full credit.
- You may use a TI-30X IIS calculator during this exam. Other calculators and electronic device are not permitted.
- You do not need to simplify your answers.
- If you use a trial-and-error or guess-and-check method when a more rigorous method is available, you will not receive full credit.
- If you write on the back of the page, please indicate that you have done so!
- Draw a box around your final answer to each problem.
- You may use one hand-written double-sided 8.5" by 11" page of notes.
- You have 170 minutes to complete the exam.

1. [5 points per part] For parts (a) through (c), consider the following multipart function:

$$f(x) = \begin{cases} 1 + \sqrt{9 - x^2} & \text{if } -3 \leq x < 0 \\ 2x & \text{if } 0 \leq x \leq 2 \\ 1 & \text{if } 2 < x \leq 4 \end{cases}$$

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



(b) Find all values of x such that $f(x) = -2x + 2.2$.

(c) Let $g(x)$ be the function found by taking the graph of $f(x)$ and shifting it 1 unit left.

Write the multipart rule for $g(x)$.

2. (a) **[4 points]** A mysterious red dot is moving through the xy -plane at a constant speed. At time $t = 0$, it starts at $(-1, -1)$. It moves in a straight line towards the point $(31, 13)$, reaching it in 10 seconds.
- Write parametric equations for the red dot's coordinates after t seconds.

- (b) **[5 points]** Fungo is also moving in the xy -plane. At time $t = 0$, he starts at $(2, 6)$. Fungo runs in a straight line towards $(8, -2)$ at a speed of 2 units per second.
- Write parametric equations for Fungo's coordinates after t seconds.

- (c) **[7 points]** When is Fungo closest to the red dot?

3. The population of Threattle triples every ten years.

Four years from now, there will be 10,000 more people in Threattle than there are today.

(a) [6 points] Write a function $f(x)$ for the population of Threattle x years from today.

(b) [6 points] Compute the inverse of the function you found in part (a).

(c) [2 points] In one sentence, explain the meaning of the inverse function you found.

4. **[14 points]** Angelica and Eliza are standing 100 meters apart, and Peggy is standing exactly halfway between them. Somewhere else in between them is a tree.

From where they stand, Angelica, Eliza, and Peggy all measure the angle of elevation of the top of the tree above the ground.

Angelica measures it to be 32° . Eliza measures it to be 27° .

What measurement does Peggy get?

5. $f(x)$ is a linear-to-linear rational function whose graph has a horizontal asymptote of $y = 5$ and passes through the points $(1, -10)$ and $(2, -35)$.

(a) [7 points] Write a formula for $f(x)$.

(b) [2 points] What is the domain of $f(x)$?

(c) [6 points] Let $g(x) = f(f(x))$. Find the asymptotes of $g(x)$.

6. **[14 points]** The temperature in Meereen is a sinusoidal function of time.

The temperature will decrease for the next 5 years until it reaches a minimum of 20° . Then the temperature will climb until 21 years from now, when it reaches a maximum of 80° .

Dany is unhappy when the temperature in Meereen is below 70° . Over the next 100 years, for how long will she be unhappy?

7. (a) **[12 points]** Essun is running 3 meters per second clockwise around a circular track. From her starting point, it takes her 9 seconds to reach the northernmost point of the track, and then an additional 13 seconds to reach the easternmost point of the track. After 2 minutes, how far east is Essun from the westernmost point of the track?

- (b) **[0 points]** You're done! Please check your work, then enjoy this celebratory maze. Help Essun get to the exit. Unfortunately, after spending so much time running clockwise, she has forgotten how to turn left.

