

Math 120 Autumn 2017  
Final Exam  
December 9, 2017

Name: \_\_\_\_\_

Student ID no. : \_\_\_\_\_

Signature: \_\_\_\_\_

Section: \_\_\_\_\_

1	10	
2	10	
3	10	
4	10	
5	10	
6	10	
7	10	
Total	70	

- Complete all seven questions.
- Show all work for full credit.
- The only calculator you may use during this exam is a TI-30XIIs. All other electronic devices are not allowed, and should be turned off and put away for the duration of the exam.
- If you use a trial-and-error or guess-and-check method when an algebraic method is available, you will not receive full credit.
- You may use one, two-sided, hand-written 8.5 by 11 inch page of notes. Write your name on your notesheet and turn it in with your exam.
- You have 170 minutes to complete this exam.

1. Chuckster and Jarley are walking around the coordinate plane.

Chuckster begins at  $(37, -5)$  and walks in a straight line at constant speed towards  $(3, -57)$ , reaching it in 10 seconds.

Jarley begins at  $(17, 20)$  and walks towards  $(50, -36)$  at a speed of 13 units per second.

(a) Write parametric equations for Chuckster's coordinates after  $t$  seconds.

(b) Write parametric equations for Jarley's coordinates after  $t$  seconds.

(c) When are Chuckster and Jarley closest together?

2. For this problem,  $f(x)$  is some function, and  $g(x) = 2f(-x) - 5$ .

(a) The table on the right shows some values of  $f$ . Find  $g(g(-2))$ .

$x$	$f(x)$
-2	3
-1	1
0	2
1	4
2	2

(b) Explain what transformations are needed to change the graph of  $y = f(x)$  into the graph of  $y = g(x)$ .

(Do scratch work here, then fill in the blanks below.)

• First, you \_\_\_\_\_.

• Then, you \_\_\_\_\_.

• Finally, you \_\_\_\_\_.

(c) Suppose that  $f(x)$  has domain  $(-3, 7)$  and range  $[1, 5]$ .

Find the domain and range of  $g(x)$ .

3. Gary the gull is hovering above the Puget Sound. His height in feet above the Sound after  $t$  seconds is given by the following:

$$H(t) = \begin{cases} 40 & 0 \leq t \leq 6 \\ t^2 - 22t + 136 & 6 < t \leq 13 \\ 19 & 13 < t \leq 15 \\ 8t - 101 & 15 < t \leq 20 \end{cases}$$

- (a) What is the range of  $H$ ?

- (b) Another gull, Gertrude, is hovering above the Sound. Her height is given by  $g(t) = 2t + 1$ . When are Gertrude and Gary at the same height?

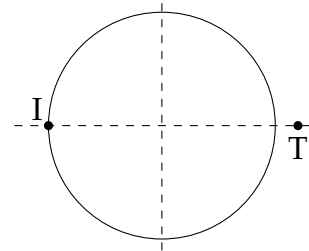
4. A farming town in Idaho grew 168,000 potatoes in 2008. The population of the town that year was 1200. In 2012 the population was 1414. The number of potatoes the town produces per year doubles every 6 years.

(a) Give an exponential function in the form  $y = Ab^t$  relating the population  $y$  of the town to the year  $t$ . (Take  $t = 0$  in 2008).

(b) Give an exponential function in the form  $z = Ab^t$  relating the number of potatoes  $z$  to the year  $t$ .

(c) In what year will they grow 300 potatoes for each person in the town?

5. Isobel is jogging **clockwise** around a circular race track. The distance around the track is  $\frac{1}{4}$  mile. Isobel jogs at a constant speed of 5 miles per hour. Tafu starts his stopwatch when Isobel is at the due West point on the track. Tafu is standing 10 feet East of the edge of the track. (See the picture.)



- (a) Give parametric equations for Isobel's position as a function of time. Measure distance in feet and time in minutes. (There are 5280 feet in a mile.)
- (b) After 35 minutes, Isobel stops for a rest. What is her distance from Tafu at this time?

6. You're standing in a field thinking about trigonometry when you notice a dinosaur off in the distance, running towards you at a constant speed.

Oh no.

From your position, the top of the dinosaur's head is at an angle of  $4^\circ$  above the horizon.

You wait one minute pondering the situation, then measure the angle again. Now it's  $6^\circ$ !

So you run away at a speed of 12 feet per second. One minute later, you measure the angle and find it to be  $7^\circ$ .

This is really bad. How tall is that dinosaur?

7. The secret to cooking Sine Stew is to use a special pressure cooker whose pressure varies as a sinusoidal function of time.

When you turn on the pressure cooker, it's at a minimum pressure of 10 psi. The pressure then increases until 9 minutes later, when it reaches a maximum of 13 psi.

(a) Write a function for the pressure in the pressure cooker after  $t$  minutes.

(b) To make the perfect Sine Stew, you must turn off the pressure cooker when the stew has been above 12 psi for exactly 17 minutes.

After starting the pressure cooker, how long should you wait before turning it off?