

# Math 110 Exam #2

October 21, 2015

**Time:** 1 hour and 25 minutes  
**Instructions:** Show all work for full credit.  
No outside materials or calculators allowed.  
**Extra Space:** Use the backs of each sheet for extra space. Clearly label when doing so.

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

**ID #:** \_\_\_\_\_

**Instructor/Section:** \_\_\_\_\_

*"I pledge by my honor that I have abided by the NJIT Academic Integrity Code."*

\_\_\_\_\_ (Signature)

Problem(s)	Score	Total

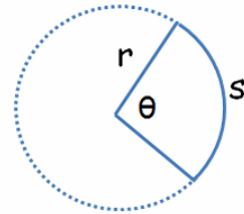
### Relevant Formulas for this Exam:

Circular motion and equations relating to a sector of a circle, radius  $r$  (as shown to the right).

$$A = \frac{1}{2}\theta r^2 \quad (\text{where } A \text{ is the area of the sector cut out by } \theta)$$

$$s = r\theta \quad (\text{where } s \text{ is the arc length as shown})$$

$$v = \omega r \quad (\text{where } v \text{ is velocity and } \omega \text{ is angular velocity})$$



1. Evaluate the following. Also show or state which quadrant or axis each angle is in. **(9 pts):**

a.  $\tan\left(\frac{-3\pi}{4}\right)$

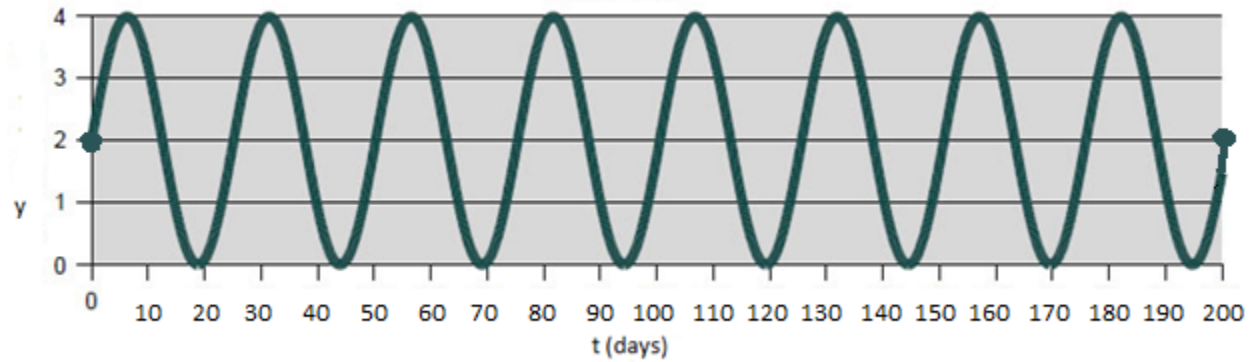
b.  $\sin\left(\frac{6\pi}{4}\right)$

---

c.  $\csc\left(\frac{39\pi}{4}\right)$

2. For  $\theta = \frac{25\pi}{7}$  determine which quadrant the angle lies in and calculate its reference angle:  
**(3 points)**

3. The graph below pictures a sine wave of the form  $y = A\sin(\omega t) + B$  where  $A$ ,  $\omega$ , and  $B$  are constants. Find the values of the three constants. **(5 points)**



4. If  $\tan \theta = \frac{1}{2}$  and  $\sin \theta < 0$  find the trig evaluation of  $\theta$  for the other 5 trigonometric functions.  
You may leave answers not rationalized: **(7 points)**

5. In the following triangle, if  $\sin(\theta) = 1/8$ , find  $\cos(\theta)$  and the side length  $x$ . Rationalize and simplify your answers. **(8 points)**



6. The kangaroo population,  $K$ , in a certain region is given by the function **(12 points)**

$$K(t) = 500 + 150 \sin\left(\frac{\pi}{6}t\right) \text{ with time } t \text{ measured in years (with } t=0 \text{ being the year 2000)}$$

- What is the largest number of kangaroos present at any given time?
- How many kangaroos are present in 2007?
- When the kangaroo population is at a minimum, how long will it take for the population to return to a maximum?

7a. Sketch one period of the following function, showing all quarter period points. **(8 points)**

$$f(x) = 3 \sin\left(\frac{1}{2}x + \frac{\pi}{2}\right)$$

7b. Sketch two periods of the following function, showing all quarter period points. **(8 points)**

$$f(x) = -2 \cos(\pi x) + 1$$

8. Fill in the blank to complete the trig identities or a fully simplified expression: **(24 points)**

a.  $6\sin^2 x + 6\cos^2 x =$  \_\_\_\_\_

c.  $\tan^2(10x) - \sec^2(10x) =$  \_\_\_\_\_

b.  $\log_2\left(\csc\frac{3\pi}{4}\right) =$  \_\_\_\_\_

d.  $\frac{\cos^2 \theta}{\sin^2 \theta} \tan \theta =$  \_\_\_\_\_

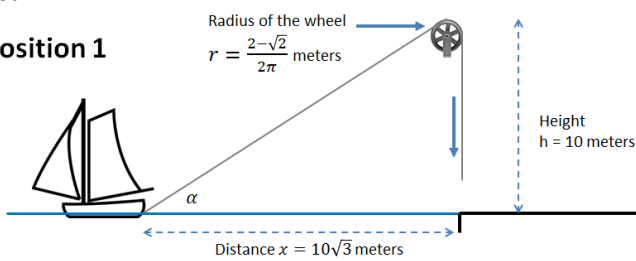
8e. Given that  $4\sin^2(\theta) = k$  evaluate the expression  $2\cos^2(\theta) + 4\sin^2(\theta)$  in terms of k

8f. Fully simplify the following expression:  $\frac{\sqrt{16x^2 - 16}}{4x - 4}$

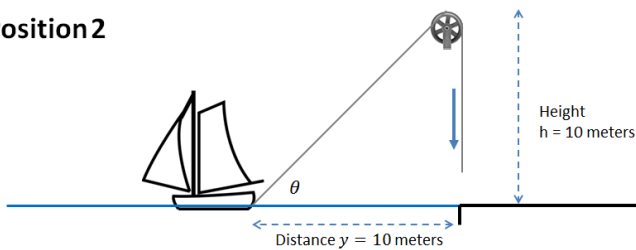
9. Suppose that the second hand on a clock is 6 inches long. Find the speed of the tip of the second hand in inches/second. **(6 points)**

10.

Position 1



Position 2



A boat is slowly being pulled into a dock by a rope as illustrated in the figure. In its initial position (Position 1) the boat is  $10\sqrt{3}$  meters away from the dock. After some time, its distance is reduced to 10 meters. The height of the pulley tower and the radius of the pulley wheel are shown. **(12 points)**

- Calculate the angles  $\alpha$  and  $\theta$
- How much rope is pulled in while the boat moves from Position 1 to Position 2?
- How many rotations does the pulley wheel complete during this time? Express the result in radians.