

By providing my signature below I acknowledge that I abide by the University's academic honesty policy. This is my work, and I did not get any help from anyone else:

Name (sign): \_\_\_\_\_

Name (print): \_\_\_\_\_

Student Number: \_\_\_\_\_

Instructor's Name: \_\_\_\_\_

Class Time: \_\_\_\_\_

Problem Number	Points Possible	Points Made
1	20	
2	28	
3	10	
4	10	
5	10	
6	13	
7	15	
8	10	
9	10	
10	10	
11	10	
12	10	
13	10	
Total:	166	

- If you need extra space use the last page. *Do not tear off the last page!*
- Please show your work. **An unjustified answer may receive little or no credit.**
- If you make use of a theorem to justify a conclusion then state the theorem used by name.
- Your work must be **neat**. If we can't read it (or cannot find it), we cannot grade it.
- The total number of possible points that is assigned for each problem is shown here. The number of points for each subproblem is shown within the exam.
- Please turn off your mobile phone.
- You are only allowed to use a TI-30 calculator. No other calculators are permitted.
- A calculator is not necessary, but numerical answers should be given in a form that can be directly entered into a calculator.
- Common identities:

$$\begin{aligned}\cos(\alpha + \beta) &= \cos(\alpha)\cos(\beta) - \sin(\alpha)\sin(\beta), \\ \sin(\alpha + \beta) &= \sin(\alpha)\cos(\beta) + \cos(\alpha)\sin(\beta).\end{aligned}$$

1. Please determine all values of  $x$  that satisfy each equation below. Print your answer(s) in the box provided.

\_\_\_\_\_ (a) [5 pts]  $\log_8(x^2 - 1) = 10,000$

$x =$

\_\_\_\_\_ (b) [5 pts]  $18 \cdot 11^{1-4x} = 14^x$

$x =$

(c) [5 pts]  $\sqrt{x^2 + 3x - 2} = 5$

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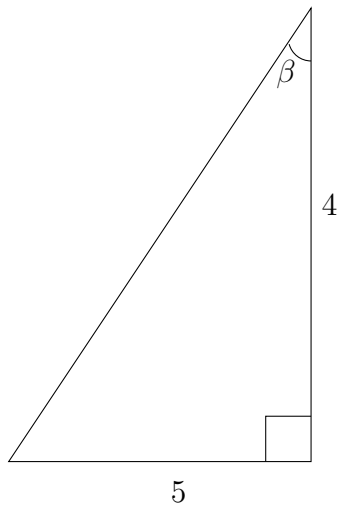
$x =$

(d) [5 pts]  $\tan(x) = -18.5$  where  $x$  is in the fourth quadrant and  $0 \leq x < 2\pi$ . (Your answer should be in radians and can be the exact answer or approximate the answer to within two decimal places.)

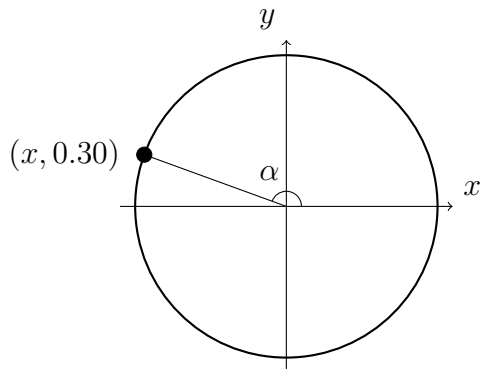
$x =$

2. Please determine the values of the requested quantities in each question below. Numerical values should be to within 0.01 of the true value. (**All angles are given in radians and should be expressed in radians if you have to determine their value.**)

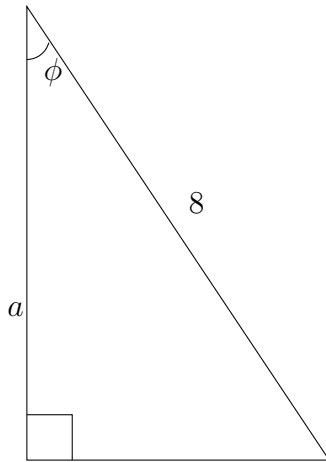
\_\_\_\_\_ (a) [7 pts] Please determine the cosine, sine, and tangent of the angle  $\beta$  in the diagram below.



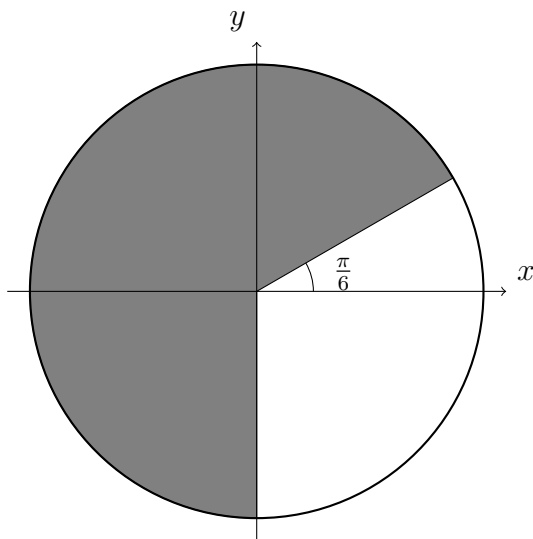
\_\_\_\_\_ (b) [7 pts] Please determine the cosine, sine, and tangent of the angle,  $\alpha$ , in the diagram below. The point shown is on the unit circle.



- (c) [7 pts] Please determine the length of the side  $a$  in the diagram below. Your answer should be exact or be within 0.01 of the true value. The angle  $\phi$  is 0.80 radians.



- (d) [7 pts] Please determine the area of the shaded region below. The circle has a **radius of two**.



3. In each question below the formula for a function is given, and a question is posed about the function.

\_\_\_\_\_ (a) [5 pts] Please determine if the function

$$b(x) = 3x^2 - 5$$

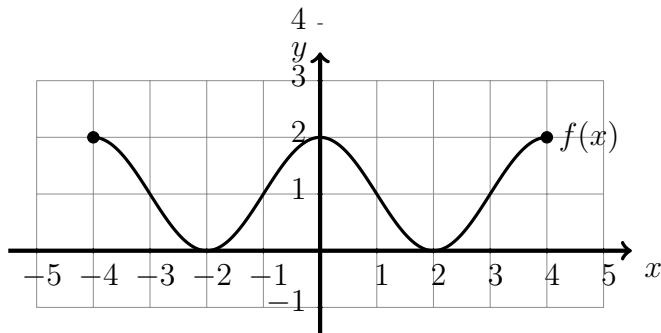
is one-to-one. (Briefly explain your reasoning and do not simply state whether or not it does or does not pass a particular test.)

\_\_\_\_\_ (b) [5 pts] Please determine the range and domain of the function

$$c(x) = \sqrt{1 - 2x}.$$

4. A number of different functions are given below. For each function please determine the coordinates of any local minima, local maxima, and also determine the intervals where the functions are increasing as well as the intervals where the functions are decreasing.

\_\_\_\_\_ (a) [5 pts]



**Local Minima**

**Local Maxima**

**Intervals Where Function Is Increasing**

**Intervals Where Function Is Decreasing**

\_\_\_\_\_ (b) [5 pts]  $h(x) = -2x^2 - x + 4$

**Local Minima**

**Local Maxima**

**Intervals Where Function Is Increasing**

**Intervals Where Function Is Decreasing**

5. [10 pts] Verify the identity

$$\frac{1}{1 - \cos(x)} - \frac{1}{1 + \cos(x)} = 2 \cot(x) \csc(x).$$



6. The questions below refer to the function

$$g(x) = m \cdot x + 4.$$

The parameter  $m$  is a constant.

\_\_\_\_\_ (a) [5 pts] For what values of  $m$  is  $g(x)$  an increasing function.

\_\_\_\_\_ (b) [5 pts] For what values of  $m$  is  $g(x)$  a decreasing function.

\_\_\_\_\_ (c) [3 pts] What values of  $m$  will ensure that the two functions  $f(x) = e^x$  and  $g(x)$  will intersect for some positive value of  $x$  ( $x > 0$ ).

7. For each scenario below circle the phrase that best describes the **kind** of function that will best approximate the phenomena described.

\_\_\_\_\_ (a) [5 pts] A vial of radioactive material is found. The amount of the material in the vial as a function of time.

Linear  
Function

Quadratic  
Function

Exponential  
Function

Trigonometric  
Function

\_\_\_\_\_ (b) [5 pts] A factory, NeveraCom, produces twenty new refrigerators an hour. The total number of refrigerators produced as a function of the time since the start of the day.

Linear  
Function

Quadratic  
Function

Exponential  
Function

Trigonometric  
Function

\_\_\_\_\_ (c) [5 pts] An object spinning on a wheel at a constant rate, and the wheel is mounted on a wall. The height of the object above the ground as a function of time.

Linear  
Function

Quadratic  
Function

Exponential  
Function

Trigonometric  
Function

8. Please determine the **exact** values of each of the expressions below. If an answer does not exist explain why.

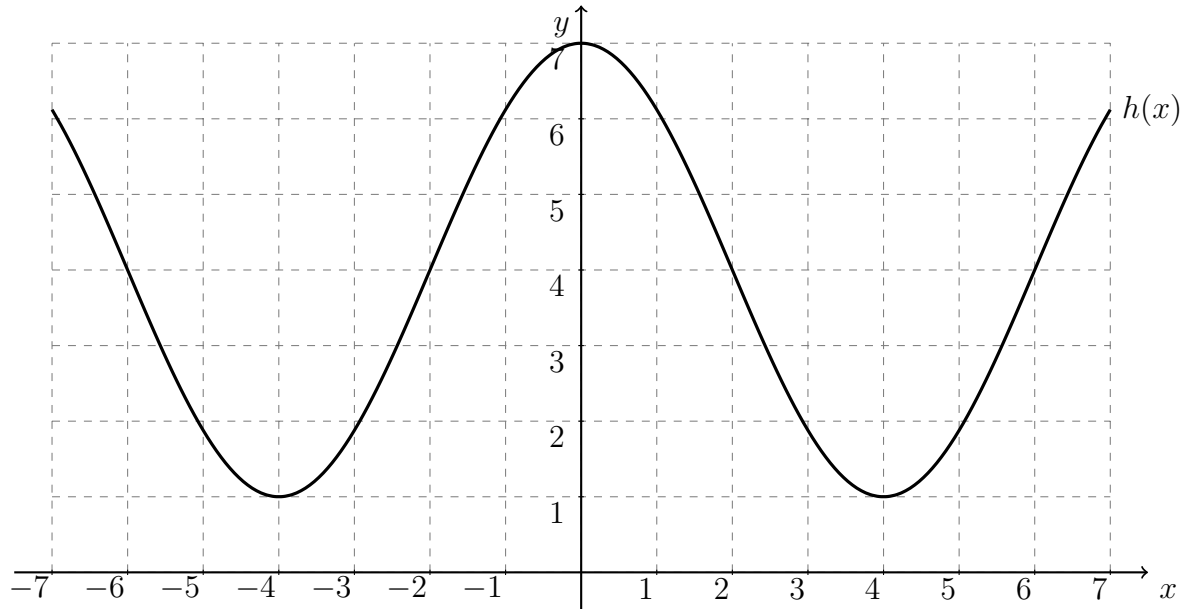
\_\_\_\_\_ (a) [5 pts] The value of  $\tan(\arccos(x))$

Express the value so that no trigonometry functions occur in it.

\_\_\_\_\_ (b) [5 pts] The exact value of  $\cos(\alpha + \beta)$  where both  $\alpha$  and  $\beta$  are in the first quadrants and  $\cos(\alpha) = 0.1$  and  $\cos(\beta) = 0.4$ .

9. [10 pts] Please determine a formula for the function whose graph is shown below expressed as a sine function,

$$h(x) = A \sin(bx + c) + d.$$



$A =$

$b =$

$c =$

$d =$

10. When a mortgage loan is made, a home buyer is provided with an initial amount of money, the principal,  $P$ . The home buyer then makes a **monthly** payment. The bank earns an interest rate each month,  $r$ , and  $n$  total payments are made by the home buyer. These values are related by the formula

$$\text{Monthly Payment} = \frac{P \cdot r \cdot (1 + r)^n}{(1 + r)^n - 1}.$$

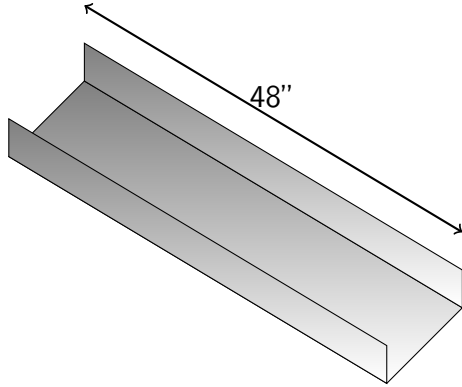
- \_\_\_\_\_ (a) [5 pts] A home buyer purchases a home with a loan of \$180,000, at a monthly interest rate of 0.25% ( $r = 0.0025$ ), and will have to make a monthly payment for 30 years. How much will the person's monthly payment be?

- \_\_\_\_\_ (b) [5 pts] A person has a monthly interest rate of 0.25%, a monthly payment of \$2,100, and the initial principal is \$190,000. How long will it take to pay off the loan?

11. [10 pts] A straight cable will connect the top of two vertical towers. The towers are on level ground but have different heights. The taller tower will have a height of 30 meters, and the angle between the cable and a horizontal line will be  $5^\circ$ . If the distance between the bases of the two towers is 20 meters, what is the height of the other tower?

12. [10 pts] Caffeine is removed from the bloodstream by the kidneys, and the amount of caffeine within the bloodstream decays exponentially. A student drinks a can of Red Bull which has 80 milligrams of caffeine, and after eight hours there is five milligrams of caffeine still in her bloodstream. If the student drank a cup of coffee with 96 milligrams of caffeine instead, how long would she have to wait until five milligrams remained in her bloodstream? (Assume that the rate caffeine is removed from the bloodstream is the same for both beverages.)

13. [10 pts] A rectangular piece of metal has a width of six inches, and it is 48 inches long. Two folds along the length of the piece will be made that have the same width, and when folded up the piece will form a box with a rectangular cross section and two open ends. Where should the folds be made so that the volume of the box will be as large as possible?





Extra space for work. **Do not detach this page.** If you want us to consider the work on this page you should print your name, instructor and class meeting time below.

Name (print): \_\_\_\_\_ Instructor (print): \_\_\_\_\_ Time: \_\_\_\_\_