

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	0	
2	20	
3	20	
4	10	
5	20	
6	15	
7	10	
8	10	
9	10	
10	10	
11	10	
12	10	
13	10	
14	10	
Total:	165	

- 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. [2 Bonus] Common Knowledge: Was Elisa Balsamo's disqualification for a sticky water bottle at Paris-Roubaix the right decision?

2. Please determine all values of  $x$  that satisfy each equation below.

(a) [5 pts]  $\sqrt{2x - 1} = 5$

\_\_\_\_\_

$x =$

(b) [5 pts]  $\frac{1}{\sqrt{x^2 + 3x + 1}} = 2$

\_\_\_\_\_

$x =$

(c) [5 pts]  $7 \cdot 4^{2x} = 18 \cdot 3^{x-1}$

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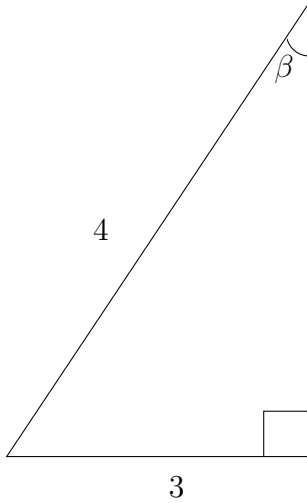
$x =$

(d) [5 pts]  $\sin(x) = 0.2$  where  $x$  is in the second 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.)

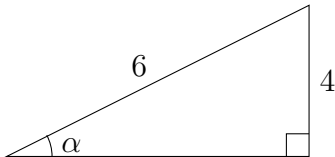
$x =$

3. 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.**)

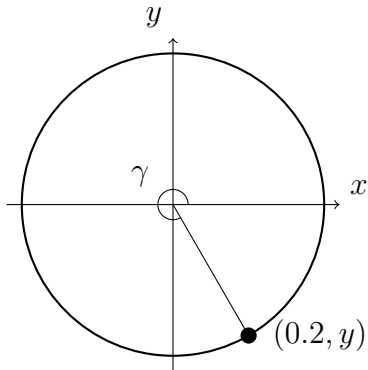
\_\_\_\_\_ (a) [5 pts] Please determine the cosine, sine, and tangent of the angle  $\beta$  in the diagram below.



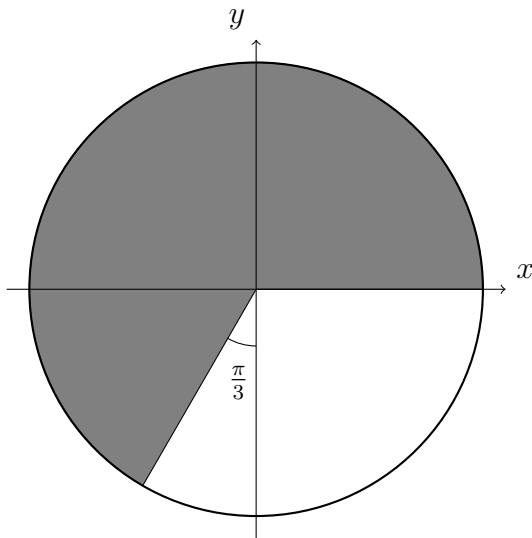
\_\_\_\_\_ (b) [5 pts] Determine the angle  $\alpha$  in the diagram below. Your answer should be exact or be within 0.01 of the true value.



- (c) [5 pts] Please determine the cosine, sine, and tangent of the angle,  $\gamma$ , in the diagram below. The point shown is on the unit circle.



- (d) [5 pts] Please determine the area of the shaded region below. The circle has a **radius of two**.



4. The questions below refer to the function

$$k(x) = \frac{5}{6-x}.$$

\_\_\_\_\_ (a) [5 pts] Show that the function 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] Determine the inverse of the function.

5. For each function below determine the coordinate for the minimum and maximum of the function on the given interval. Also determine the intervals where the function is increasing and where it is decreasing.

- \_\_\_\_\_ (a) [10 pts] Determine the minimum and the maximum, as well as the values of  $x$  for the minimum and maximum for  $2x^2 - 2x + 3$  on the interval  $[0, 2]$ . Also, determine which parts of the interval where the function is increasing and where it is decreasing.

**Minimum:**

**Maximum:**

**Intervals Where Function Is Increasing:**

**Intervals Where Function Is Decreasing:**

- \_\_\_\_\_ (b) [10 pts] Determine the minimum and the maximum, as well as the values of  $x$  for the minimum and maximum for  $\sin(x)$  on the interval  $[0, 2\pi]$ . Also, determine which parts of the interval where the function is increasing and where it is decreasing.

**Minimum:**

**Maximum:**

**Intervals Where Function Is Increasing:**

**Intervals Where Function Is Decreasing:**

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

\_\_\_\_\_ (a) [5 pts] Bacteria are placed in a sample in which there are no constraints on their growth. The number of bacteria in the sample as a function of time.

Linear  
Function

Quadratic  
Function

Exponential  
Function

Trigonometric  
Function

\_\_\_\_\_ (b) [5 pts] A pendulum is swinging in the atrium of a museum. The height of the pendulum above the floor as a function of time.

Linear  
Function

Quadratic  
Function

Exponential  
Function

Trigonometric  
Function

\_\_\_\_\_ (c) [5 pts] Cars move onto a highway from an entry ramp. Cars enter the ramp at a constant rate. The number of cars that enter the highway as a function of time.

Linear  
Function

Quadratic  
Function

Exponential  
Function

Trigonometric  
Function



7. [10 pts] A video camera is located at the ground level of a bird watching station. The camera is 20m from a great blue heron, and the camera will be rotated to follow the bird. The bird takes off and flies straight up. Determine the angle of elevation,  $\theta$ , of the camera as a function of the bird's height above the ground,  $h$ .

8. [10 pts] A food truck sells crepes. From 11:00am till 12:00pm (noon) it sells 0.8 crepes per minute. From 12:00pm till 1:00pm it sells 0.6 crepes per minute. Determine the function that gives the number of crepes sold in one day given the number of minutes past 11:00am. State your final answer as a function of time.

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

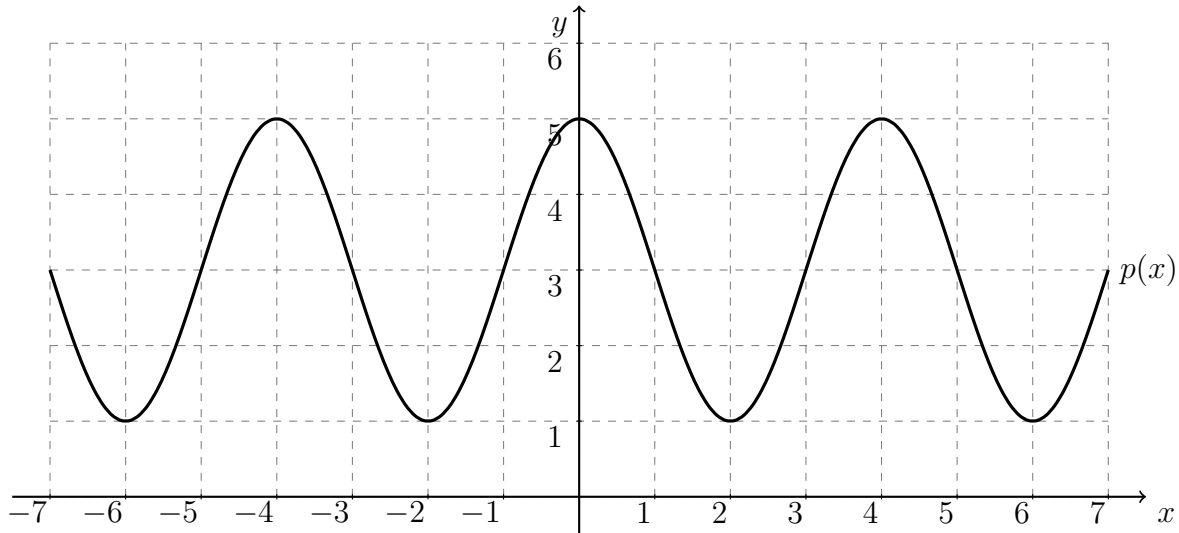
\_\_\_\_\_ (a) [5 pts] The value of  $\sin(\arctan(1.3))$

Express the **exact** value so that no trigonometry functions occur in it (do not use a calculator).

\_\_\_\_\_ (b) [5 pts] The exact value of  $\sin(\alpha - \beta)$  where both  $\alpha$  and  $\beta$  are in the first quadrants and  $\cos(\alpha) = 0.4$  and  $\cos(\beta) = 0.3$ .

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

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



$$A =$$

$$b =$$

$$c =$$

$$d =$$

11. A radioactive material is used in a medical device. A package of 0.3g of the material is sent to a hospital. If the package is not used it is expected to contain 0.25g after one year.

\_\_\_\_\_ (a) [5 pts] Assuming the package is not opened, how much of the material will be in the package after three years?

\_\_\_\_\_ (b) [5 pts] If the amount falls below 0.2g the package can no longer be used in the device. How long can the package be stored until it cannot be used?

12. [10 pts] The water level at a beach oscillates between 0.2m **below** the mean tidal level and 2.4m **above** the mean tidal level. The time between low and high tides is 6.5 hours. If low tide occurs at midnight, express the water level as a cosine function where the time is the number of hours past midnight,

$$h(t) = A \cos(bt + c) + d.$$

13. The interest on a savings account will be compounded monthly.

- \_\_\_\_\_ (a) [5 pts] If the annual interest rate is 1.2% compounded monthly, how long will it take for the balance to double?

- \_\_\_\_\_ (b) [5 pts] If the balance doubles every twenty years, what is the annual interest rate? (The interest is compounded monthly.)

14. [10 pts] Farmer Bruce will construct a rectangular pen for his prize emus, Bruce and Matilda. He will divide the pen into two equal parts by running a small fence across the middle of the rectangle. The cost of fencing for the outside part of the rectangle is eight dollars per meter. The cost of fencing for the inside fence is six dollars per meter. Farmer Bruce has \$3,000 to spend. What dimensions will result in the greatest combined area?



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: \_\_\_\_\_