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	10	
3	10	
4	10	
5	14	
6	15	
7	10	
8	10	
9	14	
10	15	
11	10	
12	10	
13	10	
14	10	
Total:	168	

- 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] $\log_{10}(1-3x) = 3,000$

$x =$

_____ (b) [5 pts] $7^{8-2x} = 6 \cdot 4^x$

$x =$

(c) [5 pts] $\dfrac{1+4x}{2+x} = 3$

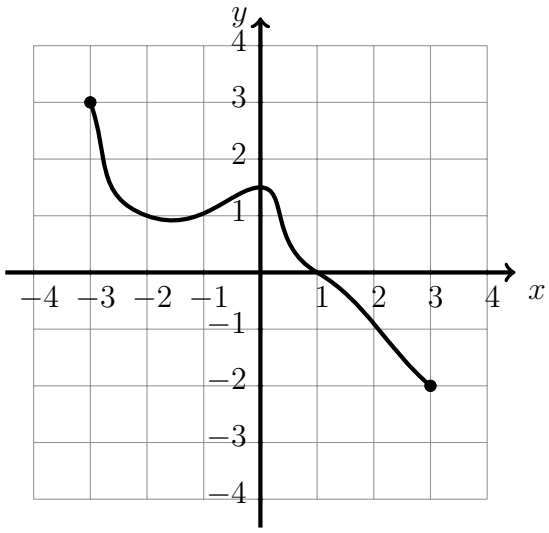
$x =$

(d) [5 pts] $\sin(x) = -0.7$ where x is in the third 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.)

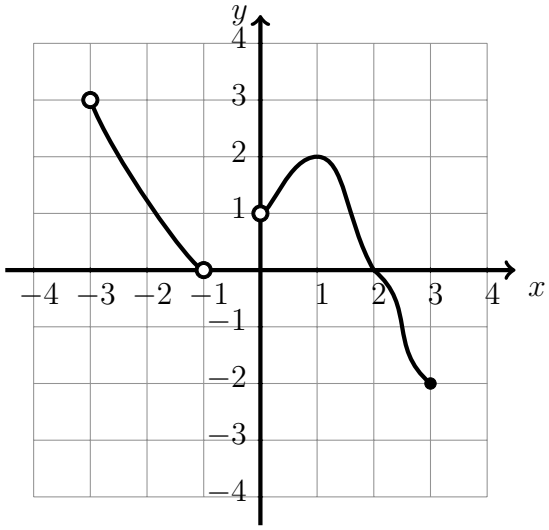
$x =$

2. In each question below the graph of a function is given, and a question if posed about the function.

_____ (a) [5 pts] Please determine if the following function is one-to-one. (Briefly explain your reasoning.)

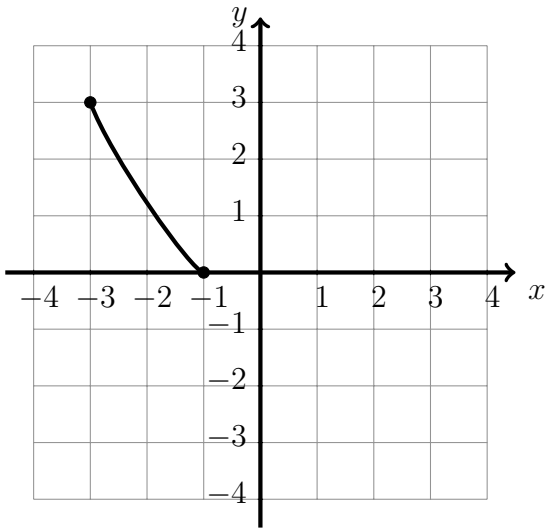


_____ (b) [5 pts] Please determine the range and domain of function shown below.



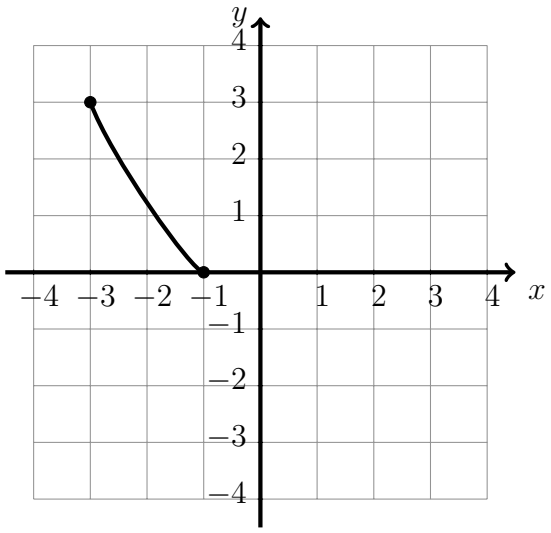
3. Please answer each question below.

(a) [5 pts] A function is even, and the graph of the function for negative x is shown below. Please sketch the missing parts of the function. **Also, please state the set of values of x where the function is increasing.**



x where the function is increasing:

(b) [5 pts] A function is odd, and the graph of the function for negative x is shown below. Please sketch the missing parts of the function. **Also, please state the set of values of x where the function is decreasing.**



x where the function is decreasing:

4. A function is given by

$$h(x) \;=\; \sqrt{13-x}.$$

(a) [5 pts] Please determine the domain and range of the function.

(b) [5 pts] Please determine the inverse of the function. (You can assume the function is 1-1.)

5. The questions below refer to the function

$$g(x) = e^{bx}.$$

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

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

(c) [2 pts] What values of b will ensure that the two functions $f(x) = 2e^{4x}$ and $g(x)$ will intersect for some positive value of x ($x > 0$).

(d) [2 pts] What values of b will ensure that the two functions $f(x) = 2e^{4x}$ and $g(x)$ will intersect for some negative value of x ($x < 0$).

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] A herd of elk that is introduced into a refuge area with limited grazing area. The function is the number of elk in the refuge as a function of time.

Linear Function	Quadratic Function	Exponential Function	Logistic Function	Trigonometric Function

_____ (b) [5 pts] A chemical is spilled in a lake, and each month 10% of the chemical that remains decays. The function is the amount of chemical in the lake as a function of time.

Linear Function	Quadratic Function	Exponential Function	Logistic Function	Trigonometric Function

_____ (c) [5 pts] A small child is swinging on a tire that is hung from a tree limb. The height of the child as a function of time.

Linear Function	Quadratic Function	Exponential Function	Logistic Function	Trigonometric Function

7. Determine the **exact** values of each of the expressions below. If an answer does not exist explain why.

_____ (a) [5 pts] $\sin(\arctan(0.35))$
(Do not use a value from a calculator but derive an expression for the exact value.)

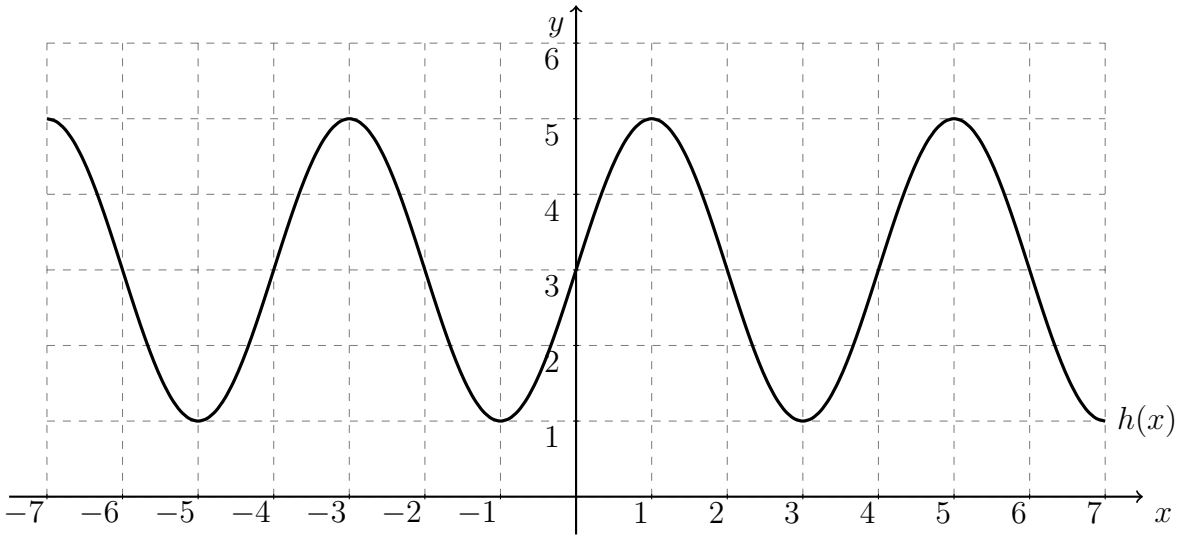
_____ (b) [5 pts] $\sin\left(\arccos\left(\frac{\sqrt{2}}{2}\right) + \arctan(0.35)\right)$
(Do not use a value from a calculator but derive an expression for the exact value.)

8. In a given month Corporation Zed will give a salesperson a salary of 5% of their total sales plus \$1,000 as long as their sales are less than or equal to \$100,000. If a salesperson's sales exceed \$100,000 they receive 3% of their total sales plus \$3,000.

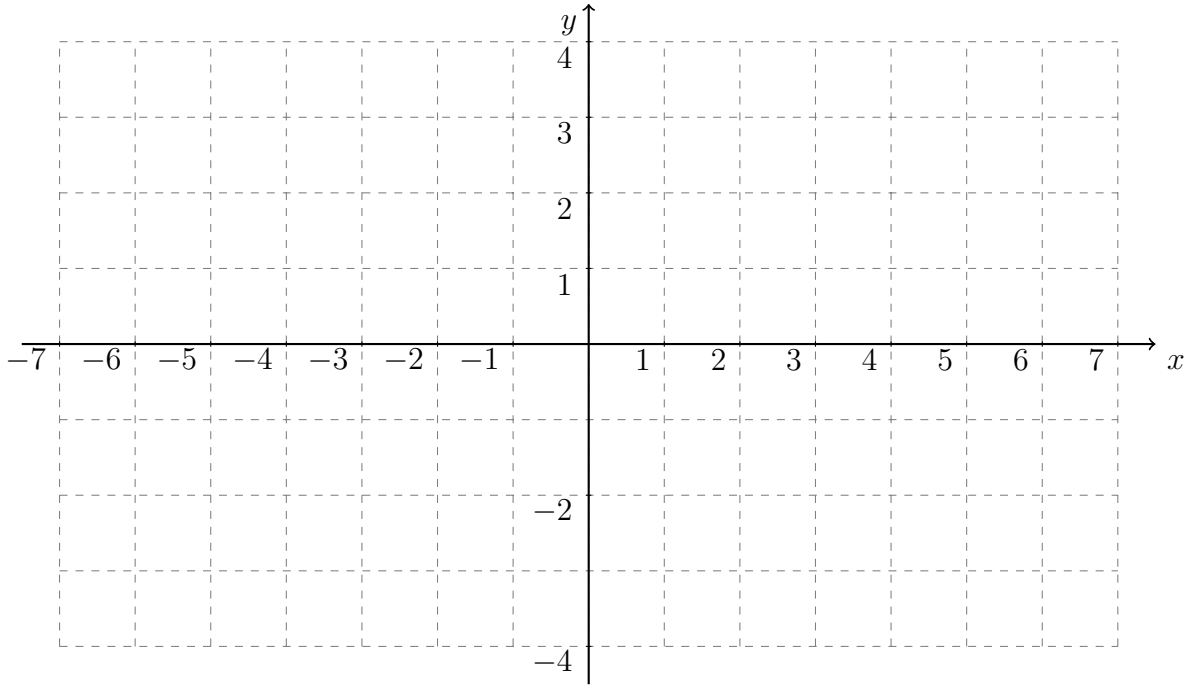
_____ (a) [5 pts] Express the salesperson's pay as a function of their sales, and express it as a piece-wise defined function using proper notation.

_____ (b) [5 pts] If a person's sales are \$100,000 is it to their advantage to continue making more sales? (Explain your reasoning.)

9. (a) [7 pts] Please determine a formula for the function below expressed as a cosine function.



(b) [7 pts] Use the axis below to make a rough sketch of the function defined below, and **indicate and label two local maxima and two local minima.**



$$h(x) = 2\sin\left(\pi x - \frac{\pi}{2}\right) + 1.$$

10. Kleiber's law is used to approximate an animal's metabolic rate. For a particular species of feline it is estimated that an animal's metabolic rate is approximated by

$$E = 0.0012M^{0.75},$$

where M is the animal's mass in kilograms, and E is the animals metabolic rate in Watts.

(a) [5 pts] A feline of the given species is captured, and its mass is 4.5kg. What is the animal's metabolic rate?

(b) [5 pts] A feline of the given species is captured, and its metabolic rate is estimated to be 0.0041W. What is the estimate for its mass?

(c) [5 pts] A new species of sea invertebrate is discovered. The mass of a speciman is 0.1 kg, and its metabolic rate is 0.000031 Watt. If the metabolic rate is approximated by

$$E = 0.03M^{\alpha}$$

determine the value of α.

11. [10 pts] Verify the identity

$$\frac{\cos(t)}{\tan(t)} = \csc(t) - \sin(t).$$

12. [10 pts] Ike's coffee shop offers a newsletter for its customers and currently has 250 people subscribing. Ike estimates that a new advertising campaign will attract 25 new people per month. Jane's shop currently has 4,000 subscribers for its newsletter. Jane expects that next year there will be 4,050 subscribers with the same number of new subscribers each subsequent year.

    Please determine the two functions that will provide the total number of subscribers for each shop given the number of months after the start of the advertising campaigns. At what point in time after the start of the campaign will the two shops have the same number of subscribers?

13. [10 pts] Farmer Bob has 200m of fencing, and he will be making a fenced in area for his chickens. He will construct two pens by first building one large rectangular area and then splitting it into two equal halves by adding a fence straight across the rectangle. What dimensions should he use to maximize the area and use up all of his fencing?

14. [10 pts] A state park maintains a herd of wild burros. It is estimated that the population can be approximated using a logistic equation,

$$P(t) = \frac{\mathrm{A}}{1 - \frac{2}{5}e^{-rt}},$$

where t is the time in months since 1 January, 2018. The initial population is 500 animals, and after six months the population is 450. Determine the population after twelve months. What will the long term population be?

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: _____