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 during the exam:

Name (sign): _____ Name (print): _____

Student Number: _____

Instructor's Name: _____ Class Time: _____

Problem Number	Points Possible	Points Made
1	0	
2	27	
3	15	
4	15	
5	16	
6	17	
7	10	
Total:	100	

- If you need extra space use 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**. This will make it easier to properly grade and give you the credit you deserve.
- 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.
- 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: How will the win by Magdeleine Vallieres in Rwanda impact her career?

2. Determine all of the values of x for each question below that satisfy the given equation. If no values of x satisfy the equation provide a brief justification as to how you arrived at your conclusion.

   (a) [5 pts] $e^{3x+1} = 8$.

   (b) [5 pts] $\ln(x+1) = \ln(3x-1) + 5$.

(c) [7 pts] $\log_2(2x+1) + \log_2(x-1) = 3$.

(d) [10 pts] $8e^{1-2x} = 4^x$.

3. Use the properties of logarithms to answer each question below.

   (a) [5 pts] Expand the expression below as far as possible so it only contains the logarithms of single terms,

   $$\log_7\left(7 \cdot x^4 \cdot y^{-3}\right)$$

   (Your final result should not have the logarithm of a known constant.)

   (b) [5 pts] Expand the expression below as far as possible so it only contains the logarithms of single terms,

   $$\log_{13}\left(x^4 \cdot \frac{w^{1/3}z^3}{\sqrt{y}}\right)$$

   (Your final result should not have the logarithm of a known constant.)

   (c) [5 pts] Combine the terms in the following expression into a single logarithm

   $$4\log_3(w) - \frac{1}{2}\log_3(u) + \frac{4}{7}\log_3(x).$$

4. An exponential function is given by

$$p(x) = 5 + Ae^{rx},$$

where A and r are constants.

(a) [5 pts] If r is negative and A is positive what value will $p(x)$ get close to for very large values of x? Provide a brief justification for your conclusion. If it does not get close to any value explain why.

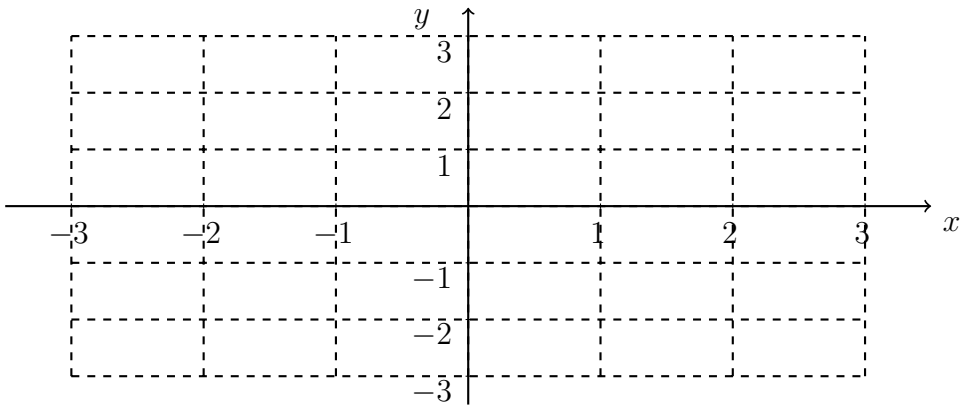
(b) [5 pts] If r is positive and A is positive what value will $p(x)$ get close to for very large values of x? Provide a brief justification for your conclusion. If it does not get close to any value explain why.

(c) [5 pts] In the case where $p(0) = 3$ and $p(10) = 4.5$ determine the values of A and r.

5. The function $k(x)$ is defined to be

$$k(x) = \begin{cases} -2(x+1)+1 & -2 \leq x \leq -1, \\ -\left(3^{-x+1}\right) & 0 \leq x \leq 1. \end{cases}$$

(a) [5 pts] Use the axes below to make a sketch of the function, $k(x)$.



(b) [5 pts] Just by using your graph provide a brief argument as to whether or not the function is one-to-one. (Do not simply state that it passes a test but explain why the function meets the necessary conditions to be one-to-one.)

(c) [6 pts] Determine the inverse of $k(x)$. (If the function is not one-to-one determine a restriction on the domain and then determine the inverse on the restricted domain.)

6. The body mass of a male deer is related to its normalized antler length[1]. The relationship can be approximated by

$$\text{antler length} \;=\; C \cdot (\text{body mass})^r,$$

where C and r are constants. It is estimated that a body mass of 20 kg results in a standardized antler length of 128mm, and a body mass of 30kg results in a standardized antler length of 164mm.

(a) [7 pts] Determine estimates of C and r.

(b) [5 pts] A deer with a mass of 25kg is captured. Determine an estimate of what its standardized antler length should be.

(c) [5 pts] Determine the function that gives the estimate for the body mass of a deer given its standardized antler length.

[1]Lemaître J-F, Cheynel L, Douhard F, et al. The influence of early-life allocation to antlers on male performance during adulthood: Evidence from contrasted populations of a large herbivore. J Anim Ecol. 2018; 87: 921–932. https://doi.org/10.1111/1365-2656.12833

7. [10 pts] The amount of a medication in a patient's blood stream decays exponentially as it is processed by the patient's liver. A patient is initially given a dose of 30mg of a medication, and after twelve hours 15mg is in the patient's blood stream. If the patient should receive a second dose when there is 10mg of the medication present, when should the next dose be administered?

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: _____