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	22	
3	20	
4	13	
5	10	
6	15	
7	10	
8	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**. If I can't read it (or can't find it), I can't 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.
- 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: Who will win Lord Stanley's Cup this year?

2. Determine all of the values of x for each question below that satisfy the given equation.

(a) [7 pts] $3^{x-2} = 7$

(b) [7 pts] $\ln(4x + 1) = 16 + \ln(x + 1)$

(c) [8 pts] $8 \cdot 6^{x+1} = 3^{2x-1}$

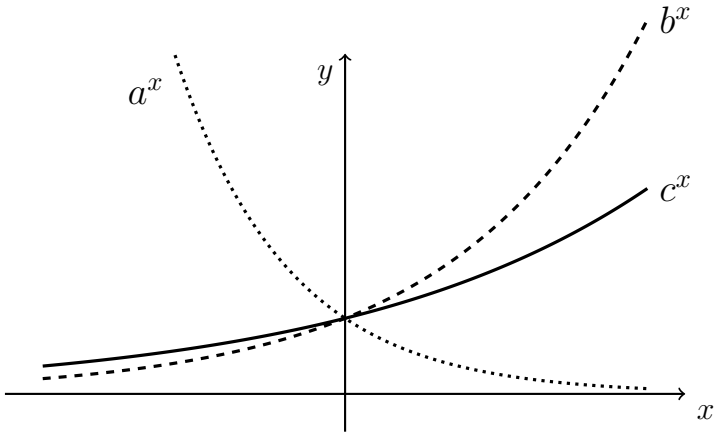
3. Use properties of logs and exponentials to answer each question below.

   (a) [10 pts] Rewrite the expression $e^{x^2} \cdot e^{3x} \cdot e^5$ as e raised to a single exponent.

   (b) [10 pts] Expand the expression $\ln\left(\dfrac{3x^2y}{z^4}\right)$. Each of the resulting logarithms should only have one variable and no exponents.

4. Compare the growth and decay rates as described in each question below.

_____ (a) [8 pts] Three exponential functions are given below. Express the order of the values of a, b, and c. That is rank the numbers in order from smallest to highest.



(b) [5 pts] Two radioactive isotopes are examined. The first isotope takes 4 days to decay by 50%. The second isotope takes 2 days to decay by 25%. Which isotope decays faster?

5. [10 pts] Show that the function

$$h(x) = \frac{5}{x+1}$$

is one-to-one. Also, determine the inverse of the function.

6. In 1983 Theodore Garland[1] claimed that the minimal amount of energy required for a mammal to move a small distance is given by

$$E = 10.678M^{0.7},$$

where M is the mass of the mammal in kg, and E is the energy in Joules.

(a) [5 pts] What is the minimal energy required for a mammal whose mass is 0.2kg?

(b) [5 pts] The minimal energy for a mammal to move is estimated to be 3.9J. What is its mass?

(c) [5 pts] Suppose that another researcher claims that the minimal energy for an animal's movement is given by $E = 10.678M^l$, where l is an unknown constant. If an animal's estimated energy is 4.0J and its mass is 0.3kg what is the best estimate for l?

[1] Scaling the Ecological Cost of Transport to Body Mass in Terrestrial Mammals, Theodore Garland, Jr., The American Naturalist, Vol. 121, No. 4 (Apr., 1983), pp. 571-587.

7. [10 pts] A bank advertises a savings account that offers 1.2% annual interest compounded monthly. How long will it take for an initial investment to double?

8. [10 pts] Chemicals are released in to a lake to reduce the amount of algae. The chemical decays exponentially. Initially 150kg are put into the lake, and after ten days it is estimated that there is 30kg left. How long will it take until 10 kg is in the lake?

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: _____