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: __________________________

- 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:

\[
\cos(\alpha + \beta) = \cos(\alpha)\cos(\beta) - \sin(\alpha)\sin(\beta),
\]
\[
\sin(\alpha + \beta) = \sin(\alpha)\cos(\beta) + \cos(\alpha)\sin(\beta).
\]

1. [2 Bonus] Common Knowledge: Who will win the first Le Tour Femmes? (No credit for obvious answers like Lizzie Deignan.)
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) [7 pts] $e^{8x-3} = 7.$

(b) [7 pts] $\ln(\sqrt{x+1}) = 5.$

(c) [10 pts] $4 \cdot 3^{2x-1} = 5 \cdot 6^{x+1}$
3. Determine the inverse of each of the following functions.

(a) [7 pts] Determine the inverse of \( m(x) = \ln(2x - 8) - 3 \)

(b) [7 pts] Determine the inverse of \( p(x) = \sqrt{7e^{x-3}} \)
4. For each question below determine the possible values given the conditions stated.

(a) [5 pts] The function

\[ A(t) = 3 \cdot e^{rt} \]

is used to model the decay of a radioactive material. What are the possible values of the constant \( r \)? Express your answer as an interval, and the value of \( r \) could be any number in the interval.

(b) [5 pts] The function

\[ P(t) = 3 \cdot b^t \]

is used to model the number of individuals in a growing population. What are the possible values of the constant \( b \)? Express your answer as an interval, and the value of \( b \) could be a number in the interval.
5. The power output (Watts) of an individual from a particular species of bird depends on its mass (kg),

\[
\text{Power} = 0.4 \times (\text{Mass})^{0.8}.
\]

The surface area (m$^2$) of a bird also depends on its mass,

\[
\text{Surface Area} = 1.4 \times (\text{Mass})^{0.67}.
\]

(a) [5 pts] If the mass of a bird is 0.3 kg, what is its power output and its surface area?

(b) [8 pts] Determine the formula to obtain the mass of a bird given its power output.

(c) [8 pts] Determine the formula to obtain the surface area of a bird given its power output.
6. A bank account will have an annual interest rate that is compounded monthly.

(a) [5 pts] If the annual interest rate is 0.9% and the initial investment is $250,000 what will the balance be after six years?

(b) [8 pts] If the annual interest rate is 0.8% how long will it take for any initial investment to double?

(c) [8 pts] What interest rate will ensure that any initial investment will double every twenty five years?
7. [10 pts] A graphics card will be used to run an algorithm for a calculation to verify the security of a potential crypto currency transaction. The calculation is made on a string with length $n$. The cost of the energy required to complete the calculation scales exponentially with $n$. The energy cost to check a string of length 2056 is 0.02$, and the cost to check a string of length 8224 is 0.38$. Your budget allows for a calculation that has an energy cost of 0.50$. What is the highest possible value of $n$ that can be used?
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: _____________