Honor Pledge __________ Name __________

This is a 70 minute exam. 100 points are possible, and point values are indicated for each problem. Calculators are permitted, but no other aids, such as books or notes.

I. CALCULATIONS (10 pts each)

   a) \( \int_{-\pi/2}^{\pi/2} (x+1) \cos x \, dx \)

   b) \( \int e^{t^2} \, dt \)
c) \[ \int_{-1}^{\infty} \frac{1}{t^3} \, dt \]

d) Solve the initial value problem
\[ y' = e^{2x} \sqrt{y}, \quad y(0) = 1 \]
II. WORD PROBLEMS

10 pts) A) Find the future value after 40 years of a continuous income stream of $2000/year, invested at a continually compounded rate of 9% annual interest. How much better is this than stashing $2000/year in a mattress?

15 pts) B) Find the monthly payment for a 20 year mortgage of $90,000 at 6.5% interest. How much total interest will be paid over the 20 years?
Lab mice are bred at Jackson Laboratories. They are given ample food and space, so they reproduce continuously at a rate proportional to the population at any given time. They are also packed up and shipped off to researchers around the country at a constant rate of 100,000 mice/month. Write a differential equation describing the population.

Find equilibrium solutions, draw the slope field and some typical solutions (for various initial values of the population, \( p(t) \)). What should the population growth rate be to have a stable 1 million mouse population?
III. ESSAY (20 pts)

Answer ONE of the following (~1 paragraph)

a) State the formulas for consumers' and producers' surpluses. Explain how we get them. Draw a graph to help explain.

b) State the logistic differential and difference equations. Explain how their solutions differ. (not just that one is a function and one is a sequence!)