Instructions:
1. Do NOT open your exam until you are told to.
2. You have 50 minutes for this exam.
3. Before start the exam, PRINT your name and student ID in the space above.
4. NO notes or books are allowed.
5. Calculators may NOT be used for this exam. Do not replace precise quantities such as \( \sqrt{3}, e^2, \ln 2 \), with decimal approximations.
6. Show all your work clearly on the pages provided.
7. Please raise your hand if you have any questions during the exam.
1 (12 pts.) Determine whether each statement is true (T) or false (F). Then CIRCLE the appropriate answer. You do not need to show work. Assume that \(x\) and \(y\) are positive numbers.

(a) \(\ln(x/y) = \ln x - \ln y\) \hspace{1cm} T \hspace{1cm} F
(b) \(e^x/e^y = e^{x-y}\) \hspace{1cm} T \hspace{1cm} F
(c) \((\ln x)^2 = 2(\ln x)\) \hspace{1cm} T \hspace{1cm} F

2 (10 pts.) Find the equation of the line tangent to \(y = \ln(\frac{1}{1+e^{x-y}})\) at the point \((1, -\ln 2)\).
3 (15 pts.) The number of a certain type of bacteria increases continuously at a rate proportional to the number present. There are 100 present at a given time and 800 present 3 hours later.

(a) Give a function $P(t)$ to model the number of bacteria $t$ hours after the initial time.

(b) How many will there be 10 hours after the initial time?

(c) How long will it take for the population to triple?
Sketch the graph of the function $f(x) = \ln(x^2 + 1) - 2$. Determine extrema, points of inflection, axes intercepts and horizontal and vertical asymptotes.
A ball is thrown upward with an initial velocity of 20 meters per second from an initial height of 10 meters. (The acceleration due to gravity is -10 meters per second squared.)

(a) Derive formulas for the velocity (in meters/second) and height (in meters) of the ball as functions of the time $t$ (in seconds.)

(b) How long will it take for the ball to reach the maximum height? What is the maximum height?

(c) How long will it take for the ball to hit the ground? What is the velocity of the ball when it hits the ground?
Evaluate the following indefinite integrals. Simplify your answers as much as possible. Show your work.

(a) \( \int (3x^2 + 4x)\sqrt{x^3 + 2x^2 - 1} \, dx \)

(b) \( \int \frac{x^3 - x^2 + 2x - 1}{x^2 + 2} \, dx \)

(c) \( \int \frac{1 - e^{-x}}{1 + e^{-x}} \, dx \)

(d) \( \int \frac{1 + 3x^3}{x} e^{\ln x + x^3} \, dx \)

(e) \( \int \frac{1}{x \ln x} \, dx \)