1. (25 pts) Integrate:
   a. \[ \int_{2}^{+\infty} \frac{1}{x^2 + x - 2} \, dx = \]
   b. \[ \int_{0}^{\infty} te^{-2t} \, dt \]
   c. \[ y' = 2 - 3y \text{ and } y(0) = 1 \]
2. (25pts) (a) Expand the function \( f(x) = e^{2x} \arctan(3x) \) at 0 to the third degree (i.e. up to terms involving \( x^3 \)).

(b) Expand the function \( f(x) = \ln \frac{2}{x + 1} \) in a power series centered at \( x = 2 \) (Hint: consider \( f'(x) \)). What is the radius of convergence?
3. (25pts) (Movie logistics) Movie attendance spreads like a disease. Assume that 1 million people are expected to be potentially interested in the movie “The Return”. If after 2 days 100,000 people have seen the movie and after 10 days a total of 200,000 people have seen the movie, after how many day will 500,000 people have seen the movie? (Use the equation $\frac{dy}{dt} = ky(M - y)$ and use $\ln 2 = 0.7, \ln 9 = 2.2$).
4. (25pts) Basketball legend Kareem Abdul Jabbar’s sky hook. His arm is 3 ft long and rotates about his shoulder which is centered at (0, 6) in the xy-plane. Assume the movement starts \((t = 0)\) when the arm is horizontal (so that the basketball is initially at \((-3, 6)\), at rest) and then swings clockwise by a 60° angle. Letting \(\theta\) be the angle measured clockwise with \(\theta(0) = 0\), assume that the angular acceleration \(d^2\theta/dt^2\) is constant and is equal to \(\frac{3\pi}{2}\) rad/sec\(^2\).

(a) Find the time \(T\) when \(\theta(T) = \pi/3\).

(b) Write the equations for the position \((x(t), y(t))\) of the ball at time \(t\) as it swings in Kareem’s hand.

(c) Determine the position \((x(T), y(T))\) and velocity \((v_x(T), v_y(T))\) at time \(t = T\) (\(T\) is from part (a)).
(d) Time $t = T$ is when the ball leaves Kareem’s hand. It then flies subject only to gravity $(0, -32)$ and to air resistance $-(0.5)\vec{v}$. Write equations for the motion of the ball for time $t \geq T$ using the initial conditions in part (c). (Assume the mass of the ball to be 1.)
5. BONUS PROBLEM (5pts Extra Points) Consider the function

\[ F(x) = \int_0^x e^{-t^2} \, dt \]

Find the antiderivative of \( F \). (The solution may involve the function \( F \) itself.)