7. [14 points] Chickens continue to appear around you, and Franklin's army is hesitant to advance.

    a. [6 points] Let $F(t)$ give the total number of chickens that have arrived after t seconds. You observe that $F(t)$ obeys the following differential equation

$$\frac{dF}{dt} = e^{-F}t^2.$$

    If there are initially 20 chickens, find a formula (in terms of t) for $F(t)$.

    b. [4 points] A large, familiar-looking chicken steps forward from the flock and clucks, "Koo Koo Katcha!". This large chicken waddles towards Franklin following the parametric equations

$$x(t) = \frac{\sin(\pi t) + 1}{\pi} \qquad\qquad y(t) = \ln(t + 1)$$

    where t is the time, in seconds, after the chicken steps forward from the flock and both x and y are measured in feet. Find the chicken's speed 10 seconds after it steps forward. Include units.

    c. [4 points] Franklin says, "BEEP BOOP BEEP. YOU'RE RIGHT, WHAT HAVE I BECOME?" A single robot tear falls from Franklin's robot eye. Consider the region in the xy-plane bounded by $y = \dfrac{\sin(x)}{x + 2}$, $x = \pi$, $x = 2\pi$, and the x-axis. The volume of Franklin's tear is given by rotating this region around the x-axis. Write an integral giving the volume of Franklin's tear. Do not evaluate this integral.