8. [12 points] For each of the following parts, circle the correct answer. Ambiguous answers will receive no credit. You do not need to show your work.

a. [3 points] For nonzero constants $a$ and $b$, the curve $r = \frac{a}{\sin(\theta) + b\cos(\theta)}$ is a line. What is the Cartesian equation of the line?

$$ y = -bx + a \quad y = ax - b \quad y = bx - a \quad y = -ax + b \quad y = -bx - a $$

b. [3 points] Raymond Green left a bowl of ice cream in a $50^\circ C$ sauna. Over the first $2 \ln(2)$ hours, the ice cream goes from $-10^\circ C$ to $20^\circ C$. Which of the following describes the change in $Q(t)$, the temperature of the ice cream in $^\circ C$ after $t$ hours?

$$ \frac{dQ}{dt} = \frac{Q - 50}{2} \quad \frac{dQ}{dt} = 2(50 - Q) \quad \frac{dQ}{dt} = \ln(2) \left( 25 - \frac{Q}{2} \right) $$

$$ \frac{dQ}{dt} = 25 - \frac{Q}{2} \quad \frac{dQ}{dt} = -\frac{1}{2}(Q - 25) $$

c. [3 points] Let $\alpha > 0$ be a constant. What is the value of $\lim_{u \to \infty} \left( \frac{u}{u - \alpha} \right)^{u-\alpha}$?

$$ e^{\alpha} \quad 1 \quad \text{DIVERGES} \quad e^{\frac{1}{\alpha}} \quad \alpha $$

d. [3 points] Consider the differential equation $y' = 1 + \beta xy$, where $\beta$ is a constant, and let $y(x)$ be a solution satisfying $y(0) = 1$. For which value of $\beta$ does Euler's method with 2 steps give the estimate $y(4) \approx 0$?

$$ -\frac{3}{4} \quad -\frac{1}{6} \quad -\frac{5}{12} \quad -\frac{1}{2} \quad -\frac{6}{11} $$