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 $r = \dfrac{a}{\sin(\theta) + b\cos(\theta)}$ is a line. What is the Cartesian equation of the line?

$\boxed{y = -bx + a}$ $\quad$ $y = ax - b$ $\quad$ $y = bx - a$ $\quad$ $y = -ax + b$ $\quad$ $y = -bx - a$

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

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

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

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

$\boxed{e^{\alpha}}$ $\quad$ 1 $\quad$ DIVERGES $\quad$ $e^{1/\alpha}$ $\quad$ α

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

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