

4. [5 points] Drake is running for president. Suppose $F(t)$ is the fraction of the total population of the country who supports him t months after he announces he is running. Drake gains supporters at a steady rate of 2% of the **total population** of the country per month, but he also steadily loses 3% of **his supporters** per month. Write a **differential equation** that models $F(t)$.

Solution:

$$\frac{dF}{dt} = 0.02 - 0.03F$$

5. [6 points] Adele is also running for president. Suppose $P(t)$, the total number of supporters she has in millions t days after she announces, is modeled by the differential equation

$$\frac{dP}{dt} = kP(100 - P)$$

with $k > 0$.

- a. [4 points] Find the equilibrium solutions to this differential equation and indicate stabilities for each. Make sure your answer is clear.

Solution: The equilibrium $P = 0$ is unstable and the equilibrium $P = 100$ is stable.

- b. [2 points] If Adele starts with one million supporters, what is the maximum number of supporters she can get in the long run? You do not need to show your work.

Solution: 100,000,000 supporters