

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