Name:

Quiz #4 - February 4, 2004

1. A completely filled 30 gallon tank is initially filled with 50 pounds of dissolved salt. Pure water enters the tank at 5 gallons per minute and well-stirred water leaves at the same rate. Find an equation for the amount of salt in the tank at any time t. How long will it take until the concentration reaches 1 pound/gallon?

Solution: Let $Q(t)$ be the amount of salt in the tank at time t. No salt is coming in but $\frac{5Q(t)}{30}$ pounds/minute is leaving. So we have:

$$Q' = -\frac{1}{6}Q, \;\; Q(0) = 50.$$

The solution to this is:

$$Q(t) = 50e^{\frac{-t}{6}}.$$

Setting $Q(t) = 30$ and solving for t gives $t = -6\ln(3/5)$.

2. When t is measured in years the decay constant for strontium-90 is .0248. What is its half-life?

Solution: Let $P(t)$ be the amount of strontium at time t. Then:

$$P' = -.0248P$$

which gives:

$$P(t) = P_0 e^{-.0248t}.$$

Setting $P(t) = \frac{1}{2}P_0$ gives

$$t = \frac{\ln(1/2)}{-.0248}$$