MA 238-01 §1.4–1.6	**Quiz #2**	*score*	Name: Key 19 June 2000

1. A 1000-liter tank is full of a brine solution containing 100 kg of salt initially. Salt water is flowing into the tank at a rate of 5 liters per minute at a concentration of 0.5 kg salt per liter and liquid is leaving the tank at the same rate. Find a formula for the amount of salt in the tank at time t, and explain what happens as $t \to \infty$. *(7 points)*

$$y' = \frac{5}{2} - \frac{5y}{1000} \qquad y(0) = 100$$

$$y = 500 - 400\,e^{-t/200}$$

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2. Ten milligrams of radioactive material with a half-life of one hour are injected into a patient so that a scan can be done. If the patient must have at least 2 mg of the radioactive material in his/her body during the scan, by how long past the injection time must the scan be completed? Express your answer in hours and minutes (rounded to the nearest minute). *(6 points)*

$y(0) = 10$

$y' = -ky$

$y = Ce^{-kt} = 10e^{-kt}$

$5 = 10e^{-k}$

$e^{k} = 2$

$k = \ln 2$

$y = 10 \cdot 2^{-t}$

$2 = 10 \cdot 2^{-t}$

$2^{t} = 5$

$t = \log_2 5 = \frac{\ln 5}{\ln 2} \approx 2.32193$ hr

$\approx$ 2 hours 19 minutes

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3. A wiffle ball of mass m is thrown upward with an initial velocity of 30 meters per second. If air resistance is neglected, how long will the ball remain aloft? If $k/m = 0.5$/second where k is the viscous damping constant, approximate how long will be ball remain aloft. *(7 points)*

w/o resistance: $y = -4.9t^2 + 30t = t(30 - 4.9t) \Rightarrow t_f = \frac{30}{4.9} \approx 6.12$ seconds

w/ resistance: $y' = v$

$v' = -9.8 - \frac{1}{2}v$

$t_f \approx 4.54$ seconds