Name: _____ **Sort #:** _____

Worksheet 4: Modeling with 1st Order ODEs

MATH 2310, Spring 2019 Grade: / 40

1. (10 pts) A 1500 gallon tank initially contains 600 gallons of water with 5 lbs of salt dissolved in it. Water enters the tank at a rate of 9 gal/hr and the water entering the tank has a salt concentration of $\frac{1}{5}(1+\cos(t))$ lbs/gal. If a well mixed solution leaves the tank at a rate of 6 gal/hr, how much salt is in the tank when it overflows?

2. Suppose that a sum S_0 is invested at an annual rate of return r compounded continuously.

   (a) (4 pts) Find the time T required for the original sum to double in value as a function of r.

   (b) (4 pts) Determine T if $r = 7\%$. Round your results to two decimal places.

   (c) (4 pts) Find the return rate that must be achieved if the initial investment is to double in 8 years. Round your result to 4 decimal places.

3. (10 pts) A population of zombies in a certain county will grow at a rate that is proportional to their current population. In the absence of any outside factors the population will triple in two weeks time. On any given day there are 15 zombies that migrate into the county. There are 16 zombies everyday that are killed by rifle shots or getting run over by cars and 7 die of starvation due to loss of body parts necessary for consumption of brains. If there are initially 100 zombies will the population survive? If not, when do they die out?

4. (8 pts) Find a solution to population model governed by the logistic equation

$$\frac{dP}{dt} = 0.0004P(150 - P)$$

with initial condition $P(0) = 20$.