Spring 2024 − Math 3331− Homework 4

1. Suppose a population of rabbits are formed. Initial there are 15 rabbits and it is observed that after 90 days there are an additional 12 rabbits. Formulate a differential equation and solve to determine the number of rabbits at a given time. How many rabbit's will there be after 180 days?

2. Suppose a population of rabbits are formed. Initial there are 15 rabbits and it is observed that after 90 days there are an additional 12 rabbits. If the area in which the rabbits live is limited to 500, formulate a differential equation and solve to determine the number of rabbits at a given time. How many rabbit's will there be after 180 days? Compare your answer with Q1.

T2. A fluid initially at 100^oC is placed outside on a day when the temperature is 10^oC, and the temperature of the fluid drops 20^oC in one minute. Find the temperature $T(t)$ of the fluid for $t > 0$. (T2)

T6. An object is placed in a room where the temperature is 20^oC. The temperature of the object drops by 5^oC in 4 minutes and by 7^oC in 8 minutes. What was the temperature of the object when it was initially placed in the room?

T8. A tank initially contains 40 gallons of pure water. A solution with 1 gram of salt per gallon of water is added to the tank at 3 gal/min, and the resulting solution draines out at the same rate. Find the quantity $Q(t)$ of salt in the tank at time $t > 0$.

T9. A tank initially contains a solution of 10 pounds of salt in 60 gallons of water. Water with 1/2 pound of salt per gallon is added to the tank at 6 gal/min, and the resulting solution leaves at the same rate. Find the quantity $Q(t)$ of salt in the tank at time $t > 0$.

T11. A 200 gallon tank initially contains 100 gallons of water with 20 pounds of salt. A salt solution with 1/4 pound of salt per gallon is added to the tank at 4 gal/min, and the resulting mixture is drained out at 2 gal/min. Find the quantity of salt in the tank as it's about to overflow.

6. In class we derived a model of a falling body with air resistance. We assumed that the air resistance was proportional to the velocity v. Instead what if we suppose that the air resistance is proportional to v^2. Create a mathematical model and solve it assuming that the initial velocity is zero. Determine how the terminal velocity changes (if any).

Due: Monday Feb. 26, 2024