Section 2.3: Modeling with First Order ODEs (PREP WORK)

1. Suppose a holiday turkey is taken from an oven in a $70^\circ F$ room.

   (a) Let $T(t)$ be the internal temperature of the turkey after t minutes. Use Newton's Law of Cooling to write a differential equation for T.

   (b) Solve the differential equation in part (a).

   (c) Suppose the turkey initially had an internal temperature of $160^\circ F$. Solve this initial value problem.

   (d) Five minutes later the turkey has an internal temperature of $155^\circ F$. If it needs to cool to $140^\circ F$ without burning your mouth, approximately how much longer do you have to wait?

A tank initially contains 100 L of fresh water. Water containing α kg of salt per liter enters the tank at a rate of 2 liters per minute, and the completely mixed solution leaves the tank at the same rate. Write and solve a differential equation which gives us $y(t)$, the **amount** of salt (kg) in the tank after t minutes, and find the limiting value as $t \to \infty$. Sketch a graph of $y(t)$ on the domain $t \in [0, 300]$ assuming $\alpha = 3$.

Suppose in the previous example the mixed solution leaves the tank at a rate of 2.5 liters per minute. Write and solve the differential equation for $y(t)$, then sketch the graph of $y(t)$ (again assuming $\alpha = 3$) over the appropriate domain.