1. A salt brine tank has pure water flowing in at 10 L/min. The contents of the tank are mixed thoroughly and continuously. The brine flows out at 10 L/min. Initially, the tank contains 150 L of brine, at a concentration of 5 g/L. Follow the steps below to determine the concentration of brine after 30 minutes, and the limiting concentration of the brine.

(a) Let \( S(t) \) = amount of salt in the tank at time \( t \) (in g) and let \( C(t) \) = concentration of salt in the tank at time \( t \) (in g/L)

\[
C(0) = \text{__________________________}
\]

\[
S(0) = \text{__________________________}
\]

Write \( C(t) \) in terms of \( S(t) \):

\[
C(t) = \text{__________________________}
\]

(b) Now write a differential equation describing how fast is the salt is leaving the tank.

(c) Solve the initial value problem \( \frac{dS}{dt} = -\frac{S}{15}, \quad S(0) = 750 \).

(d) What is the concentration when \( t = 30 \)?

(e) What is the limiting concentration of the brine?
2. As before, a salt brine tank contains 150 L of brine at a concentration of 5 g/L. But this time brine at a concentration of 2 g/L is pumped into the tank at a rate of 10 L/min. The contents of the tank are mixed thoroughly and continuously and the brine flows out at 10 L/min. Follow the steps below to determine how long until the concentration is 3 g/L, and what the limiting concentration is.

(a) Again, let \( S(t) \) = amount of salt in the tank at time \( t \) (in g)
and let \( C(t) \) = concentration of salt in the tank at time \( t \) (in g/L)
\[ C(0) = \]
\[ S(0) = \]
Write \( C(t) \) in terms of \( S(t) \):
\[ C(t) = \]

(b) How fast is salt entering the tank?

(c) How fast is salt leaving the tank?

(d) What is the net change of the salt in the tank, \( \frac{dS}{dt} \)?

(e) Solve the initial value problem \( \frac{dS}{dt} = 20 - \frac{S}{15} \), \( S(0) = 750 \).

(f) When is \( C(t) = 3 \) g/L? What is the limiting concentration?