

- (a) A tank contains 5000 L of pure water. Brine that contains 30 g of salt per liter of water is pumped into the tank at a rate of 25 L/min. Show that the concentration of salt after  $t$  minutes (in grams per liter) is<sup>1</sup>

$$C(t) = \frac{30t}{200 + t}$$

After  $t$  minutes,  $25t$  liters of brine have been pumped into the tank, so the volume in the tank is  $5000 + 25t$  liters. After  $t$  minutes, those  $25t$  liters of brine have added  $(25t \text{ L}) \left(30 \frac{\text{g}}{\text{L}}\right) = 750t$  g of salt. So

$$C(t) = \frac{750t}{5000 + 25t} = \frac{25 \cdot 30t}{25(200 + t)} = \frac{30t}{200 + t}$$

- (b) What happens to the concentration as  $t \rightarrow \infty$ ?

We compute

$$\begin{aligned} \lim_{t \rightarrow \infty} \frac{30t}{200 + t} &= \lim_{t \rightarrow \infty} \frac{30t \cdot \frac{1}{t}}{(200 + t) \cdot \frac{1}{t}} \\ &= \lim_{t \rightarrow \infty} \frac{30}{\frac{200}{t} + 1} \\ &= 30 \end{aligned}$$

Thus the concentration approaches 30 gms/L as the process continues indefinitely.

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<sup>1</sup>Stewart, *Calculus, Early Transcendentals*, p. 139, #68.