

## STUDENT VERSION

### SALT COMPARTMENTS

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**Abstract:** Model a phenomena in which salt mixtures from two tanks are mixed with changing volumes of water.

#### SCENARIO DESCRIPTION

Suppose we have two tanks of liquid, Tank 1, holding 100 liters of pure water, and Tank 2, holding 200 liters of pure water - reasonable size fish tanks you might have in your home/office. We dump 100 g of salt (NaCl) into Tank 2, thoroughly dissolve and mix so the salt is uniformly distributed in the tank. Each tank has a capacity of 300 l.

Next we start a pumping action in which we pump 4 l/min of thoroughly mixed saline solution from Tank 1 to Tank 2 and at the same time we pump 3 l/min of thoroughly mixed saline solution from Tank 2 to Tank 1.

Let us assume that a stirrer in each tank keeps the solution thoroughly mixed so that at the very instant saline solution enters a tank its salt is thoroughly mixed in that tank. Let  $x(t)$  be the amount of salt in g in Tank 1 at time  $t$  in min and  $y(t)$  be the amount of salt in g in Tank 2 at time  $t$  in min.

- Set up a system of linear differential equations with initial conditions to describe the flow of salt in each tank at time  $t$  min.
- Solve the system by eliminating one of the variables  $x(t)$  or  $y(t)$  and solving for the remaining variable. Then use that solution to solve for the other variable. Plot the CONCENTRATIONS of salt in both tanks over a 100 minute time interval.
- From your plot describe what is happening with the salt in solution and tell why you could have predicted this at the start without any differential equations!
- Compute the total amount of salt in your tanks from your solutions at all time? Why is this to be expected?