

An incompressible, nonvolatile liquid is pumped into the bottom of a closed tank of volume V_o and diameter D . At the start of filling, the tank contains only an inert, ideal gas, such as air, that is insoluble in the liquid. The initial pressure in the tank is p_o , and the supply liquid volumetric flow rate is proportional to the difference in the inlet line pressure, p_{in} and the pressure in the tank, p (which is constant throughout the tank). The process is isothermal.

- a. Draw a sketch of the filling process and describe in words what happens.
- b. What is the final pressure in the tank?
- c. Perform a mass balance on the gas phase to establish the transient pressure in the tank as a function of the liquid volume.
- d. What is the liquid height in the tank at the final pressure?
- e. Perform a mass balance on the liquid to derive an implicit expression for the liquid height in the tank as a function of time in terms of the parameters p_o , p_{in} , V_o , and D .