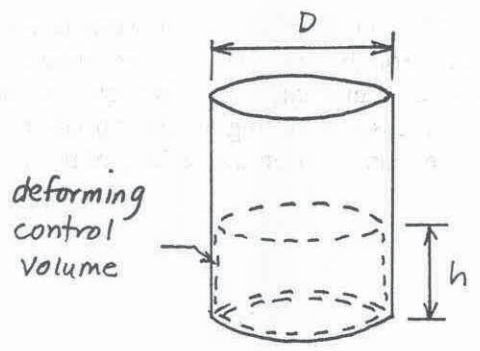
5.28

5.28 How long would it take to fill a cylindrical shaped swimming pool having a diameter of 8 m to a depth of 1.5 m with water from a garden hose if the flowrate is 1.0 liter/s?



From application of the conservation of mass principle to the control volume containing water only as shown in the figure we have

$$\frac{\partial}{\partial t}\int_{cv}\rho\, d\forall + \int_{cs}\rho\, \vec{V}\cdot\hat{n}\, dA = 0$$

For incompressible flow

$$\frac{\partial \forall}{\partial t} - Q = 0$$

or

$$\int_0^{\forall} d\forall = Q\int_0^t dt$$

Thus

$$t = \frac{\forall}{Q} = \frac{\pi D^2 h}{4\,Q} = \frac{\pi\,(8\text{ m})^2\,(1.5\text{ m})\,\left(1000\ \frac{\text{liters}}{\text{m}^3}\right)}{4\quad\left(1.0\ \frac{\text{liter}}{\text{s}}\right)\left(60\ \frac{\text{s}}{\text{min}}\right)}$$

or

$$t = \underline{\underline{1260\text{ min}}}$$