Problem 1

The large container shown in the cross section is filled with a liquid of density $1.1 \times 10^3\,\mathrm{kg/m^3}$. A small hole of area $2.5 \times 10^{-6}\,\mathrm{m^2}$ is opened in the side of the container a distance h below the liquid surface, which allows a stream of liquid to flow through the hole and into a beaker placed to the right of the container. At the same time, liquid is also added to the container at an appropriate rate so that h remains constant. The amount of liquid collected in the beaker in $2.0\,\mathrm{min}$ is $7.2 \times 10^{-4}\,\mathrm{m^3}$.

a) Calculate the volume rate of flow of liquid from the hole in $\mathrm{m^3/s}$.

b) Calculate the speed of the liquid as it exits from the hole.

c) Calculate the height h of liquid needed above the hole to cause the speed you determined in part b.

d) Suppose that there is now less liquid in the container so that the height h is reduced to $h/2$. In relation to the collection beaker, where will the liquid hit the tabletop?

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$$\boxed{h = 0.294\,\mathrm{m}}$$

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Left of the container