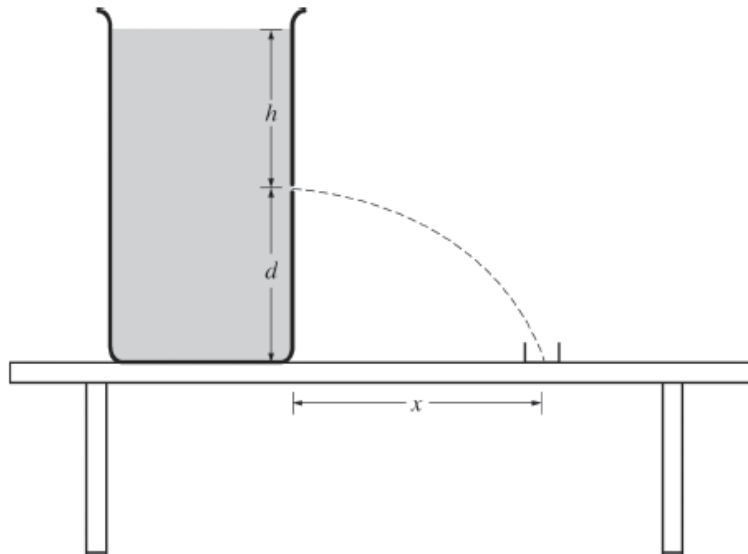


2007 AP<sup>®</sup> PHYSICS B FREE-RESPONSE QUESTIONS



4. (10 points)

The large container shown in the cross section above is filled with a liquid of density  $1.1 \times 10^3 \text{ kg/m}^3$ . A small hole of area  $2.5 \times 10^{-6} \text{ m}^2$  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 minutes is  $7.2 \times 10^{-4} \text{ m}^3$ .

- Calculate the volume rate of flow of liquid from the hole in  $\text{m}^3/\text{s}$ .
- Calculate the speed of the liquid as it exits from the hole.
- Calculate the height  $h$  of liquid needed above the hole to cause the speed you determined in part (b).
- Suppose that there is now less liquid in the beaker so that the height  $h$  is reduced to  $h/2$ . In relation to the beaker, where will the liquid hit the tabletop?

Left of the beaker       In the beaker       Right of the beaker

Justify your answer.

should say "container"