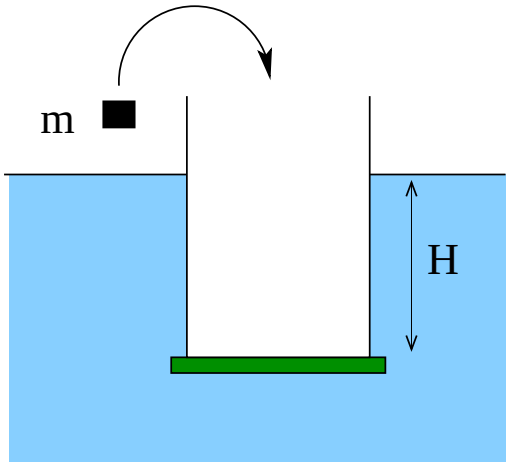
Escape from a Submarine

An open cylinder with thin light (water-tight) attached bottom is submerged into water to depth H. A weight m is placed on the bottom of the cylinder. Find the minimal weight m, and its position on the bottom, required to separate the bottom from the cylinder. The diameter of the cylinder is D, you may assume that the size of the weight is much smaller than D.



Answer of problem **Escape from a Submarine**

The pressure force from the water on the bottom is

$$F_w = \rho g H \frac{\pi D^2}{4}$$

it is pointing up and we may think it is applied to the center of the bottom. To separate the bottom from the cylinder we put the weight as close as possible to the side of the cylinder. Then the moments equation relative to the rotation axis at the diametrically opposite point will be

$$mgD - F_w \frac{D}{2} = 0 \qquad \Rightarrow \qquad \boxed{m = \frac{F_w}{2g} = \frac{1}{8}\rho H \pi D^2}$$

- only half the weight of the displaced liquid!