A ball of mass $M$ and volume $V$ is floating at rest in a tank of water. Some of the ball is submerged in the water, but part of the ball is sitting above the water level. The density of the ball is $\rho_b$ and the density of water is $\rho_{water}$.

1. Draw a free-body diagram for the ball.

2. What is the sum of all the forces on the ball? (Why?)

3. Write down an expression for the weight of the ball (in air) in terms of $V, \rho_b, g$
4. Call the portion of the ball’s volume that is submerged in the water $V_{in}$. The volume that is submerged is also the volume of water displaced. (Do you see that?) Archimedes principle tells us that the buoyant force is equal to the weight of fluid displaced. Use this to write an expression for the buoyant force in terms of just $V_{in}, \rho_{water}, g$

5. Combine everything you have considered above (and the fact that the floating ball is in static equilibrium) to find the ratio of $V_{in}$ to the total volume in terms of only the density of the ball $\rho_b$ and the density of water $\rho_{water}$.

$$\frac{V_{in}}{V} =$$

6. Look up the density of ice and the density of water. From these densities and using the relationship you found above, calculate the percentage of a block of ice’s volume that would be submerged when the ice is floating in water. You may have heard that most of an iceberg is actually under the water. Does that idea now make sense?