## Density and Buoyancy (contd.)

- Archimedes Principle:
"Buoyancy force = weight of displaced fluid"

Bouyancy Force $=\rho_{\text {fluid }} V g$

Weight of the body $=m_{\text {body }} g$


$$
\begin{gathered}
F_{\text {bouyancy }}=m_{\text {fluid }} g=\rho_{\text {fluid }} V g \\
F_{\text {total }}=\rho_{\text {fluid }} V g-m_{\text {body }} g
\end{gathered}
$$

-Buoyancy also acts on objects in gases (think of baloons in air).

- Units of Volume and Density:

$$
\begin{aligned}
& 1 m^{3}=10^{3} l=10^{6} \mathrm{~cm}^{3} \\
& 1 \mathrm{~cm}^{3}=1 \mathrm{ml}=10^{-3} l=10^{-6} \mathrm{~m}^{3} \\
& \rho_{\mathrm{H}_{2} 0}=1 \frac{g}{\mathrm{ml}}=1000 \frac{\mathrm{~kg}}{\mathrm{~m}^{3}}
\end{aligned}
$$

## Homework 3

## Problem 1

A rock of mass $m=1000 \mathrm{~kg}$ with density $\rho=2500 \mathrm{~kg} / \mathrm{m}^{3}$ is frozen inside of a small iceberg (or big piece of ice). The iceberg is floating in water and slowly melts.

Find the total volume of the iceberg (with the rock inside) at that moment when it starts to sink. Density of ice is $900 \mathrm{~kg} / \mathrm{m}^{3}$. Density of water is $1000 \mathrm{~kg} \mathrm{~m} / 3$.

## Problem 2.

Helium inside of a rubber balloon has density which is approximately $14 \%$ of the density of air: $\rho_{\mathrm{He}}=0.14 \rho_{\text {air }}$. If V is the volume of the balloon, what is the maximum mass $M$ that it can lift from the ground (including the mass of the rubber skin, and a possible extra load)? Derive the general formula for this mass M , and compute it for specific parameters: $\rho_{\text {air }}=1.2 \mathrm{~kg} / \mathrm{m}^{3} ; \mathrm{V}=3 \mathrm{~L}$. Pay attention to units!

