What percentage of an ice cube is under water when it is placed into water? What percentage of an ice cube is submerged when it is placed in a drink that is straight 80 proof whiskey? (80 proof mean that it is 40% alcohol and 60% water.)
(Density of ice $\rho_i$ = 917 kg/m$^3$, density of alcohol $\rho_A$ = 785 kg/m$^3$,

According to Archimedes principle the apparent loss in weight (up thrust) of a liquid is equal to the weight of the liquid displaced. If the density of the material of the body is less than that of the liquid, it will float on the surface of the liquid in such a way that the weight of the displaced liquid will be equal to the weight of the body. If the density of the material of the body is more than that of the liquid, it will sink to the bottom of the container.

Solution:

Let the volume of the cube of Ice be V and the volume of ice under water is $V_1$.

The density of the ice be $\rho_i$ = 917 kg/m$^3$ and that of water be $\rho_W$ = 1,000 kg/m$^3$
Thus weight of the ice cube = mg =$V*\rho_i*g$
Weight of the displaced water = $m_1g = V_1*\rho_w*g$

As the density of ice is less than the density of water the cube will be floating on the surface of water in equilibrium, the resultant force on it must be zero, or the up-thrust is balancing the weight of the cube and hence

$mg = m_1g$
Or $V*\rho_i*g = V_1*\rho_w*g$
Gives $(V_1/V) = (\rho_i/\rho_w) = 917/1000$

Hence the percentage of ice submerged in water = $(V_1/V)*100$ =91.7%

--------------------

Proof: A measure of alcoholic strength expressed as an integer twice the percentage of alcohol present **(by volume)**

Solution:

Let the total volume of the drink is $V_2$
Then volume of the alcohol in the drink = $(40/100)*V_2 = 0.4*V_2$
And the mass of alcohol in the drink (volume*density) = $0.4*V_2*\rho_A$
The volume of water in the drink = $(60/100)*V_2 = 0.6*V_2$
Thus the mass of water in the drink = $0.6*V_2*\rho_W$

Adding we get the total mass of the drink = $0.4*V_2*\rho_A + 0.6*V_2*\rho_W$

Therefore the density of the drink is given by
$\rho$ = mass/volume = $(0.4*V_2*\rho_A + 0.6*V_2*\rho_W)/V_2$
= 0.4*785 + 0.6*1000 = 914 kg/m$^3$.

Here the density of the drink 914 kg/m$^3$ is less than the density of ice 917 kg/m$^3$, the ice will not float on the surface of the drink and it will sink.

Hence the percentage of the ice submerged is 100%.

*********************