

Chapter 15

Density	density (Greek lower case ρ - 'rho') = mass/volume density of water = 1000kg/m^3 density of air = 1.29 kg/m^3
Pressure	$P = \text{force/area}$ (over which the force is applied) Atmospheric pressure = $P_{\text{at}} = 101\text{ kPa}$ where Pa [=] N/m^2 is the MKS unit of pressure
Pressure under a fluid surface	$P = \rho * g * \text{depth}$ (and to this is added any preexisting pressure on the fluid such as P_{at})

Archimedes' Principle	A submerged object is buoyed up with a force equal to the weight of the displaced fluid.
Equation of continuity	$\rho_1 * A_1 * v_1 = \rho_2 * A_2 * v_2$ Where ρ is the density of the fluid, A is the cross sectional area of the pipe and v is the velocity of the fluid.
Bernoulli's Equation	$P + 1/2 * \rho * v^2 + \rho * g * y =$ constant along a stream line Here $\rho_1 = \rho_2 = \rho$, the common density of the (incompressible) fluid and y is the height of the pipe above an arbitrary reference level for GPE

Derivation of Bernoulli's
equation for an incompressible
fluid of density ρ

$(A_2 v_2 \Delta t) \rho v_2^2$] minus the KE of the fluid removed from the system on the left during this same time $[\rho (A_1 v_1 \Delta t) v_1^2]$. Similarly, the increase in GPE of the system equals the weight of the fluid added to the system on the right $(\rho g y_2 A_2 v_2 \Delta t)$ minus the weight of the fluid lost from the system on the left $(\rho g y_1 A_1 v_1 \Delta t)$. Putting all this together and using the equation of continuity ($A_1 v_1 = A_2 v_2$) gives Bernoulli's equation: $P_1 + \frac{1}{2} \rho v_1^2 + \rho g y_1 = P_2 + \frac{1}{2} \rho v_2^2 + \rho g y_2$. (Note that points 1 and 2 are any two points along the same stream line of the fluid flow.)