Conversion Factors

Mass & Force:

$$\frac{14.59\text{ kg}}{\text{slug}} \quad \frac{32.174\text{ lb}_\text{m}}{\text{slug}} \quad \frac{2.205\text{ lb}_\text{m}}{\text{kg}} \quad \frac{2000\text{ lb}_\text{m}}{\text{ton}_\text{m}} \quad \frac{1000\text{ kg}}{\text{metric ton}_\text{m}} \quad \frac{4.448\text{ N}}{\text{lb}_\text{f}} \quad \frac{10^5\text{ dynes}}{\text{N}}$$

Length:

$$\frac{3.281\text{ ft}}{\text{m}} \quad \frac{39.37\text{ in}}{\text{m}} \quad \frac{12\text{ ft}}{\text{in}} \quad \frac{1.609\text{ km}}{\text{mi}} \quad \frac{5280\text{ ft}}{\text{mi}}$$

Volume:

$$\frac{7.48\text{ gal}}{\text{ft}^3} \quad \frac{3.785\text{ L}}{\text{gal}} \quad \frac{1000\text{ L}}{\text{m}^3} \quad \frac{1.201\text{ U.S. gal}}{\text{Imperial gallon}}$$

Volume Flow Rate:

$$\frac{449\text{ gal/min}}{\text{ft}^3\text{/s}} \quad \frac{3.785\text{ L/min}}{\text{gal/min}} \quad \frac{60{,}000\text{ L/min}}{\text{m}^3\text{/s}} \quad \frac{2119\text{ ft}^3\text{/min}}{\text{m}^3\text{/s}}$$

Energy & Power:

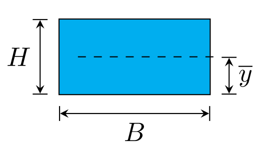
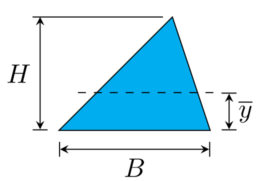
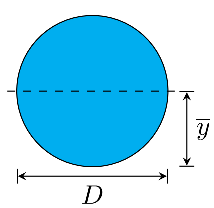
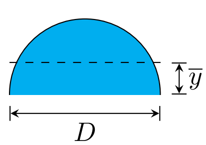
$$\frac{1.356\text{ J}}{\text{lb}\cdot\text{ft}} \quad \frac{1.0\text{ J}}{\text{N}\cdot\text{m}} \quad \frac{1.055\text{ kJ}}{\text{Btu}} \quad \frac{745.7\text{ W}}{\text{hp}} \quad \frac{550\text{ lb}\cdot\text{ft/s}}{\text{hp}} \quad \frac{3.412\text{ Btu/hr}}{\text{W}}$$

Properties of water at 15˚C / 59˚F

$$\gamma = 9.81\text{ kN/m}^3 = 62.4\text{ lb/ft}^3 \qquad \rho = 1000\text{ kg/m}^3 = 1.94\text{ slugs/ft}^3$$

$$\eta = 1.15\times10^{-3}\text{ Pa}\cdot\text{s} = 2.40\times10^{-5}\text{lb}\cdot\text{s/ft}^2 \qquad \nu = 1.15\times10^{-6}\text{ m}^2\text{/s} = 1.24\times10^{-5}\text{ ft}^2\text{/s}$$

Properties of Areas

	Area	Distance to Centroidal axis ($\overline{y}$)	Moment of Inertia about Centroidal Axis (I_c)
	BH	$H/2$	$BH^3/12$
	$BH/2$	$H/3$	$BH^3/36$
	$\pi D^2/4$	$D/2$	$\pi D^4/64$
	$\pi D^2/8$	$2D/(3\pi)$	$\left(\frac{\pi}{128}-\frac{1}{18\pi}\right)D^4$

Key Equations

PRESSURE	$p = \dfrac{F}{A}$	BULK MODULUS	$E = \dfrac{-\Delta p}{(\Delta V)/V}$
DENSITY	$\rho = m/V$	SPECIFIC WEIGHT	$\gamma = mg/V$
DYNAMIC VISCOSITY	$\eta = \tau\left(\dfrac{\Delta y}{\Delta v}\right)$	KINEMATIC VISCOSITY	$\nu = \eta/\rho$

ABSOLUTE AND GAUGE PRESSURE: $p_{\text{abs}} = p_{\text{gauge}} + p_{\text{atm}}$

PRESSURE-ELEVATION RELATIONSHIP: $\Delta p = \gamma h$

FORCE ON A SUBMERGED PLANE AREA: $F_R = \gamma h_c A$

LOCATION OF CENTER OF PRESSURE: $L_p = L_c + \dfrac{I_c}{L_c A}\,, \qquad h_p = h_c + \dfrac{I_c \sin^2\theta}{h_c A}$

PIEZOMETRIC HEAD	$h_a = p_a/\gamma$	BUOYANT FORCE	$F_b = \gamma_f\, V_d$

VOLUME, WEIGHT AND MASS FLOW RATE: $Q = Av, \qquad W = \gamma Q, \qquad M = \rho Q$

CONTINUITY EQUATION: $\rho_1 A_1 v_1 = \rho_2 A_2 v_2\,, \qquad A_1 v_1 = A_2 v_2$ (LIQUIDS)

GENERAL ENERGY EQ. (FLOW: $1 \rightarrow 2$): $\dfrac{p_1}{\gamma} + z_1 + \dfrac{v_1^2}{2g} + h_A - h_R - h_L = \dfrac{p_2}{\gamma} + z_2 + \dfrac{v_2^2}{2g}$

POWER ADDED TO FLUID BY A PUMP: $P_A = h_A W = h_A \gamma Q$

PUMP EFFICIENCY: $e_M = \dfrac{\text{Power delivered to fluid}}{\text{Power consumed by pump}} = \dfrac{P_A}{P_I}$

POWER REMOVED FROM FLUID BY A MOTOR: $P_R = h_R W = h_R \gamma Q$

MOTOR EFFICIENCY: $e_M = \dfrac{\text{Power output from motor}}{\text{Power delivered by fluid}} = \dfrac{P_O}{P_R}$

REYNOLDS NUMBER − CIRCULAR SECTIONS: $N_R = \dfrac{vD\rho}{\eta} = \dfrac{vD}{\nu}$

DARCY'S EQUATION FOR ENERGY LOSS: $h_L = f \times \dfrac{L}{D} \times \dfrac{v^2}{2g}$

MINOR LOSSES: $h_L = K\left(v^2/2g\right) \qquad (K = \text{Resistance coefficient})$

K FOR VALVES AND FITTINGS: $K = (L_e/D)\, f_T$

K FOR SUDDEN ENLARGEMENT: $K \approx [1 - (A_1/A_2)]^2$

K FOR SUDDEN CONTRACTION: $K \approx 0.45\left[1 - (A_2/A_1)^2\right]^2$

FORCE EQUATION IN X-DIRECTION: $F_x = \rho Q \Delta v_x = \rho Q\left(v_{2_x} - v_{1_x}\right)$

DRAG FORCE	$F_D = C_D\left(\rho v^2/2\right) A$	LIFT FORCE	$F_L = C_L\left(\rho v^2/2\right) A$
STOKE'S LAW	$F_D = 3\pi\eta v D$	IDEAL GAS LAW	$\dfrac{p}{\gamma T} = \text{constant} = R$