Birzeit University
Mechanical & Mechatronics Engineering Department
Thermal fluid engineering ENMC4411
Homework 3
Chapter 3 Dimensional Analysis

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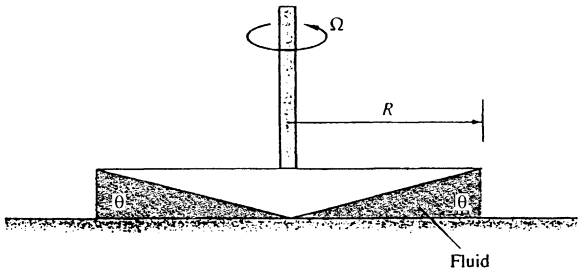
1. In forced convection, the heat transfer coefficient h is a function of thermal conductivity k, density ρ, viscosity μ, specific heat c_p, body length L, and velocity V. Heat transfer coefficient has units of W/(m^2-K) and dimensions $\{MT^{-3}\Theta^{-1}\}$. Rewrite this relation in dimensionless form, using (k, ρ, c_p, L) as repeating variables.

2. The torque M required to turn the cone-plate viscometer in Fig. P5.35 depends upon the radius R, rotation rate Ω, fluid viscosity μ, and cone angle θ. Rewrite this relation in dimensionless form. How does the relation simplify if it is known that M is proportional to θ?



3. A prototype ship is 35 m long and designed to cruise at 11 m/s (about 21 kn). Its drag is to be simulated by a 1-m-long model pulled in a tow tank. For Froude scaling find (a) the tow speed, (b) the ratio of prototype to model drag, and (c) the ratio of prototype to model power.