

Notes #1a
MAE 533, Fluid Mechanics
Fall, 1998

S. H. (Harvey) Lam
lam@princeton.edu
<http://www.princeton.edu/~lam>

September 21, 1998

Dimensional Analysis Exercises

1. Let us assume that somehow all existing experimental data on pipe flows are lost. You are in charge of a “new” research program to obtain experimental data for pressure drop Δp in perfectly straight and horizontal circular pipes with diameter D (over a distance L with the smoothest possible interior surface)—such that the resulting plot of the data can be used when the working fluid is either (Newtonian) gas or liquid (with density ρ and viscosity μ). What about rough pipes?
2. The physicist in the atomic bomb project in the second world war speculated that the velocity V of the strong shock wave generated by the explosion of the bomb (exploded at $t = 0$) is a function of E (the energy released by the bomb), ρ , the undisturbed density of the atmosphere, and t , the time elapsed since the explosion. Deduce a relation between V , E , ρ and t and a dimensionless parameter Π . Think about how you would determine the value of Π experimentally.