MIE 340
Prof. Perot
Handout #6

Steps for Flawless Control Volume Analysis

(1) **Draw a picture of the problem.**
- (a) Include everything you know in the picture.
- (b) Include a coordinate system (and stick to it).
- (c) Label all the important exits/entrances (with numbers usually).
- (d) Draw the normal vectors at exits/entrances (and where pressure acts).

(2) **Draw the control volume** (dotted line).
This is the art, and often the key, to successful control volume analysis.
- (a) Place boundaries where you know something.
- (b) Place boundaries where you want to know something.
- (c) Consider the orientation of boundaries (perpendicular is often very wise).
- (d) If the boundary follows a wall, make sure that you indicate whether it includes the wall.

(3) **Understand the physics.**
- (a) Indicate all significant forces on the sketch (and their direction).
- (b) Indicate all significant energy sources (and where the energy goes).
- (c) Account for all the fluids or solids which cross the control volume boundaries.

(4) **Define the model.**
Control Volume Analysis is always approximate - *so list your simplifying assumptions.*
- steady-state
- uniform flow
- frictionless (ignore viscosity)
- incompressible / perfect gas
- gravity is unimportant
- isothermal (no temperature change)
- etc...

(5) **Apply fundamental principals.** (Conservation of Mass, Momentum, Energy)
- (a) Write down the equations that apply. (see above)
- (b) Simplify the equations given the assumptions
  (*this is where 70% of your mistakes will be - be careful – go slowly*)

(6) **Solve the equations.**
- (a) Check that: the # of equations = the # of unknowns.
- (b) If not - may need additional equations (e.g. equation of state, extra CV).
- (c) Solve the equations.
- (d) Check the Units.
- (e) Check obvious limiting cases. *(Does the answer make sense?)*