FluidMech^{Power}

Your 24/7 Tutor for
Fluid Mechanics

Actus Potentia, Inc.
www.actuspotentia.com/Fluid.shtml

What will it do for Students

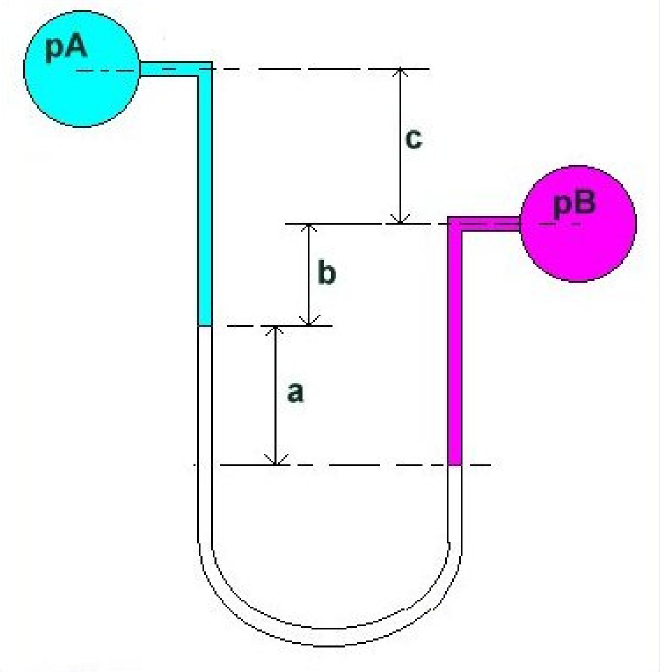
- You will get a strong foundation through guided problem solving
- You will know where to start and where to go from the step-by-step instructions
- You will get immediate feedback so that you can fix your mistakes
- You will finish your homework in a fraction of the time
- You will improve test scores and grade
- You can learn at your own pace at your own time

Manometer

Start at pA,
walk through
manometer
to pB

pA + gamma1*H1 + gamma2*H2 - gamma3*H3 = pB

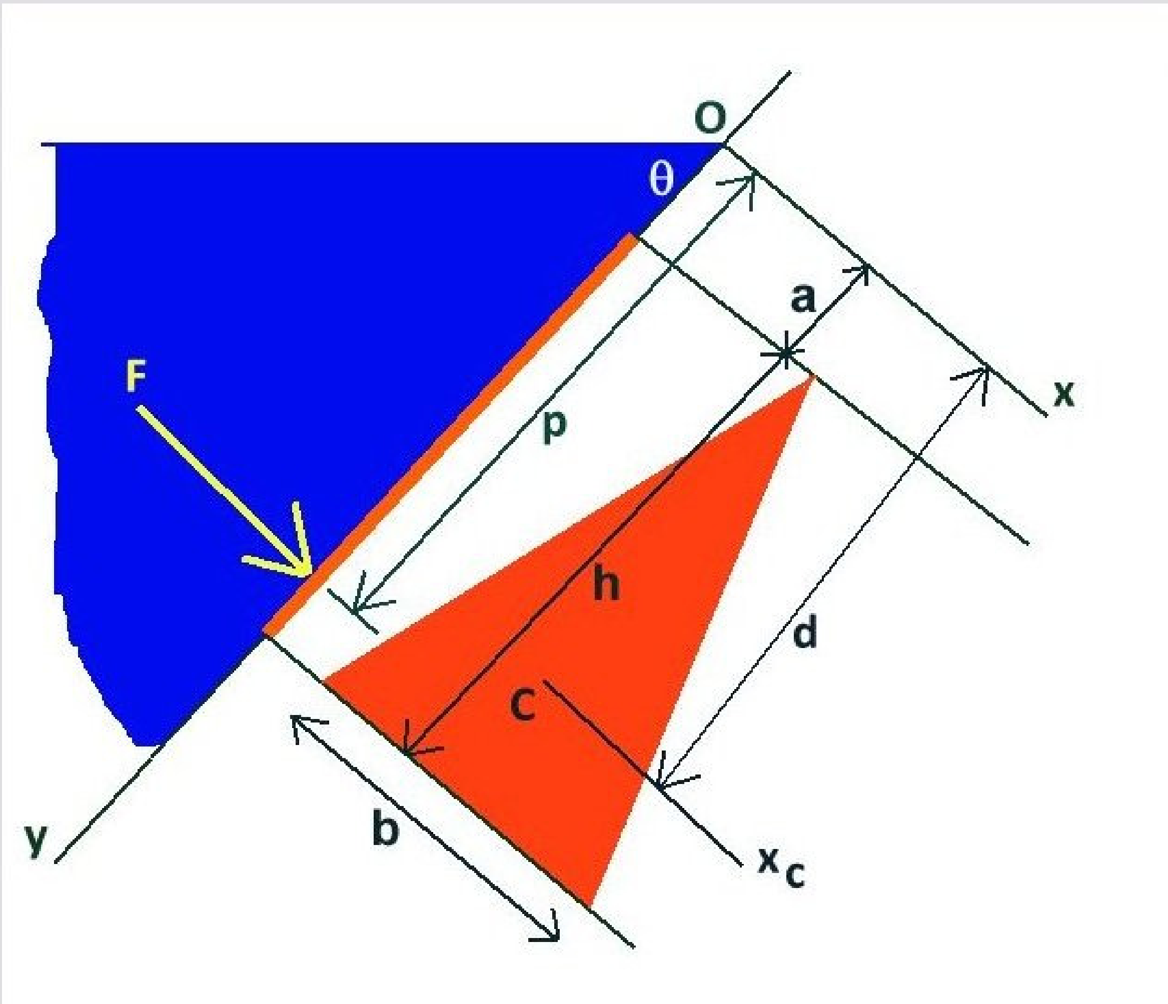
NEW



Force on Plane Area

Triangle

Show Axes | Show Planform | Find Force | Find Location



Find Area

$$A = \frac{bh}{2}$$

Locate Centroid C, draw x_c

Find 2nd Moment of Area

$$I(x_c) = \frac{bh^3}{36}$$

Find d

$$d = a + \frac{2h}{3}$$

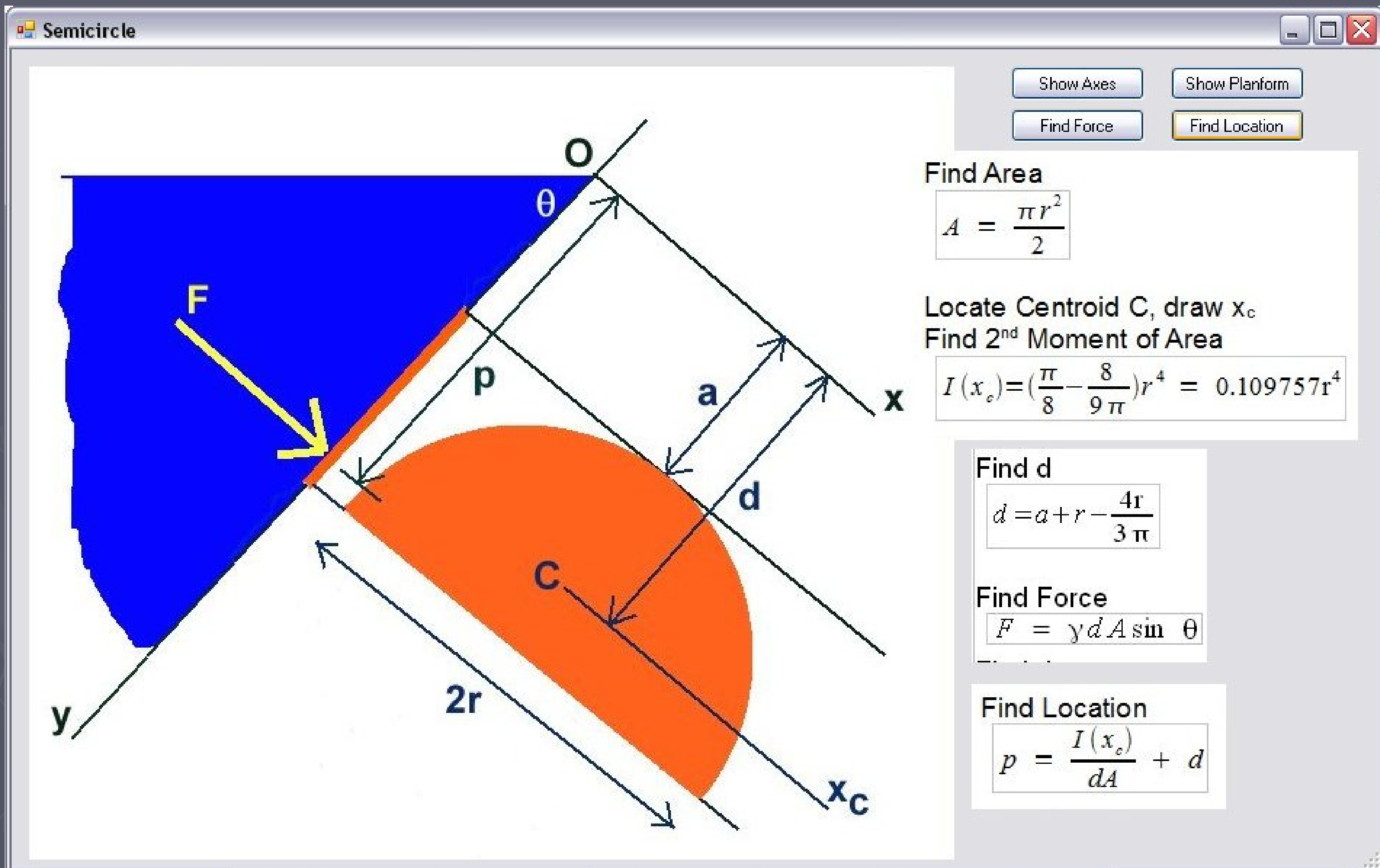
Find Force

$$F = \gamma d A \sin \theta$$

Find Location

$$p = \frac{I(x_c)}{dA} + d$$

Force on Plane Area



Force on Plane Area *help*

Force on Composite Plane Areas

Problem-1

The gate of Figure-1 is immersed in a fluid as shown in Figure-2. This gate is analyzed as a composite area consisting of two flat, rectangular gates.

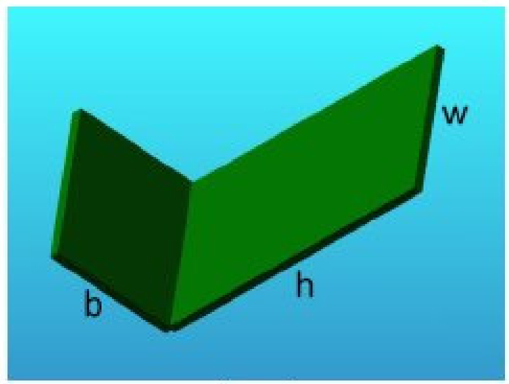


Figure-1

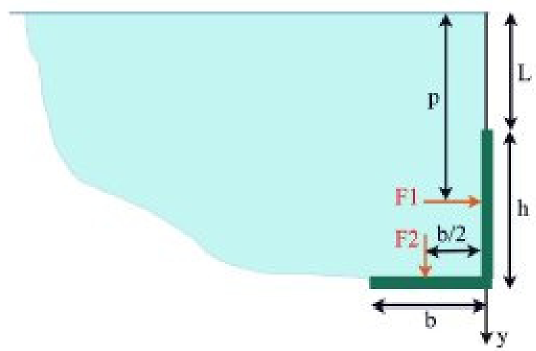


Figure-2

Force on Plane Area *help*

Problem-2

The gate of Figure-3 is immersed in a fluid. This gate is analyzed as a composite area consisting of one rectangular gate and a semi-circular gate.

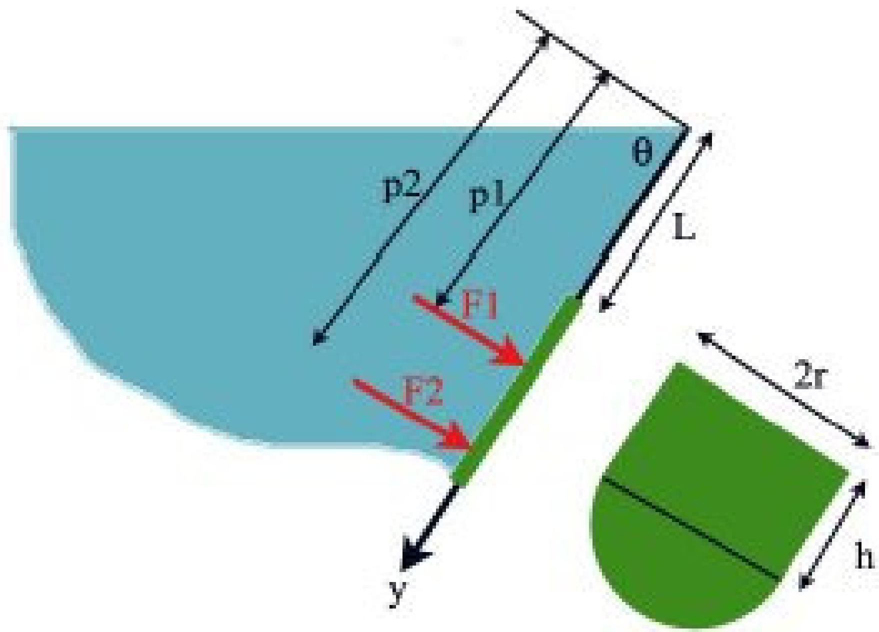
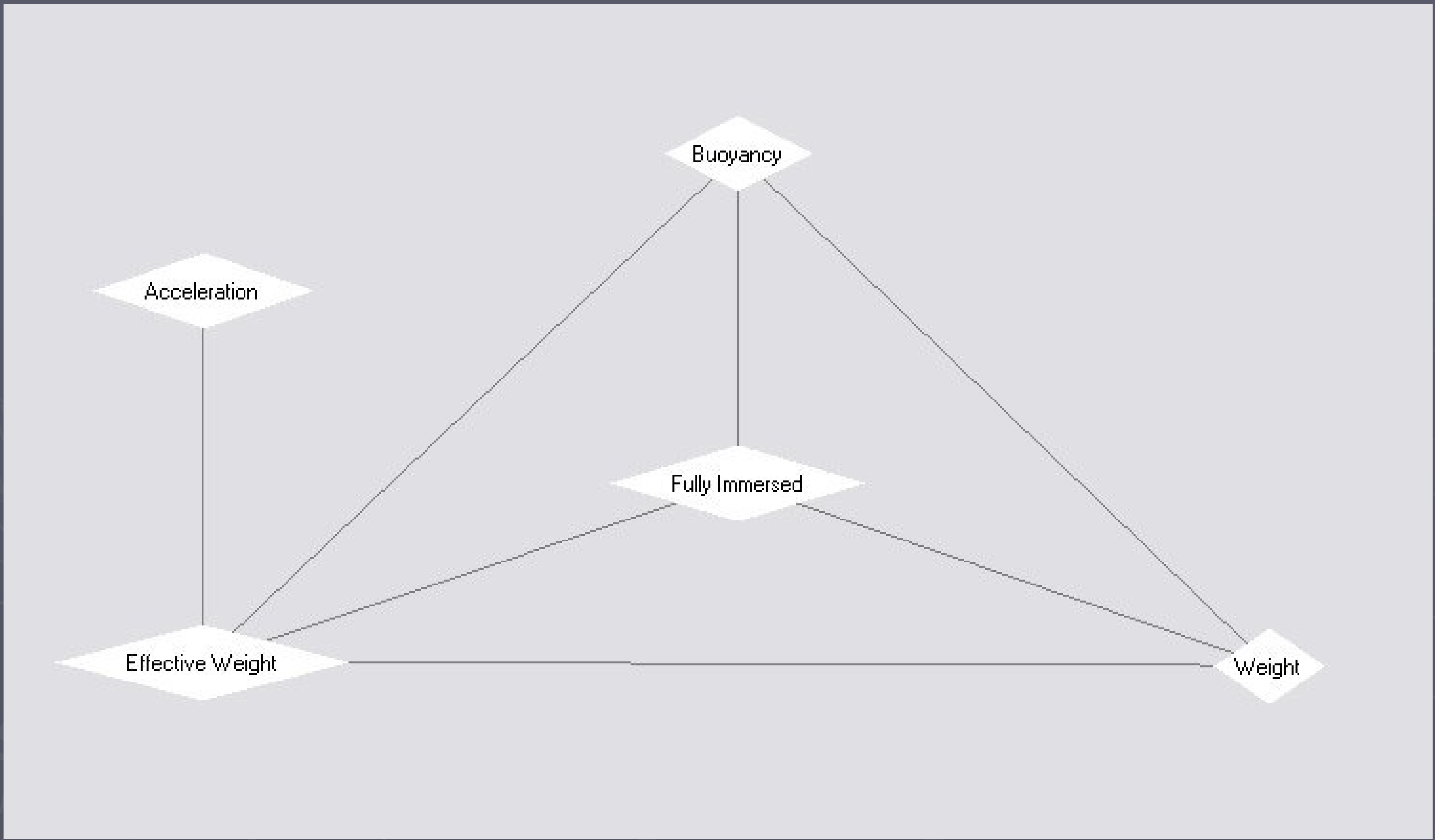
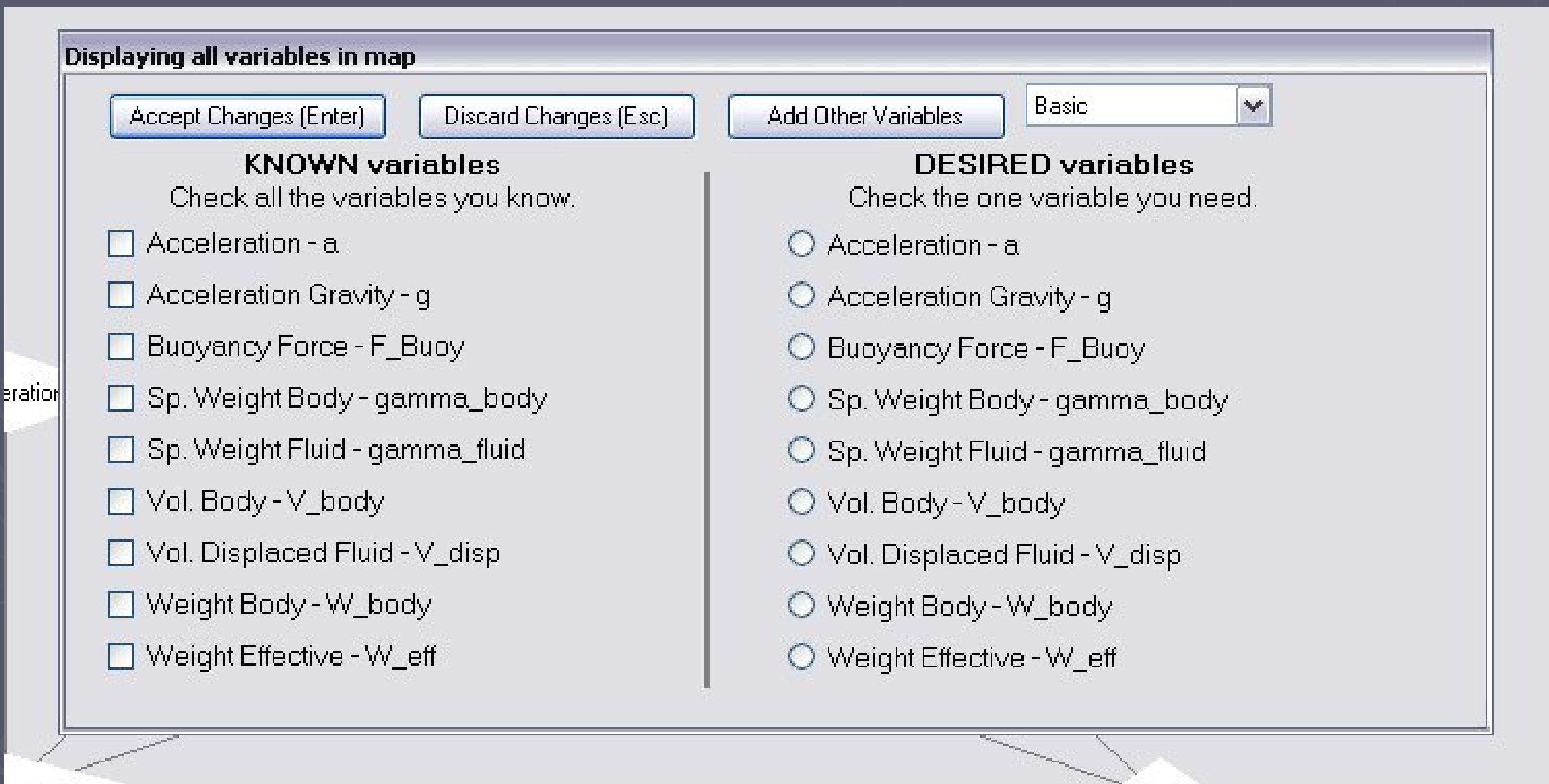


Figure-3

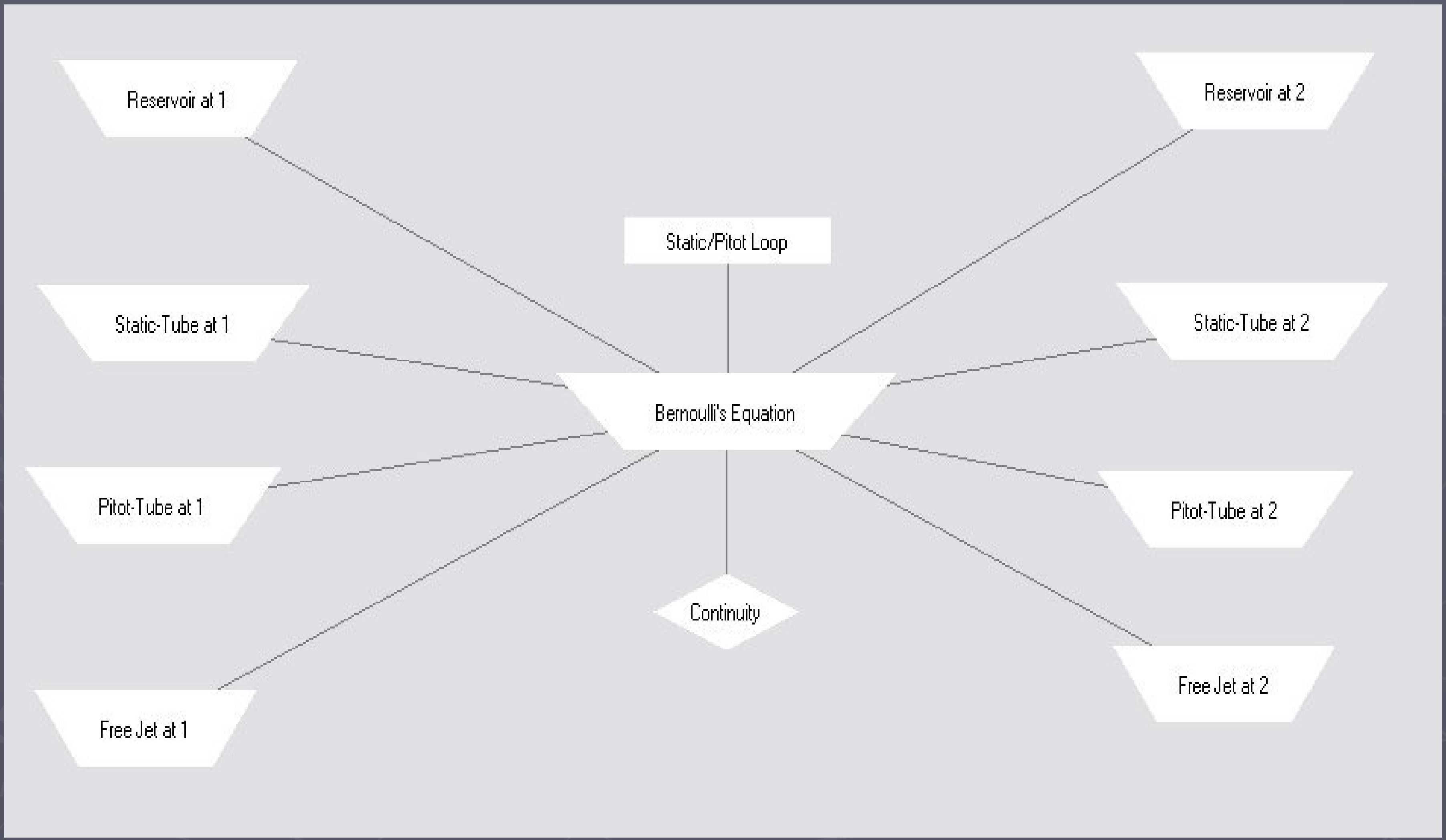
Buoyancy Concept Map



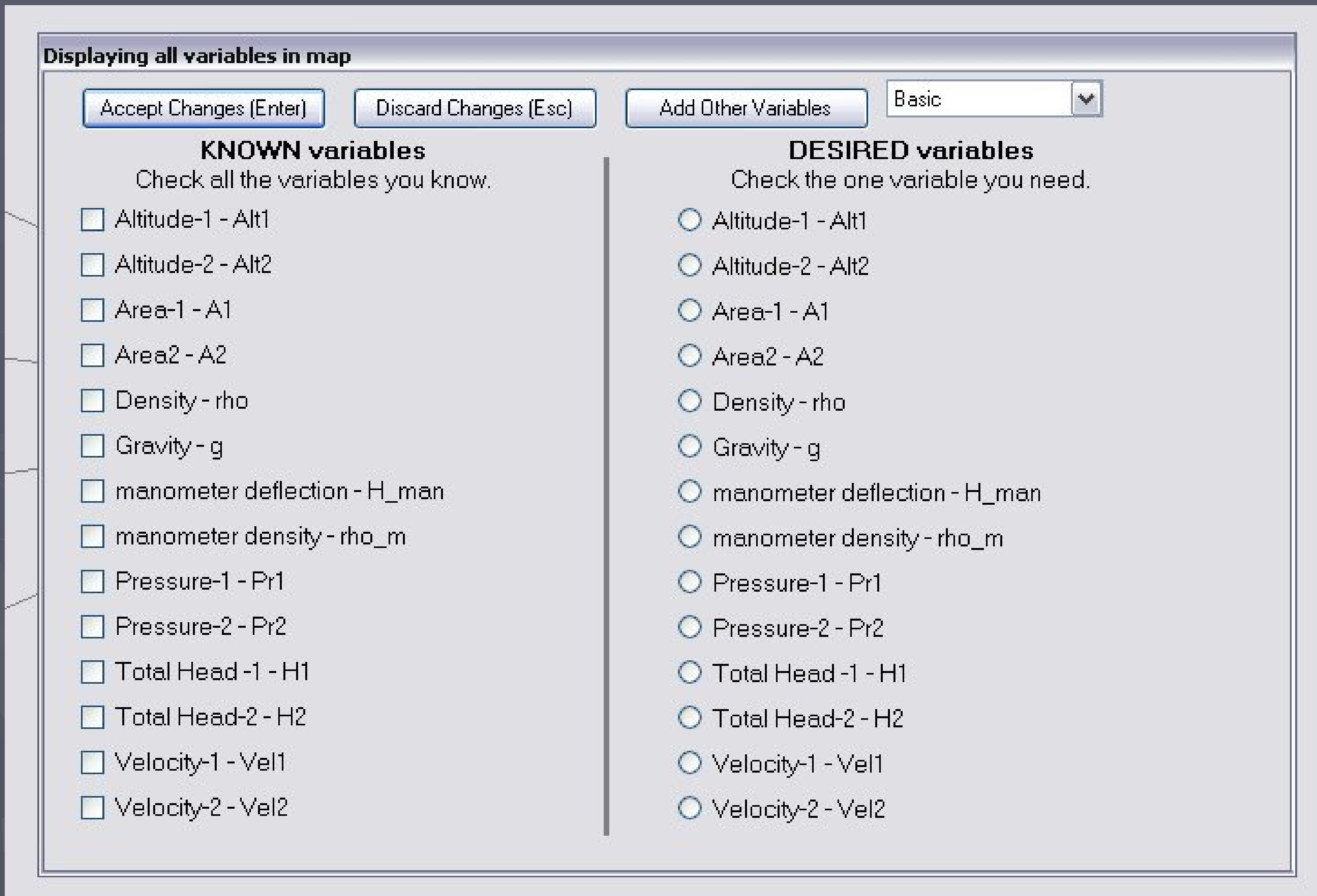
Buoyancy Concept Map - Variables



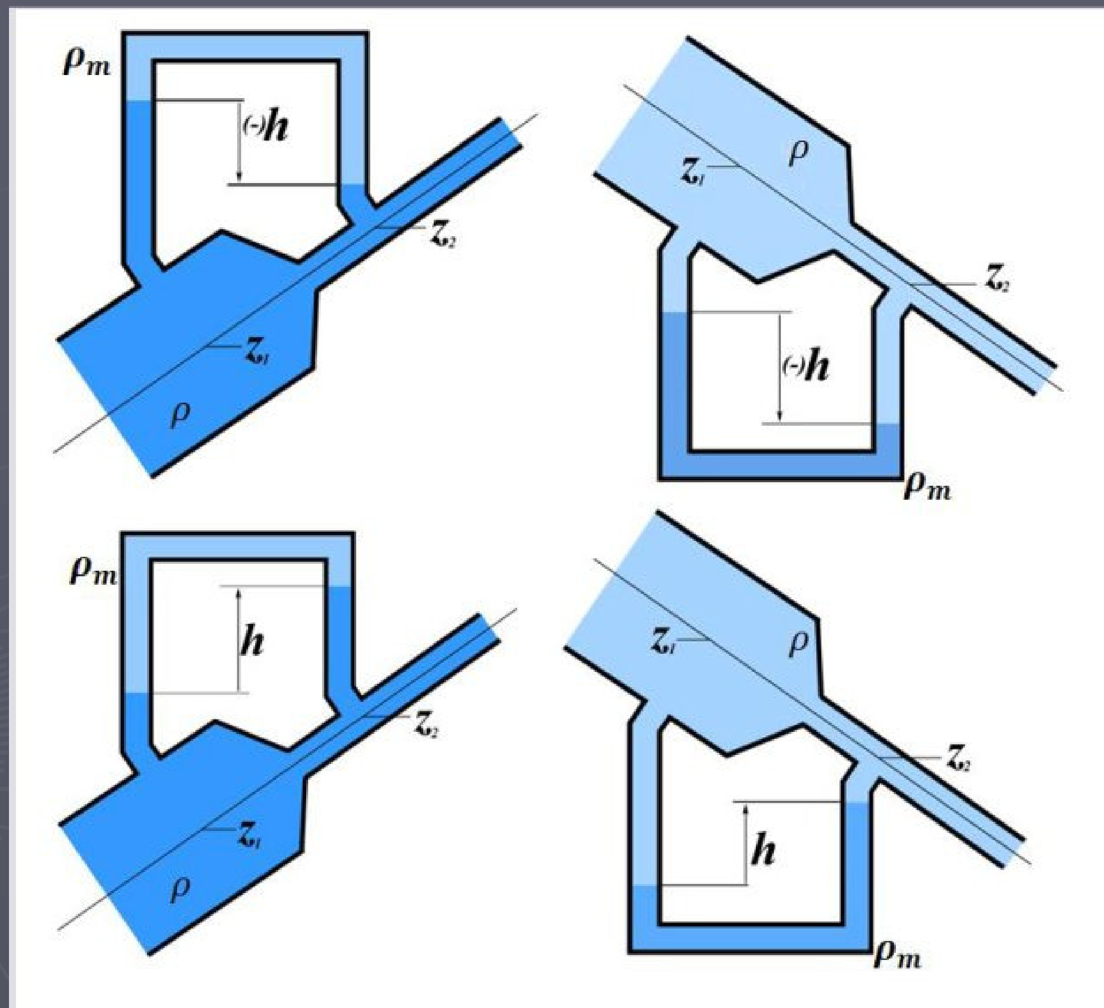
Bernoulli Eqn. Concept Map



Bernoulli Concept Map - Variables

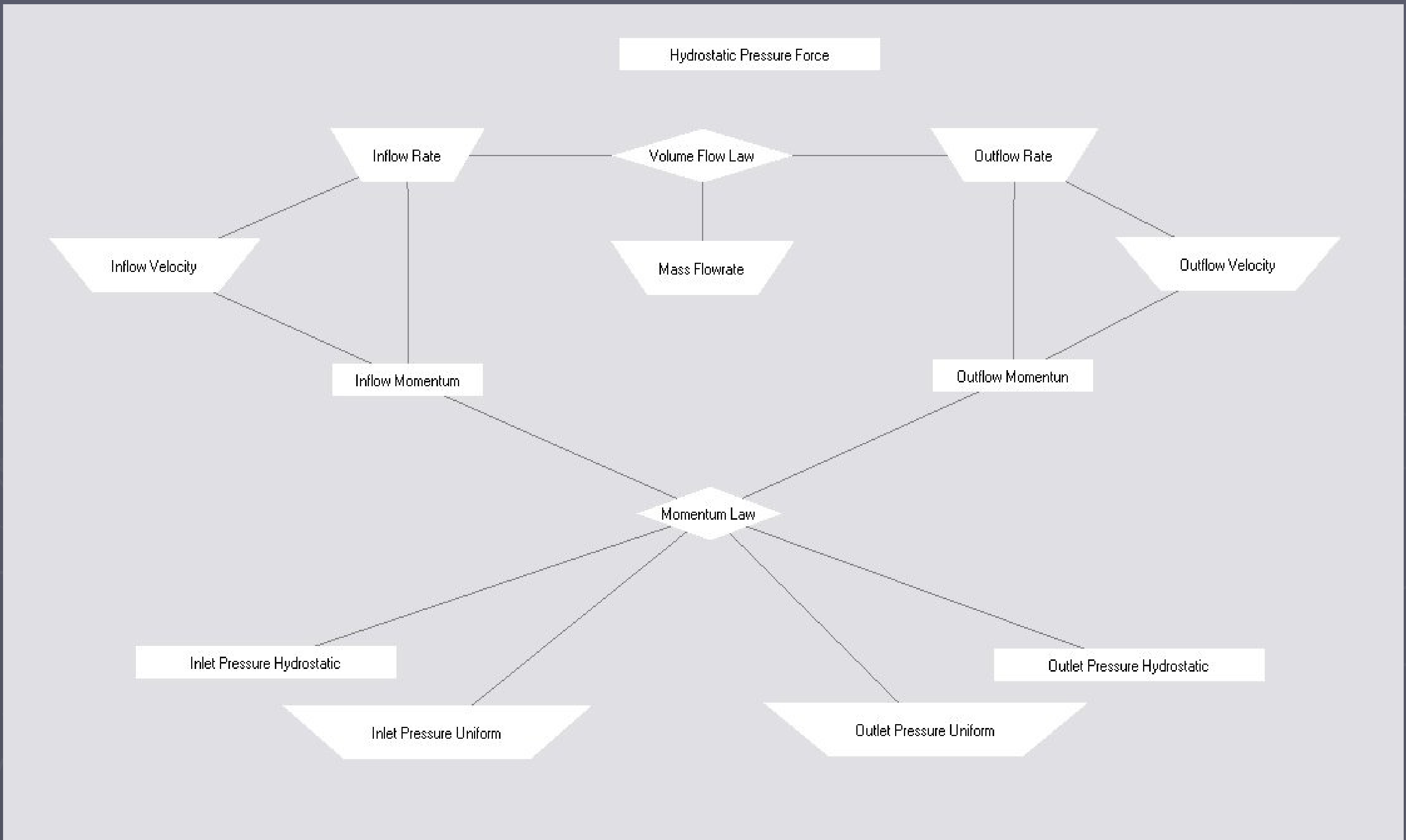


Bernoulli Concept Map - *help*

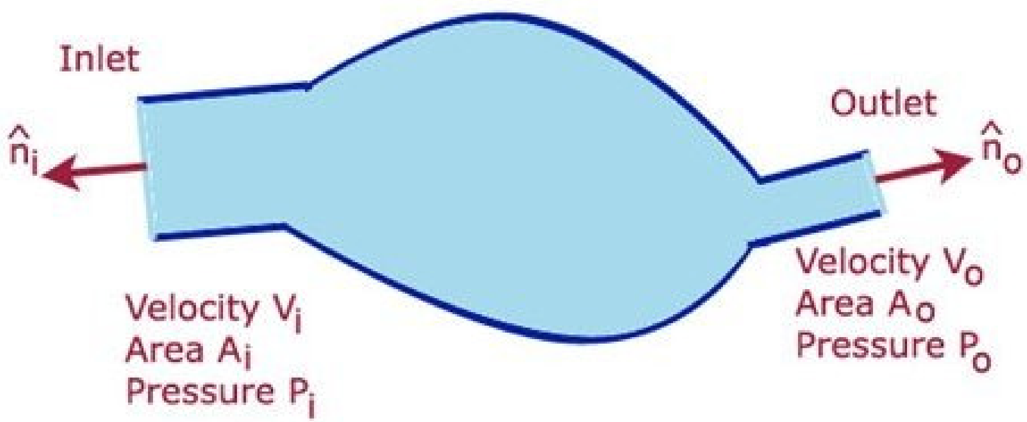


$$P_2 = \rho g(z_1 - z_2) + \rho g h - \rho_m g h$$

Momentum – Concept Map



Momentum Concept Map *help*



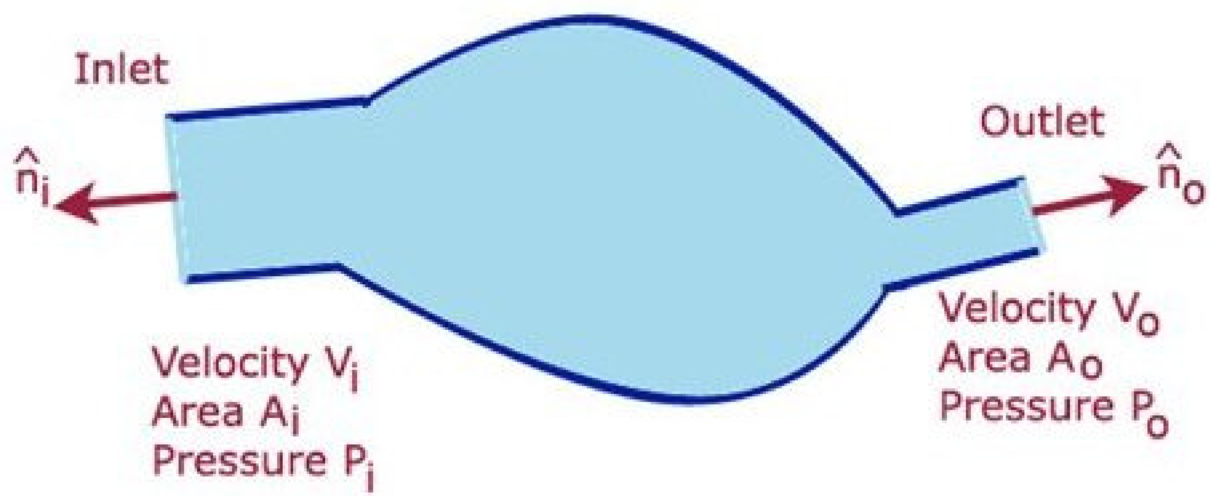
Weight of fluid = $\vec{W} = W_x \hat{x} + W_y \hat{y}$

Force from pipes, walls, surfaces in contact with the fluid =
$\vec{F} = F_x \hat{x} + F_y \hat{y}$

Momentum Equation:

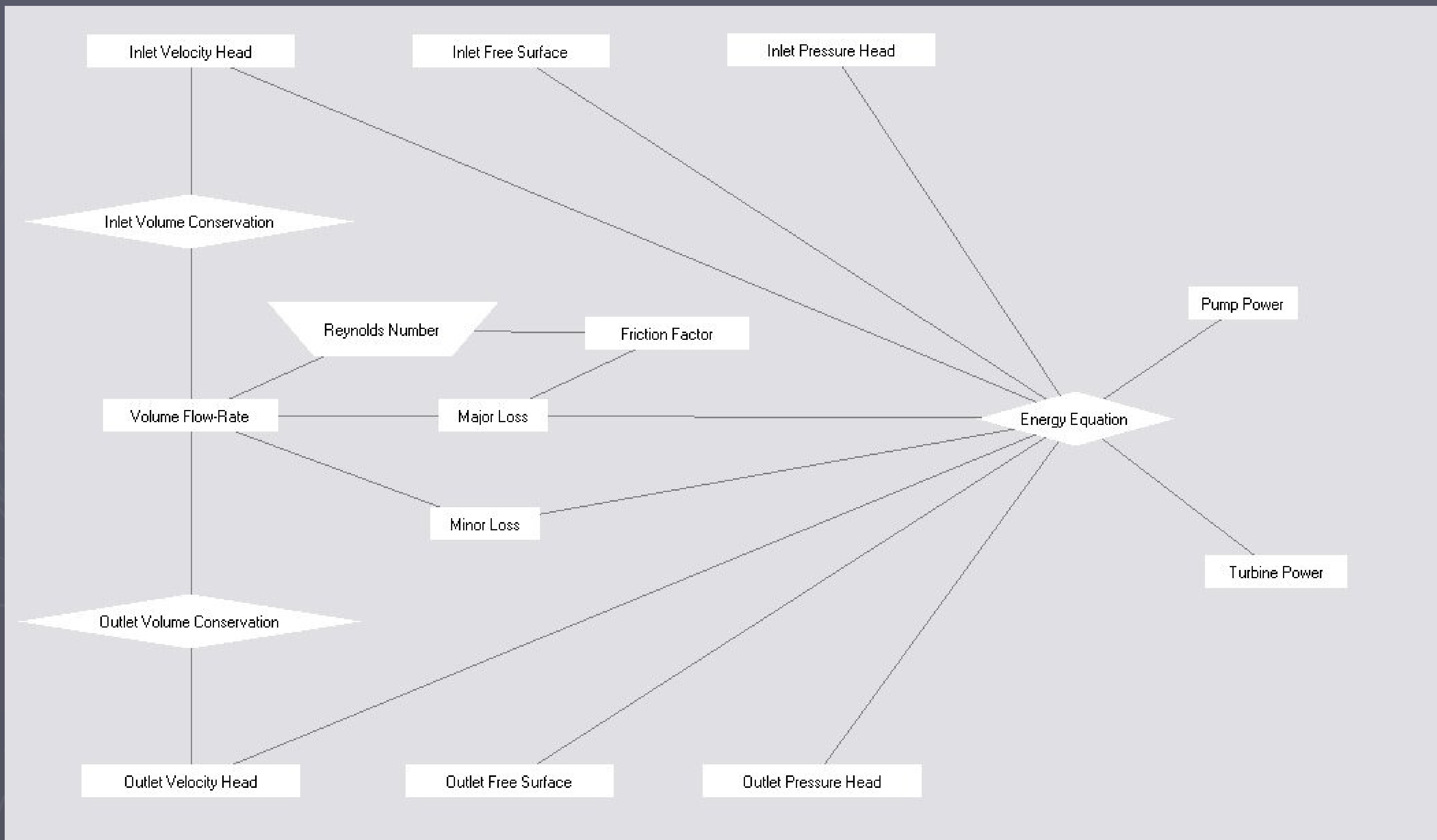
$$\vec{M}_i + \vec{P}_i + \vec{P}_o + \vec{W} + \vec{F} = \vec{M}_o$$

Momentum Concept Map *help*



Momentum inflow = $\vec{M}_i = \dot{m}\vec{V}_i = \boldsymbol{\rho} Q_i \vec{V}_i$

Energy Concept Map

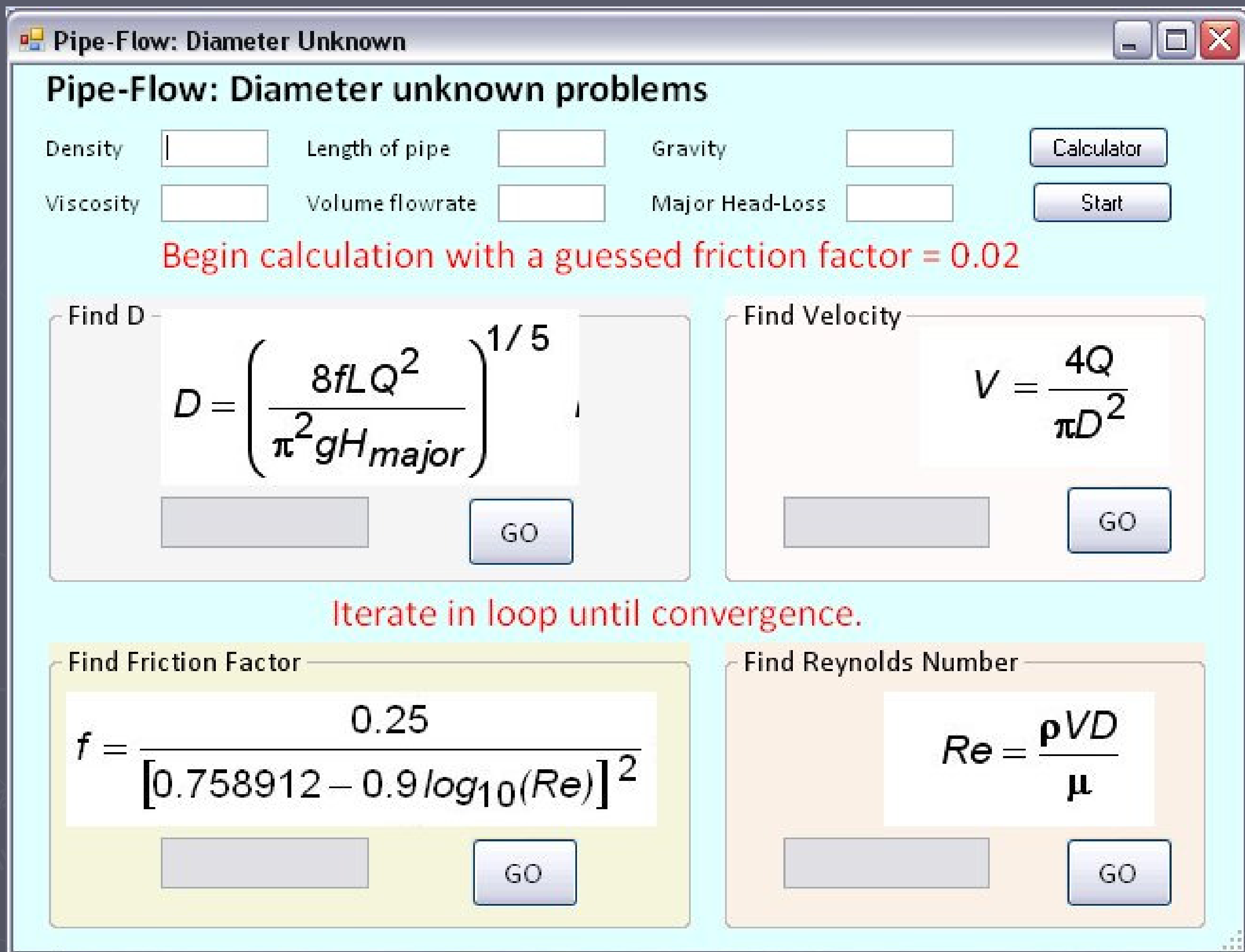


Energy Concept Map *help*

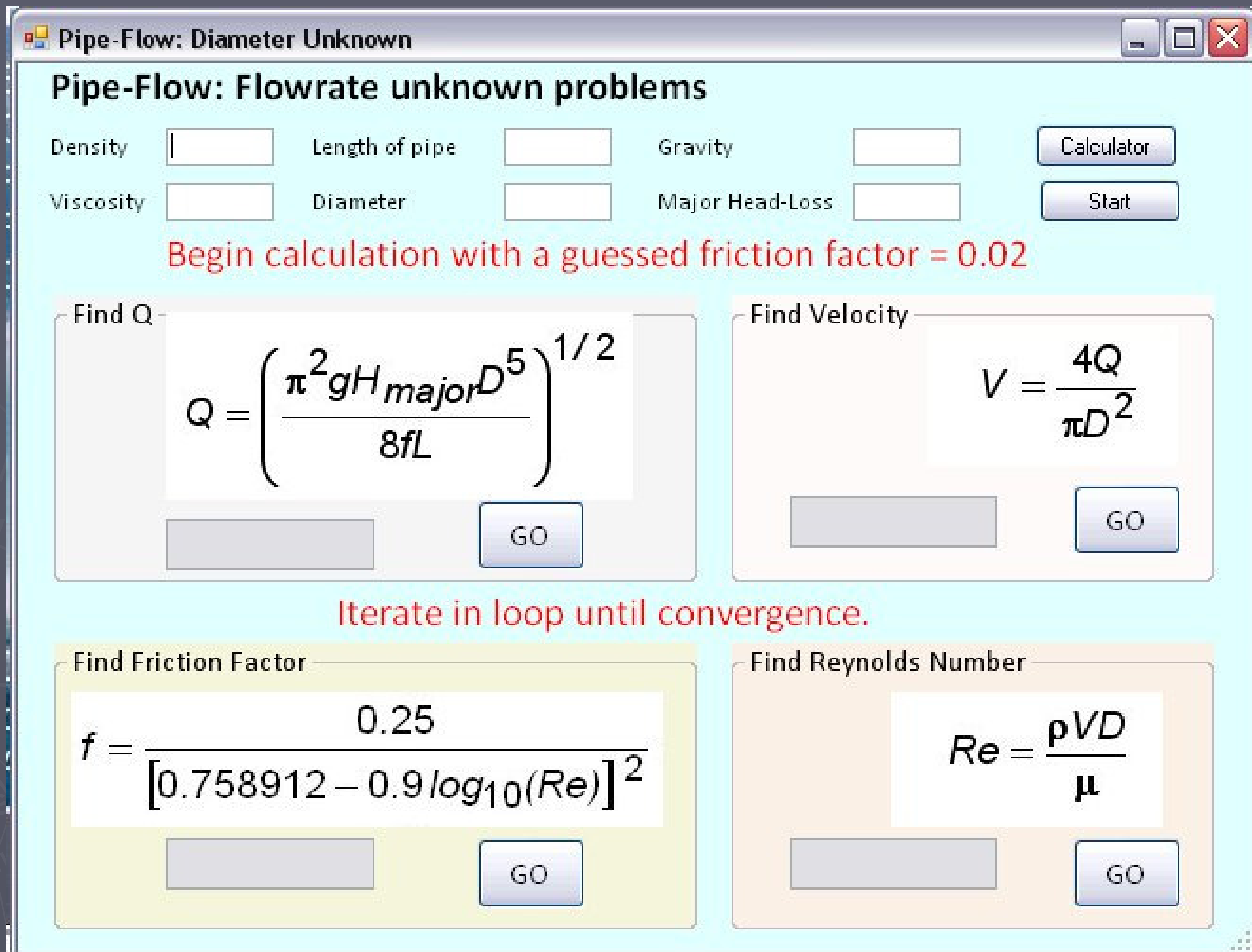
Inlet velocity head = H_{Vi}
Inlet pressure head = H_{Pi}
Inlet altitude = H_i
Major Head Loss = H_{Major}
Minor Head Loss = H_{Minor}
Pump Head = H_{Pump}
Turbine Heed = H_{Turb}
Outlet velocity head = H_{Vo}
Outlet pressure head = H_{Po}
Outlet altitude = H_o
Energy Equation:

$$H_{Vi} + H_{Pi} + H_i - H_{Major} - H_{Minor} + H_{Pump} - H_{Turb} = H_{Vo} + H_{Po} + H_O$$

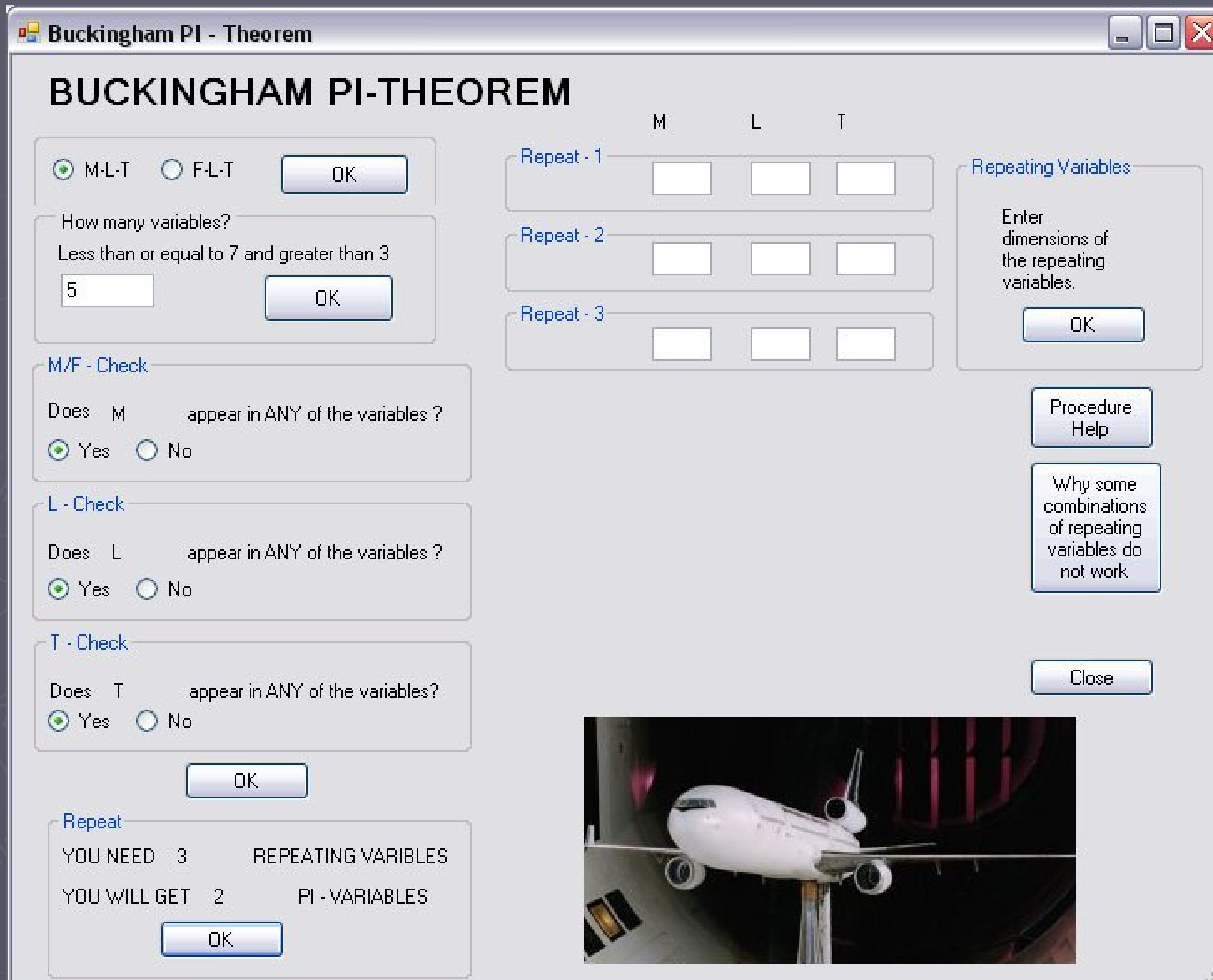
Pipe Flow – Iterative Solution



Pipe Flow – Iterative Solution



Dimensional Analysis



Dimensional Analysis *help*

Why Some Combinations of Repeating Variables Do Not Work

A set of repeating variables cannot be used to non-dimensionalize other variables when – two or more variables in the set can form non-dimensional groups among themselves.

Example-1

A set of repeating variables contain a length (D), an angular velocity (ω), and a velocity (V).

$$D := [L]$$
$$\omega := [T^{-1}]$$
$$V := [LT^{-1}]$$

These three variables can be combined into a dimensionless group

$$\Pi = D\omega / V$$

Therefore, the set (D, ω, V) is unsuitable as a set of repeating variables.

Example-2

A set of repeating variables contain a pressure (p), a density (ρ), and a velocity (V).

$$p := [ML^{-1}T^{-2}]$$
$$\rho := [ML^{-3}]$$
$$V := [LT^{-1}]$$

These three variables can be combined into a dimensionless group

$$\Pi = \rho V^2 / p$$

Therefore, the set (p, ρ, V) is unsuitable as a set of repeating variables.