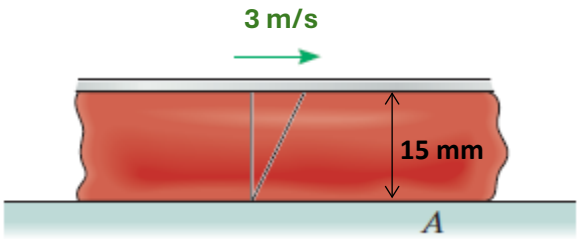
**Fluid Properties**

An experimental test using an unknown fluid indicates that it exerts a shear stress of $\tau = 98.5\ N/m^2$. Determine the apparent dynamic viscosity of the unknown fluid.

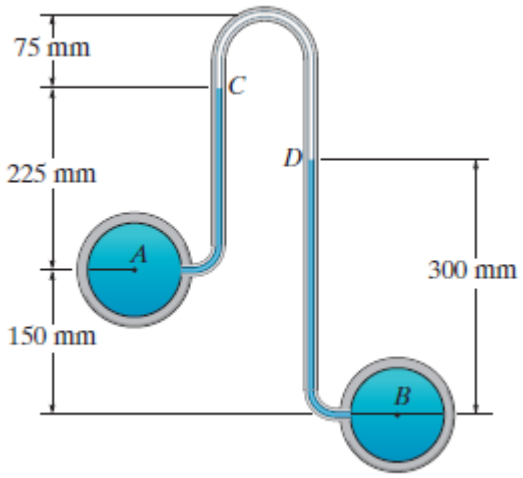



$\mu$ = _____

**Fluid Measurement**

The inverted U-tube manometer is used to measure the difference in pressure between water in pipe A and oil in pipe B ($s_{oil}$ = 0.95). Segment CD is filled with mercury ($s_{Hg}$ = 13.5). Determine the magnitude of the pressure difference between pipes A and B.

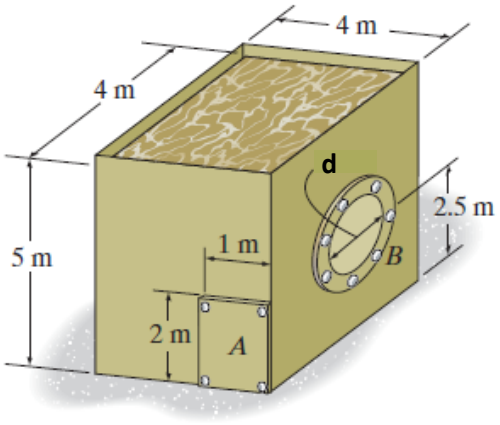
Δp = _____



**Fluid Statics**

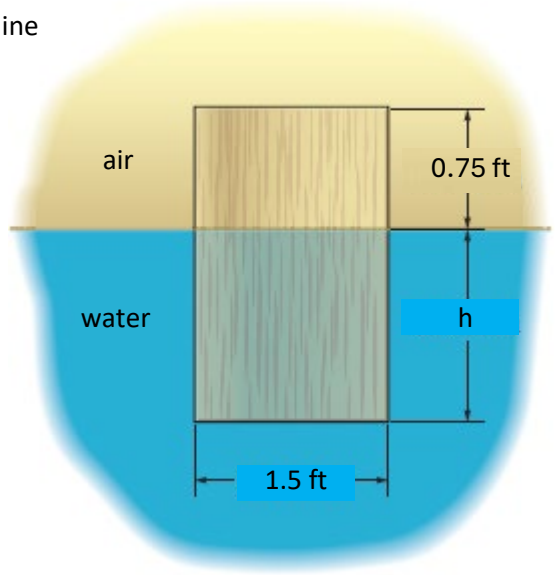
The tank contains oil (s = 0.95) and the maximum resultant force the glass of window B can support is 50 kN. Determine the maximum diameter of window B.

$d_B$ = _____



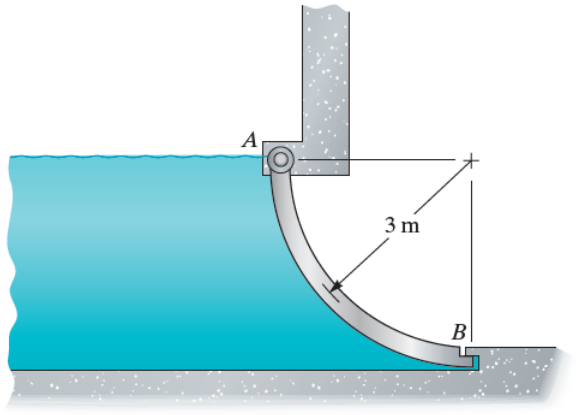
The 210 lb cylinder floats in water to the level shown. Determine the depth the cylinder is submerged.

h = _____



Gate AB has a width of 2 m into the page and the radius shown. Determine the resultant force of the water acting on the gate. *You will not receive full credit without a free body diagram of gate AB.*

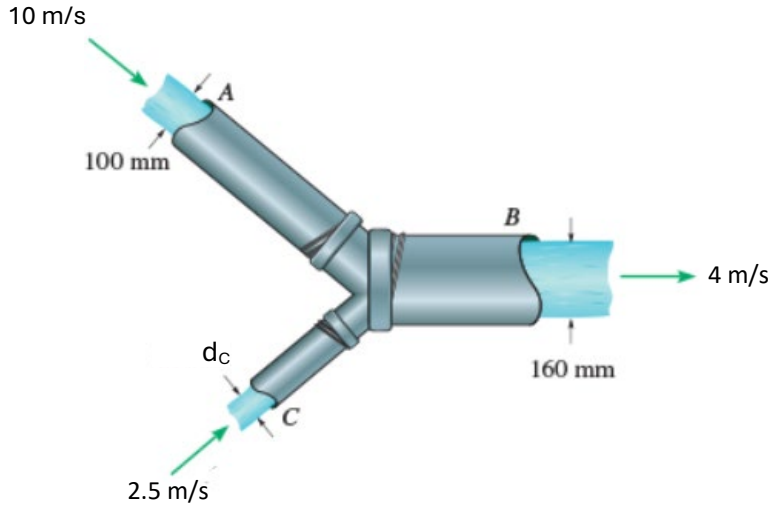
$F_R$ = _____



**Conservation of Mass**

Water flows into pipes A and C and exits pipe B. The velocities and known diameters are shown on the figure. Determine the required diameter at entrance pipe C.

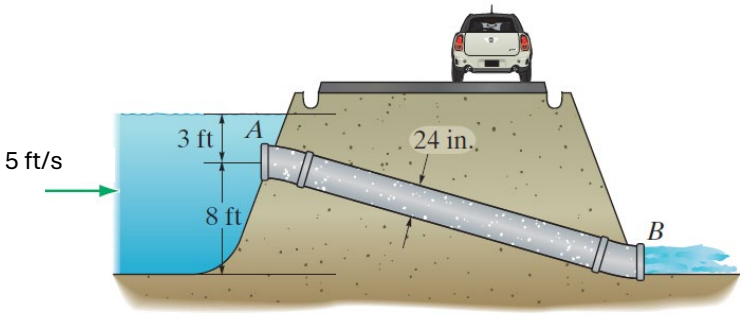
$d_C$ = _____



**Energy – Bernoulli's Equation**

The water in an open channel drainage canal flows with a velocity of 5 ft/s into the drainpipe that crosses a highway embankment. Determine the volumetric discharge through the pipe. *You may neglect any losses.*

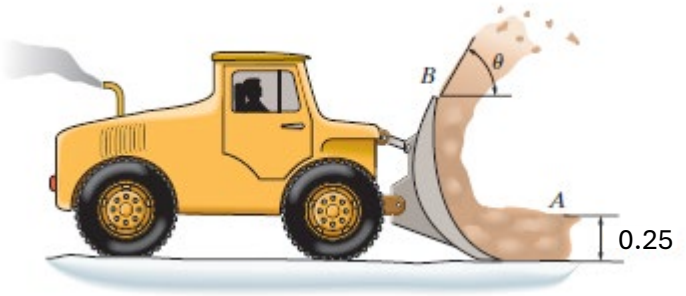
Q = _____



**Momentum**

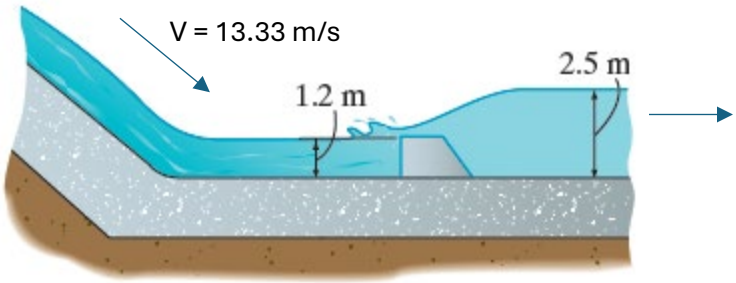
The snow plow is shoveling 250 mm deep snow slush (120 kg/m$^3$). The blade is 3 m wide (into the page) and the angle of the slush as it exits point B is 70°. Determine the maximum speed the plow can travel if the traction force just before slipping is 4 kN. *You may assume the slush is thrown off the blade at the same rate it enters.*

V = _____



A rectangular stilling basin is 5 m wide and is used to confine the flow over a spillway. The slow the flow, baffle blocks are used. Determine the horizontal force on the blocks if the upstream velocity of the water is 13.33 m/s.

$F_H$ = _____

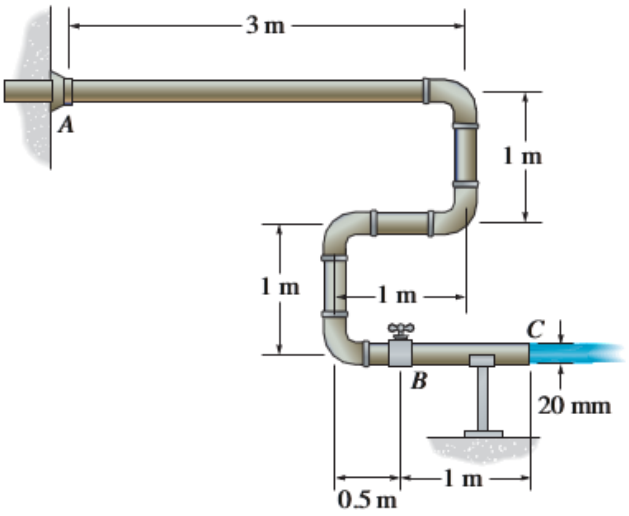


**Pipe Losses**

Water at flows through the 20 mm diameter, re-entrant, galvanized iron pipe (ε = 0.15mm) such that it discharges as an open jet at C from the fully opened gate valve B at 0.003 $m^3/s$. All elbows may be considered short radius. Determine the major and minor losses within the system. $\nu_{water} = 1.00(10^{-6})m^2/s$

$h_{Lmajor}$ = _____

$h_{Lminor}$ = _____

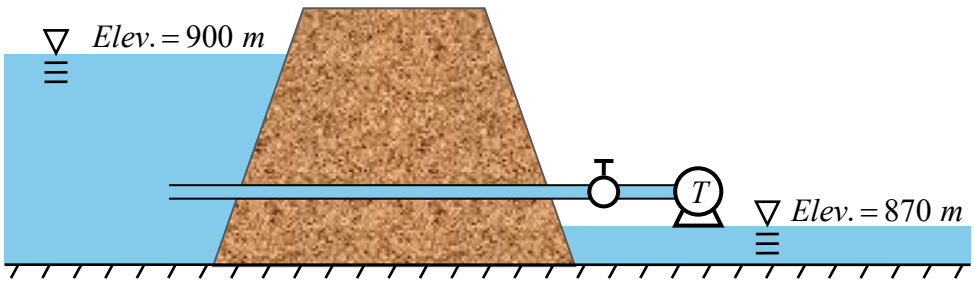


**Energy Equation**

A reservoir is used to provide flow of 0.85 $m^3/s$ to a turbine for generation of electricity. A 200 m long reinforced concrete pipe (ε = 0.0003 m) with diameter 600 mm carries flow to the turbine. The pipe includes a flush entrance on the upstream side of the dam and an open angle valve. The turbine discharges into a downstream tank. The turbine runs at 0.92 efficiency. *This drawing is not to scale*. $\nu_{water}$ = 0.474 ($10^{-5}$) $m^2/s$ Calculate the major and minor losses in this system.

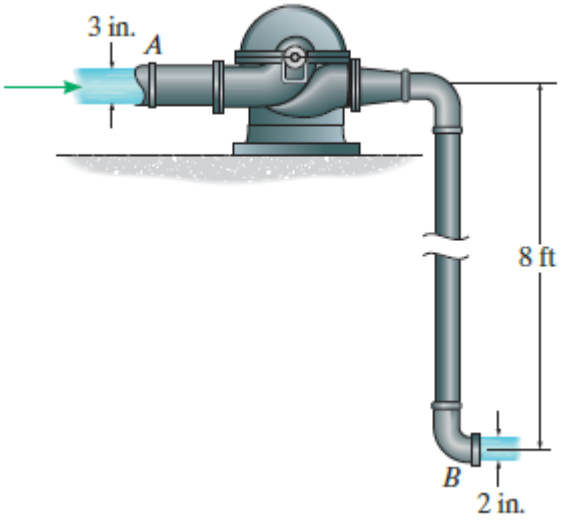
$h_{Lmajor}$ = _____

$h_{Lminor}$ = _____



The pump discharges water at B at 0.3 $ft^3/s$. If the head loss from A to B is 2 ft and the pump adds 45 ft of head to the system. Determine the pressure at A.

p = _____



**Open Channels**

Determine the flow through the channel if y = 6 ft, $S_o$ = 1.5/1000, and n = 0.02.

Q = _____