$$(D) \quad V_2^2$$

then

$$\frac{V_{2t}^2}{2g} - \frac{V_1^2}{2g} = \left(\frac{V_{2t}^2}{2g}\right) - \left(\frac{D_2}{D_1}\right)^4 \frac{V_{2t}^2}{2g} = \frac{V_{2t}^2}{2g}\left[1 - \left(\frac{D_2}{D_1}\right)^4\right] = increase\ in\ kinetic\ energy$$

$$\frac{V_1^2}{2g} + \frac{p_1}{w} + Z_1 = \frac{V_2^2}{2g} + \frac{p_2}{w} + Z_2$$

$$\frac{V_2^2}{2g} - \frac{V_1^2}{2g} = \frac{p_1}{w} - \frac{p_2}{w} + Z_1 - Z_2$$

$$\frac{V_2^2}{2g}\left[1 - \left(\frac{D_2}{D_1}\right)^4\right] = \frac{p_1}{w} - \frac{p_2}{w} + Z_1 - Z_2$$

Considering the pressure head in meters of water from point 1 to point 2, let X and Y in meters, using principles of manometers and Pascal's Law.

$$\frac{p_1}{w} + Y - \left(\frac{80}{1000}\right)\left(\frac{sp.gr._{subs}}{sp.gr_{fluid}}\right) - X = \frac{p_2}{w}$$

$$\frac{p_1}{w} - \frac{p_2}{w} = \left(\frac{80}{1000}\right)\left[\left(\frac{sp.gr._{liquid}}{sp.gr._{water}}\right)\right] + X - Y$$

But:

$$0.30 + Y = 0.80 + X$$

$$X - Y = -0.50\ m$$

Substitute:

$$\frac{p_1}{w} - \frac{p_2}{w} = \left(\frac{80}{1000}\right)\left[\left(\frac{1.5}{1}\right)\right] - 0.50 = 0.70\ m\ of\ water$$

$$\frac{V_{2t}^2}{2g}\left[1 - \left(\frac{D_2}{D_1}\right)^4\right] = \frac{p_1}{w} - \frac{p_2}{w} + Z_1 - Z_2$$

$$\frac{V_{2t}^2}{2g}\left[1 - \left(\frac{15}{30}\right)^4\right] = 0.70 + 0 - 0.30 = 0.40$$

$$V_{2t} = \sqrt{\frac{2g(0.40)}{1 - \left(\frac{1}{2}\right)^4}} = 3.235\ m/s$$

Then:

$$Q_t = A_2 V_{2t} = \frac{\pi}{4}(D_2^2)V_{2t} = \frac{\pi}{4}(0.15^2)(3.235) = 0.057\ m^3/s$$

$$Q = CQ_t = 0.97(0.057) = 0.055\ m^3/s$$

3. In a test to determine the discharge coefficient of a 50 mm by 12.5 mm Venturi meter the total weight of water passing through the meter in 5.0 minutes was 3420 N. A mercury-water differential gage connected to inlet and throat of the meter showed an average mercury difference during that time of 38 cm. Determine the meter coefficient.

Given:

$$\frac{V_2^2}{2g} - \frac{V_1^2}{2g} = \frac{p_1}{w} - \frac{p_2}{w} + Z_1 - Z_2$$

$$\frac{V_2^2}{2g}\left[1 - \left(\frac{D_2}{D_1}\right)^4\right] = \frac{p_1}{w} - \frac{p_2}{w} + Z_1 - Z_2$$