33.26 **A pump supplies $200gpm$ of water to a reservoir $30ft$ above the pump via a $50ft$ long $4in$ nominal diameter standard weight steel pipe. The discharge piping has two elbows, each with a K value of 1, and a fully open globe valve with a K value of 2.5. The friction factor is $.02$. What are the total losses in the discharge piping?**

A. $1ft$

B. $2ft$

C. $3ft$

D. $4ft$

Major losses are typically calculated using the Darcy-Weisbach Equation. In this scenario, it is also necessary to account for Fittings Losses, sometimes refered to as minior losses. The equations for the major and minor losses may be added together to find the total losses. Factor out the common terms.

$$h_{f,major} = \frac{fLv^2}{2Dg}$$

$$h_{f,minor,} = K\left(\frac{v^2}{2g}\right)$$

$$h_{f,total} = h_{f,major} + h_{f,minor} = \frac{fLv^2}{2Dg} + K\left(\frac{v^2}{2g}\right)$$

$$h_{f,total} = \left(\frac{fL}{D} + K\right)\left(\frac{v^2}{2g}\right)$$

Use the Steel Pipe Friction Tables to obtain the diameter of nominal $4in$ pipe and the velocity for $200gpm$ of volume flow rate flowing through a pipe of this size.

$$D = 4.026in$$

$$v = 5.04\frac{ft}{s}$$

The value for K must be the total of the individual K values for all valves and fittings, in this case (2) elbows and (1) globe valve. Often times obtaining these values involves using lookup tables, however the K values have been given in this problem. Calculate K_{total}.

$$K_{total} = 2\,(1) + 2.5 = 4.5$$

Determine the total losses.

$$h_{f,total} = \left[\frac{(0.02)\,(50ft)}{\left(\frac{4.026in}{12\frac{in}{ft}}\right)} + 4.5\right]\left[\frac{\left(5.04\frac{ft}{s}\right)^2}{2\left(32.2\frac{ft}{s^2}\right)}\right] = 2.95ft$$

Answer C