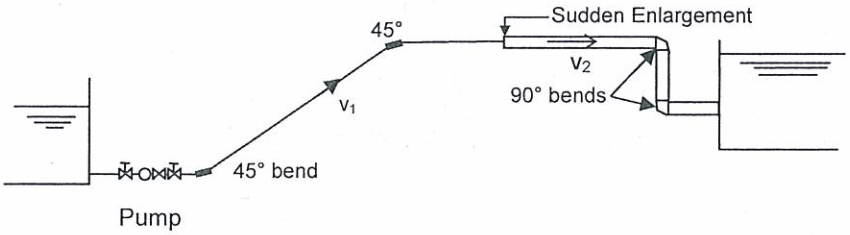
Example 1.1



a) Tabulate the MINOR losses occurring in the pumping system shown and express them in terms of the velocity head of the smaller pipe. The pipes have diameters of 100mm and 150mm respectively. All valves are fully open and bends have an r/d ratio of 2.5

b) Calculate the total MINOR head loss if water is pumped at a rate of 35 ℓ/s?

Solution: (Note: Velocity head is expressed as $v^2/2g$)

a) From continuity: $Q_1 = Q_2$

$$\therefore v_1 A_1 = v_2 A_2$$

$$\therefore v_2 = (0.1/0.15)^2 v_1 = 0.44\, v_1$$

$$\therefore \frac{v_2^2}{2g} = \frac{(0.44 v_1)^2}{2g}$$

Tabulate MINOR losses: K-values are obtained from **Appendix A1**

Fitting	K	Calculation	Head loss
Entrance	0.5	$= (0.5)\frac{v_1^2}{2g}$	$0.50\frac{v_1^2}{2g}$
2 x Sluice valves	0.2	$= 2\,(0.2)\frac{v_1^2}{2g}$	$0.40\frac{v_1^2}{2g}$
1 x Reflux valve	2.0	$= (2)\frac{v_1^2}{2g}$	$2.00\frac{v_1^2}{2g}$
2 x 45° Bends	0.1	$= 2\,(0.10)\frac{v_1^2}{2g}$	$0.20\frac{v_1^2}{2g}$
Enlargement	0.33	$= (0.33)\frac{v_1^2}{2g}$	$0.33\frac{v_1^2}{2g}$
2 x 90° Bends	0.13	$= 2\,(0.13)\frac{v_2^2}{2g} = 0.26\frac{(0.44v_1)^2}{2g}$	$0.052\frac{v_1^2}{2g}$
Exit	1.0	$= 1\,\frac{v_2^2}{2g} = \frac{(0.44v_1)^2}{2g}$	$0.20\frac{v_1^2}{2g}$
			$3.68\frac{v_1^2}{2g}$

b) For Q = 35 ℓ/s, first calculate flow velocity v_1: