

1.) Sp. gravity = 0.8, D1 = 150 mm = 0.15 m; D2 = 75 mm = 0.075 m; Z2 – Z1 = 150mm=0.15m

Qact = 40 litres/sec. = 0.04 M<sup>3</sup>/secs Cd = 0.96.

Pressure difference (P1 – P2):

$$A1 = \pi r^2/4$$

$$A1 = \pi \times (150/1000)^2/4 = 0.01767\text{m}^2$$

$$A2 = \pi \times (75/1000)^2/4 = 0.00442\text{m}^2$$

$$Q_{act} = C_d \times A1 \times A2 \times \sqrt{2gh/\sqrt{A1^2 - A2^2}}$$

$$0.04 = 0.96 \times 0.01767 \times 0.00442 \times \sqrt{2 \times 9.81 \times h/\sqrt{0.01767^2 - 0.00442^2}}$$

$$h = (0.04/0.96 \times 0.004565 \times 4.429)^2$$

$$h = 4.247\text{m}$$

$$4.247 = (P1/W - P2/W) + (Z1 - Z2)$$

$$(P1 - P2/pg) - 0.15$$

$$(P1 - P2) = pg(4.247 + 0.15)$$

$$(0.8 \times 1000 \times 9.81)(4.247 + 0.15)\text{N/m}^2$$

$$= 34.51\text{kN/m}^2$$

2.) Diameter at inlet, D1 = 300 mm = 0.3 m

∴ Diameter at Throat D2 = 150mm = 0.15m

(i)

$$A1 = \pi r^2/4$$

$$A1 = \pi \times (300/1000)^2/4 = 0.07\text{m}^2$$

$$A2 = \pi \times (150/1000)^2/4 = 0.01767\text{m}^2$$

$$h = 0.25(13.6/0.9 - 1) = 3.5\text{m of oil}$$

$$Q = C_d \times A1 \times A2 \times \sqrt{2gh/\sqrt{A1^2 - A2^2}}$$

$$Q = 0.98 \times 0.07 \times 0.01767 \times \sqrt{2 \times 9.81 \times 3.53/\sqrt{0.07^2 - 0.01767^2}}$$

$$Q = 0.1489\text{m}^3/\text{s}$$

$$(ii) (P1/W - P2/W) + (Z1 - Z2) = 3.53$$

$$Z_1 - Z_2 = 0.3 \text{ m}$$

$$P_1/W - P_2/W = 3.53 + 0.3 = 3.83 \text{ m}$$

$$P_1 - P_2/W = 3.83$$

$$W = \rho g$$

$$P_1 - P_2 = 3.83 \times 0.9 \times 9.81 = 33.8 \text{ kN/m}^2$$

$$\therefore P_1 - P_2 = 33.8 \text{ kN/m}^2$$