

(a) A centrifugal pump delivers $19.4 \times 10^{-3} \text{ m}^3/\text{s}$ of water when operating at a speed of 1100 rev/min. The static head difference between inlet and outlet flanges is 20.8 m of water. The impeller diameter is 325 mm and outlet width is 13.5 mm. Water enters the impeller radially and the manometric efficiency is 65%.

Determine the blade angle of the impeller at exit.

(b) The static lift of the system in which the pump of (a) is installed is 12.5 m of water. Calculate

- (i) the shut-off head developed by the pump when operating against a closed delivery valve at 1100 rev/min
- (ii) the pump speed at which flow will commence when all valves are open.

$$\Delta h_m = \Delta H / \eta_m = 20.8 / 0.65 = 28 \text{ m}$$

$$\Delta h_m = u_2 v_{w2} / g \quad u_2 = \pi \times 1100 / 60 \times 0.325 = 18.71 \text{ m/s}$$

$$v_{w2} = 28 \times 9.81 / 18.71 = 16.77 \text{ m/s}$$

$$A = \pi D t = \pi \times 0.325 \times 0.0135 = 0.01378 \text{ m}^2$$

$$v_R = Q / A = 19.4 \times 10^{-3} / 0.01378 = 1.407 \text{ m/s}$$

$$v_{w2} = u_2 - v_R / \tan \alpha \quad \text{hence } 1.407 / 1.94 = \tan \alpha \quad \alpha = 36^\circ$$

$$\text{Shut off } \Delta h = u^2 / g = 18.71^2 / 9.81 = 35.68 \text{ m}$$

Static lift given in some text books as $N = 83.5 h^{1/2} / D = 83.5 \times 12.5^{1/2} / 0.325 = 908 \text{ rev/min}$