HW1

1. MATLAB plot - See attached

2. MATLAB plot - See attached

3. $D = 12\,m$ $\quad \bar{U} = 8\,m/s$ $\quad \rho = 1.225\,kg/m^3$ $\quad M = 0.4$

$t = 1\,yr \cdot 365\,days \cdot 24\,hrs \cdot 3600\,s = 3.1536 \cdot 10^7\,sec$

$P_T = \frac{1}{2} \rho A \bar{U}^3 t = \frac{1}{2}(1.225)\left(\frac{\pi\, 12m^2}{4}\right)(8)^3 (3.1536 \cdot 10^7)$

$P_T = 1.118 \cdot 10^{12}\,J$ =

$P_P = M P_T = 0.4\,(1.118 \cdot 10^{12}) = 4.47 \cdot 10^{11}\,J$

$\boxed{P_P = 447399\,MJ}$

4. $D = 30\,m$ $\quad h = 50\,m$ $\quad C_p = \frac{P_R}{P_W} = 0.2$

$H_H = 65\,m$ $\quad H_L = 35\,m$ $\quad H_0 = 10\,m$

$U = U_0 \left(\frac{H}{H_0}\right)^{\alpha}$ $\quad \alpha = 1/7$

$\frac{P_{RH}}{P_{RL}} = \frac{\frac{1}{2} C_p \rho A U_H^3}{\frac{1}{2} C_p \rho A U_L^3} \rightarrow \frac{U_H^3}{U_L^3} = \frac{\left(\frac{H_H}{H_0}\right)^{3\alpha}}{\left(\frac{H_L}{H_0}\right)^{3\alpha}} = \left(\frac{H_H}{H_L}\right)^{3\alpha}$

$\frac{P_{RH}}{P_{RL}} = \left(\frac{65}{35}\right)^{3/7} = 1.3$

$\boxed{\frac{P_{RH}}{P_{RL}} = 1.3}$

5. $P = 100\ kW$ $\quad U = 7.5\ m/s$ $\quad -S.A$

- $C_p = \frac{16}{27}$ $\quad \eta = 1$

$$P_w = \frac{P_R}{C_p} = \frac{1}{2} \rho A U^3$$

$$A = \frac{2 P_R}{C_p \rho U^3} = \frac{2(100 \cdot 10^3)}{\left(\frac{16}{27}\right)(1.225)(2.5)^3} = 653.$$

$$\frac{\pi D^2}{4} = \longrightarrow \boxed{D = 28.84\ m}$$