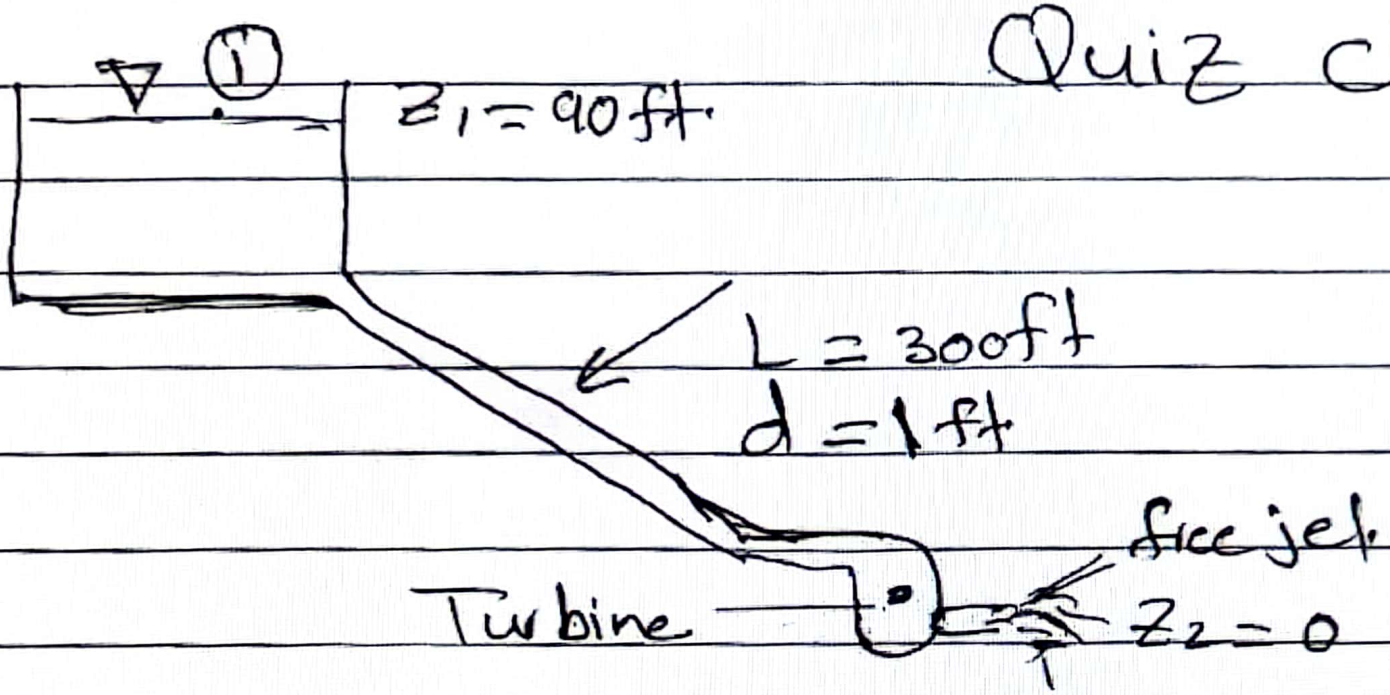
Quiz ch 6



The Turbine in the system above extracts 50 hp from the water flowing between points 1 & 2.
If the friction factor is estimated to be 0.02, & the minor losses are negligible. Find the flow rate ~~of th~~ through the turbine.

$f = 0.02$, Power $= 50\ hp$, $Z_1 = 90\ ft$, $L = 300\ ft$

$d = 1\ ft$, $Z_2 = 0$, Q ??

Power $= 50\ hp = 50(550) = 27500\ ft.lb/sec.$

Power $= \rho g Q h_T = 27500$

$$\boxed{Q = \frac{13.686}{h_T^4}} \Rightarrow \boxed{h_T = h_f}$$

$$\frac{P_1}{\rho g}^{0} + \frac{V_1^2}{2g}^{0} + Z_1 = \frac{P_2}{\rho g}^{0} + \frac{V_2^2}{2g} + Z_2^{0} + h_f$$

$$90 = \frac{V_2^2}{2(32.2)} + \frac{fL\,V_2^2}{2gd} = \frac{V_2^2}{64.4} + \frac{(0.02)(300)V_2^2}{64.4(1)}$$

$\Rightarrow V_2 = 28.77\ ft/sec.$

$\Rightarrow h_f = \frac{fLV_2^2}{2gd} = 77.116\ ft.$

$\Rightarrow Q = \frac{13.686}{77.116} = 0.177\ ft^3/sec$