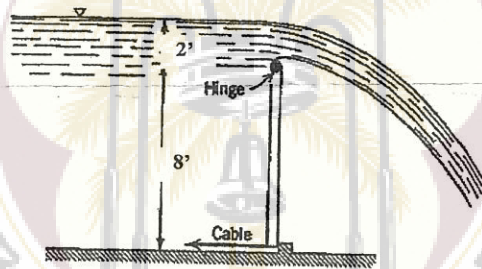
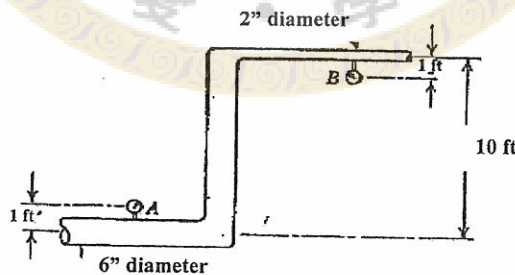


1. A differential manometer is used to measure the pressure difference across a pump. The heavy liquid in the manometer is mercury (specific weight of 13.6), while pure water is filled in all pipeline and the pump. If the liquid level in the manometer is different by 50cm, calculate the pressure rise across the pump with pressure unit of pascal and psi (pound per square inch), separately. (Note: pascal is the international system of unit of pressure, SI unit) (5%)
2. Same as the above problem, draw a free hand sketch to show the pipeline and pump system, the manometer, the connection tubes, and the flow direction in pipe. Be sure that the mercury level difference indicates the high and low pressure sides of the pump. (5%)
3. A wind turbine with its blade length of 20 meters, calculate the power output of this turbine at the following condition. approaching wind speed: 12 m/sec; tail wind speed: 4 m/sec; air density: 1.2 kg/m³ (Hint: use the extended Bernoulli's equation.) (15%)
4. For flow in a round pipe, the followings are the relevant parameters: U (average speed), D (diameter), Δp (pressure drop across a span, L), ρ (fluid density), ν (kinematic viscosity, unit of m²/sec or something like), L (pipe length or the span), ϵ (roughness length of pipe interior surface). Use the technique of dimensional analysis (π -theorem) to derive the functional group of the dimensionless parameters, like friction factor and Reynolds number, and so on. (10%)
5. A water main with a 24-in. I.D. carries a flow of 20 cfs. If the friction factor is 0.02 and the pump is 85% efficient, how much horsepower is required to pump the water through 10,000 ft of pipeline? (10%)
6. A rectangular gate 5 ft wide and 8 ft high is hinged at the top. If the water level is 2 ft over the top of the gate, what tension in a cable, attached at the bottom of the gate, is required to open the gate? (10%)



7. Compute the rate of flow of water in gallons per minute for the system shown. Gage A indicates a pressure of 25 psi, and Gage B indicates a pressure of 15 psi. Assume that losses are negligible in the transition from the 6-in. pipe to the 2-in. pipe. (15%)



8. Given $Q=10$ cms, $h_1=1$ m, the height of ramp is 2 m. If the flow is steady. Please try to find:
 - (1) the exact value of h_2 . (15%)
 - (2) magnitude of the force on the ramp (Unit Width). (15%)

