



Name:

Program ID:

Midterm Exam # 1

Fall 2014

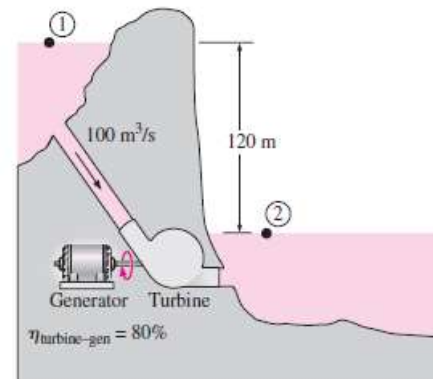
Time allowed: one hour

Round-off all numbers of your answer into reasonable digits

1. (10 points)

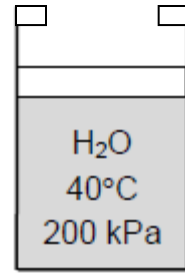
In a hydroelectric power plant, $100 \text{ m}^3/\text{s}$ of water flows from an elevation of 120 m to a turbine, where electric power is generated. The overall efficiency of the turbine-generator is 80 percent. Disregarding frictional losses in piping, determine:

- The energy potential of the water required per year. (5 points)
- The electric power output of this plant. (5 points)



2. (15 points)

A piston–cylinder device initially contains 50 L of liquid water at 40°C and 200 kPa. The piston has a surface area of 0.1 m². Heat is transferred to the water at constant pressure until the entire liquid is vaporized, at this point the piston is touching a set of two stops. Now more heat is added to the water till a pressure of 5 bar is maintained. (the atmospheric pressure is 1 bar)



- a. **What is the mass of the piston? (3 points)**
- b. **What is the mass of the water? (3 points)**
- c. **What is the volume while the piston is touching the stops? (3 points)**
- d. **What is the final temperature? (3 points)**
- e. **Show the process on a T-v diagram with respect to saturation lines. (3 points)**



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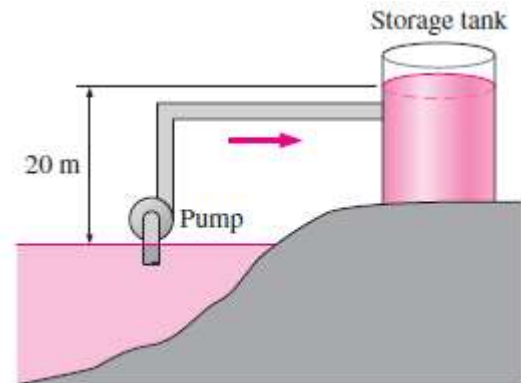
Time allowed: one hour

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1. (10 points)

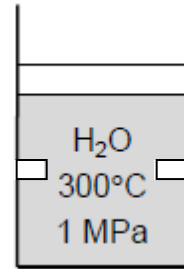
Water is pumped from a lake to a storage tank 20 m above at a rate of 70 L/s while consuming 20.4 kW of electric power. Disregarding any frictional losses in the pipes and any changes in kinetic energy, determine:

- a. The overall efficiency of the pump-motor unit. (5 points)
- b. The pressure difference between the inlet and the exit of the pump. (5 points)



2. (15 points)

A piston–cylinder device contains 8 kg of steam at 300°C and 1 MPa. Steam is cooled at constant pressure until one-half of the mass condenses, at this point the piston is touching a set of two stops. Now more heat is rejected from the water till a temperature of 165°C is achieved.



- a. **What is the initial volume of the water? (3 points)**
- b. **What is the volume of the saturated liquid when the piston touches the stops? (3 points)**
- c. **What is the final pressure of the water? (3 points)**
- d. **What is the final quality of the water? (3 points)**
- e. **Show the process on a p-v diagram with respect to saturation lines. (3 points)**