Please!
Be neat, write out equations before inserting numbers, and circle your answers.

If you cannot figure out one part, assume an answer and carry it through the other parts.

1. (34%) Air is contained in a frictionless vertical piston-cylinder assembly fitted with an electrical resistor. The atmosphere exerts a pressure of 100 kPa on top of the piston, which has a mass of 40 kg and an area of 0.1 m². Electrical current passes through the resistor, and the volume of the air slowly increases. During this process 2 kJ of heat is lost to the surroundings which are at a temperature of 25°C. The mass of the air is 0.25 kg, and its temperature increases by 35°C from an initial temperature of 50°C. Assume the air to have constant specific heats evaluated at 25°C. For the process determine:

a) the work done by the air on the surroundings.
b) the energy transfer from the resistor to the air (kJ).
c) the change in total entropy of the air and the entropy generation
d) Sketch the process on a P-V diagram (label states and put numbers on both axes).
e) Sketch the process on a T-S diagram (label states and put numbers on the T axis).
f) Determine the change in potential energy of the piston (kJ).
Problem 1 continued
2. (33%) Water at 400 kPa, 140°C flows through a valve into a flash chamber at a rate of 12 kg/s. At the throttle valve exit, the pressure is 250 kPa. Saturated liquid at 250 kPa exits from the bottom of the flash chamber and saturated vapor at 250 kPa exits from near the top. The vapor stream is fed to a steam turbine having an efficiency of 90% and an exit pressure of 10 kPa. The entire system is well-insulated and operates at steady state. Neglect any pressure dependence on the enthalpy of liquid water. Determine:

a) The mass flow rates at points 3 and 4
b) the power developed by the turbine (kW)
c) the rate of entropy generation for the valve (kW/K)
Problem 2 continued
3. (32%) Air enters the compressor of an air-standard gas turbine cycle (State 1) at 100 kPa, 25°C, with a volumetric flow rate of 5 m³/s. The compressor pressure ratio is 10. The turbine inlet temperature is 1200°C. The turbine has a component efficiency of 80% and the compressor is isentropic. Assume variable specific heats for the air. Determine:

a) the net power developed (kW)
b) the back work ratio
c) the thermal efficiency of the cycle
d) Qualitatively sketch the Pv and Ts diagrams for the cycle
problem 4 continued