1. In a regenerative Rankine cycle, some of the steam is extracted from the turbine and used to preheat feedwater to the boiler. One method of preheating the feedwater is by direct contact mixing in an open feedwater heater (OFWH), as illustrated below. Note that for 1 kg/s of steam entering the high pressure turbine (indicated as “(1)” on the diagram), a fraction $y$ is extracted and diverted to the OFWH, and the remainder, $1-y$, flows through the low pressure turbine and condenser and is pumped up to the OFWH pressure. The notations “($y$)” and “(1-$y$)” on the diagram indicate the fraction of flow in each part of the cycle.

a) For the conditions shown in the figure, analyze the control volume on the OFWH to find the fraction $y$ required to make state 6 exiting the OFWH a saturated vapor. Consider the OFWH to be adiabatic.

b) Find the total turbine work per kg of steam entering the turbine.

c) Find the total pump work per kg of steam entering the turbine.

d) What is the cycle efficiency?