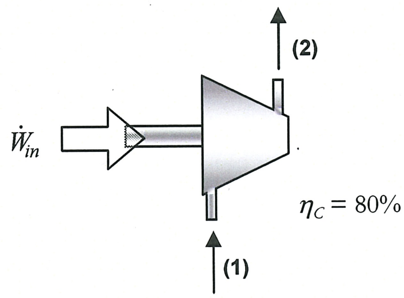
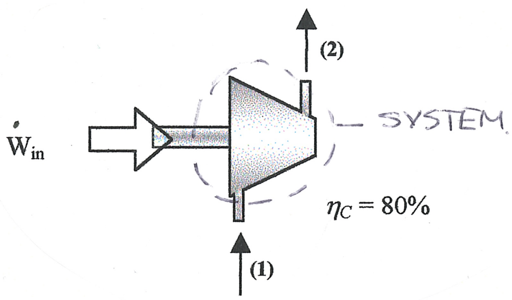
Example

1 kg/s of steam flows through a steady-state compressor. The steam enters the compressor at 100 kPa as a saturated vapor. The exit pressure is 1.0 MPa. If the **adiabatic efficiency** (ding ding ding!) is 80%,

a) find the power *input* to the compressor (in kW) and
b) the temperature of the steam leaving the compressor.
c) Sketch the process on a *T-s* diagram. Label the ideal and actual exit state points.





Energy for 1→2S

$\frac{dE}{dt} = \not{Q} + \dot{W}_{IN,S} + \dot{m}(h_1 + ..) - \dot{m}(h_{2S} + ..)$

$\dot{W}_{IN,S} = \dot{m}(h_{2S} - h_1)$

$h_1 = h(x=1, P=100\text{ kPa}) = 2675.5$ kJ/kg

$s_1 = 7.3594$ kJ/kg-K

$s_{2S} = s_1 = 7.3594$

$P_2 = 1$ MPa

$h_{2S} = 3195.5$ kJ/kg

$W_{INS} = (1)(3195.5 - 2675.5) = \boxed{520 \text{ kW}}$

BUT $\eta_c = 0.8 = \frac{W_S}{W_A}$ $\quad W_A = \frac{520}{0.8} = \boxed{650.0 \text{ kW}}$

Energy (1)-(2)

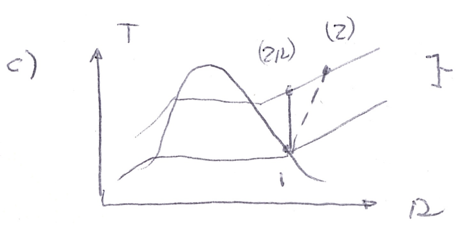
$\frac{dE}{dt} = \not{Q} + \ldots$ $\quad \dot{W}_{AC} = \dot{m}(h_2 - h_1)$ ↑ NOT S $\quad (650.) = (1)(h_2 - 2675.5)$

$h_2 = 3325.5$ kJ/kg

$P_2 = 1$ MPa ⟸ NOTE WHAT IS THE SAME FOR 2 & 2S

$T_2 = 428.7$ °C

c)



} REMEMBER "LOSSES" SHOWING UP AS ΔT ? SAME THING!