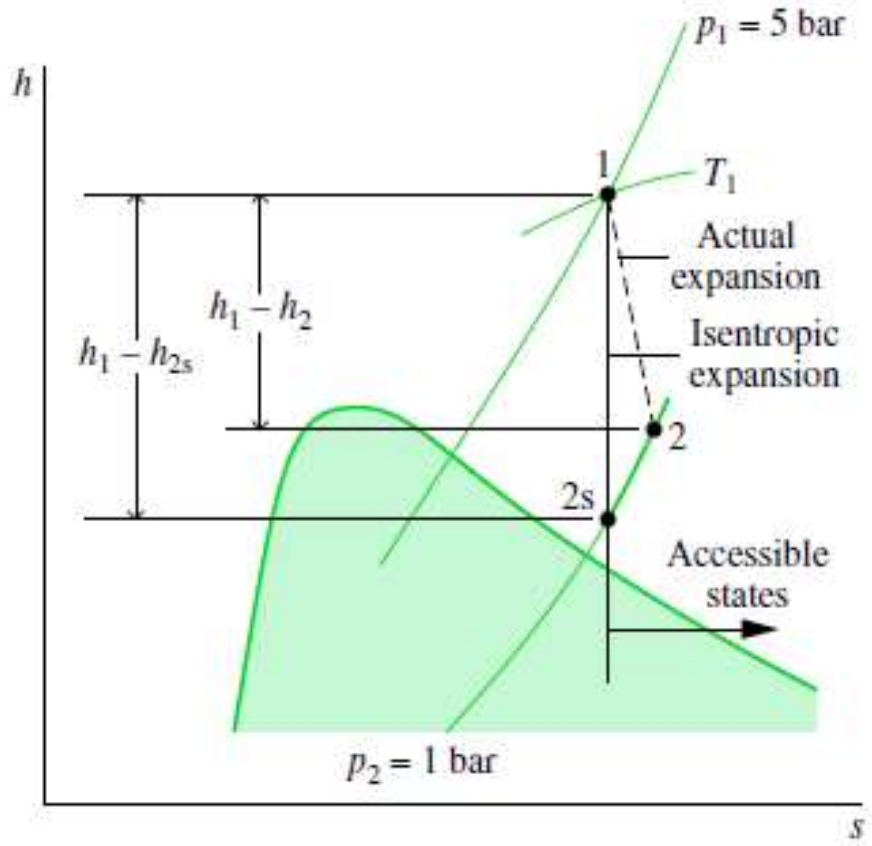
Problem

A steam turbine operates at steady state with inlet conditions of $p_1 = 5$ bar, $T_1 = 320$C. Steam leaves the turbine at a pressure of 1 bar. There is no significant heat transfer between the turbine and its surroundings, and kinetic and potential energy changes between inlet and exit are negligible. If the isentropic turbine efficiency is 75%, determine the work developed per unit mass of steam flowing through the turbine, in kJ/kg.

Diagram


$p_1 = 5$ bar
h
1
T_1
Actual expansion
$h_1 - h_2$
$h_1 - h_{2s}$
Isentropic expansion
2
2s
Accessible states
$p_2 = 1$ bar
s

Solution

Isentropic efficiency $\eta = \frac{(\frac{W_{irr}}{m})}{(W_{rev}/m)}$

$\frac{W_{irr}}{m} = \eta * (h_1 - h_{2s})$

By using table of "properties of superheated water vapor"

h_1=3105.6 kJ/kg, s_1=7.5308kJ/kg.K, h_{2s}=2743.0 kJ/kg

$\frac{W_{irr}}{m}$=0.75(3105.6-2743.0)

$\frac{W_{irr}}{m}$==271.95kJ/kg