Answer on Question #73331, Physics / Molecular Physics | Thermodynamics

4. Ten kg of water at 45°C is heated at a constant pressure of 10 bar until it becomes superheated vapour at 300°C. Find the change in volume, enthalpy, internal energy and entropy.

Solution:
From steam tables, corresponding to 45°C,
$v_1 = v_{f1} = 0.001010$ m^3 / kg;
$h_1 = h_{f1} = 188.4$ KJ/kg;
$s_1 = sf_1 = 0.638$ KJ/kg K

From steam tables, corresponding to 10 bar and 300°C,
$h_2 = 3052.1$ KJ/kg;
$s_2 = 7.125$ KJ/kg K;
$v_2 = 0.258$ m3 /kg;

Change in Volume:
$V = 10 (0.258 - 0.001010) = 2.5699$ m^3.
Change in Enthalpy:

$h = 10 (3052.1 - 188.4) = 28637$ KJ.
Change in Entropy:
$S = 10 (7.125 - 0.638) = 64.87$ KJ/K.

Change in Internal energy:
$U = m [(h_2 - h_1) - (p_2v_2 - p_1v_1)]$
$U = m [(h_2 - h_1) - p_1 (v_2 - v_1)$
$U = 10 [(3052.1 - 188.4) - 1000 (0.258 - 0.001010)] = 26067.1$ KJ.

Answer: 2.5699 m^3; 28637 KJ; 26067.1 KJ; 64.87 KJ/K.