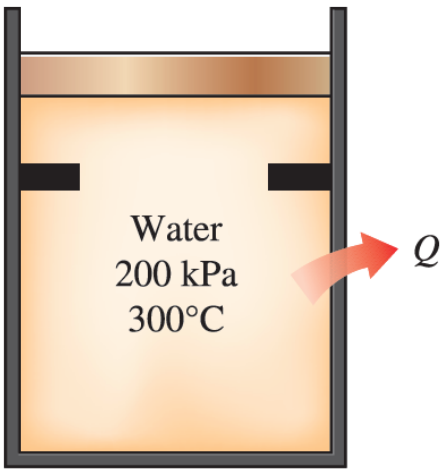
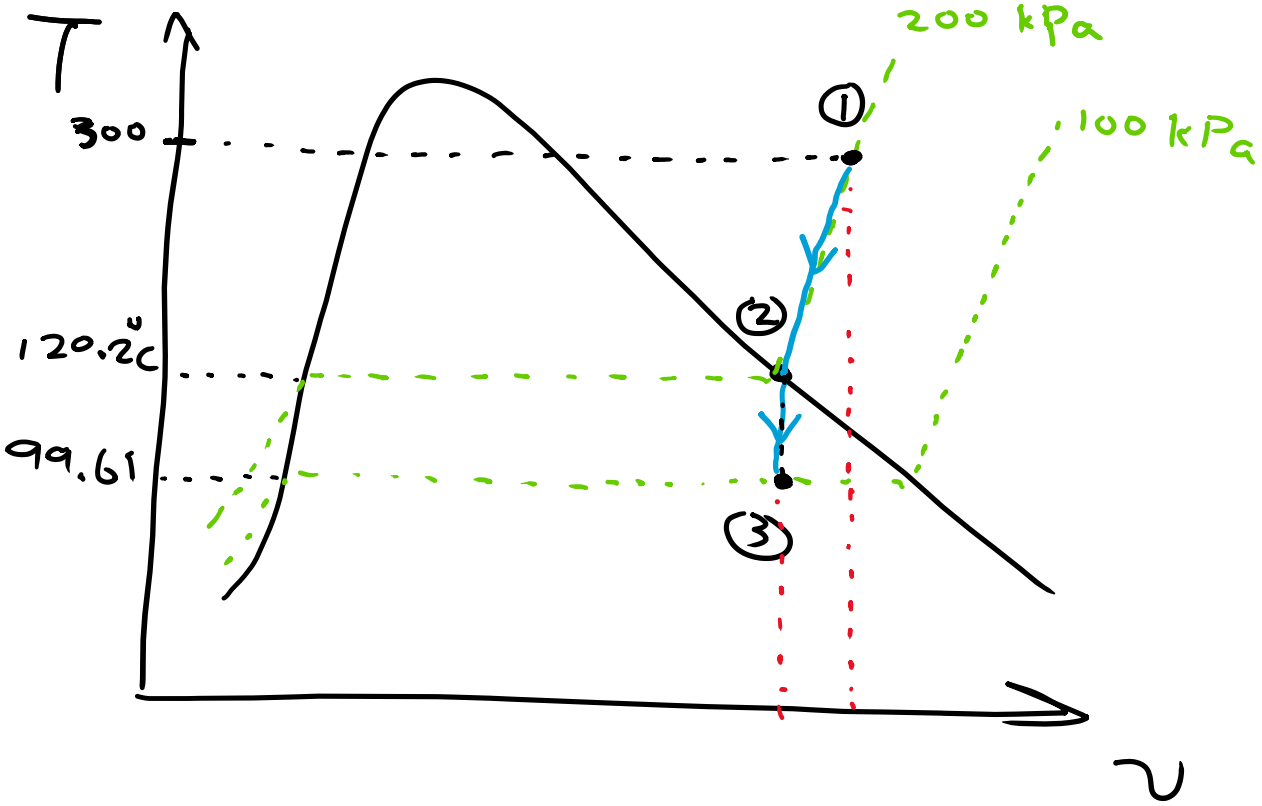
3–44 Water initially at 200 kPa and 300°C is contained in a piston–cylinder device fitted with stops. The water is allowed to cool at constant pressure until it exists as a saturated vapor and the piston rests on the stops. Then the water continues to cool until the pressure is 100 kPa. On the *T*-υ diagram, sketch, with respect to the saturation lines, the process curves passing through the initial, intermediate, and final states of the water. Label the *T*, *P*, and υ values for end states on the process curves. Find the overall change in internal energy between the initial and final states per unit mass of water.

$u_3 - u_1$





To find $u_3 - u_1$:

u_1 can be found directly from Table A-6

To find u_3, we need to find x_3

$$x_3 = \frac{v_3 - v_{f_3}}{v_{fg}}$$

$v_3 = v_1$ (Table A-5 @ 100 kPa)

v_{f_3}, v_{fg}: Table A-5 at 100 kPa

$$u_3 = u_f + x_3 u_{fg}$$

u_f, u_{fg}: Table A-5 at 100 kPa