تعداد سؤالات: تستی: **تشریحی:** ۵ **زمان آزمون (دقیقه): تستی:** **تشریحی:** ۱۲۰ **کُد سری سؤال:** یک ۱

نام درس: ترمودینامیک

رشته تحصیلی /کد درس : مهندسی برق گرایش قدرت۱۳۱۵۲۹۴

بارم هر سوال ۲/۸۰ می باشد.

جواب سوال ۱

جداول آخر کتاب توجه شود.

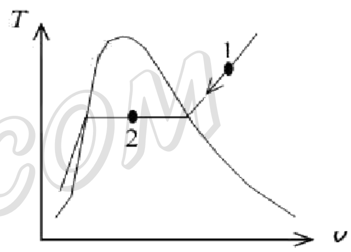
جواب ۲

$T = T_{\text{sat@1 MPa}} = \mathbf{179.88°C}$ (Table A-5)

(*c*) The quality at the final state is specified to be $x_2 = 0.5$. The specific volumes at the initial and the final states are

$$\left.\begin{aligned} P_1 &= 1.0\text{ MPa} \\ T_1 &= 300^\circ\text{C} \end{aligned}\right\} v_1 = 0.25799\text{ m}^3/\text{kg} \quad \text{(Table A-6)}$$

$$\left.\begin{aligned} P_2 &= 1.0\text{ MPa} \\ x_2 &= 0.5 \end{aligned}\right\} \begin{aligned} v_2 &= v_f + x_2 v_{fg} \\ &= 0.001127 + 0.5 \times (0.19436 - 0.001127) \\ &= 0.09775\text{ m}^3/\text{kg} \end{aligned}$$

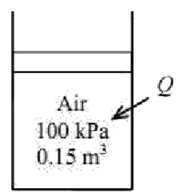


Thus,

$$\Delta V = m(v_2 - v_1) = (0.8\text{ kg})(0.09775 - 0.25799)\text{m}^3/\text{kg} = \mathbf{-0.1282\ m^3}$$

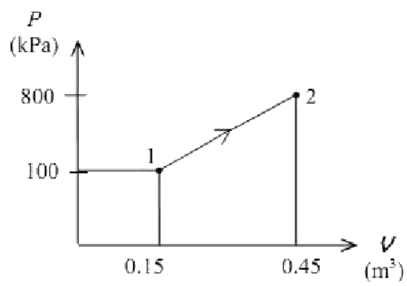
جواب۳

$$W_{\text{b,out}} = \text{Area} = \frac{P_1 + P_2}{2}(V_2 - V_1)$$
$$= \frac{(100+800)\text{kPa}}{2}(0.45 - 0.15)\text{m}^3\left(\frac{1\text{ kJ}}{1\text{ kPa}\cdot\text{m}^3}\right)$$
$$= \mathbf{135\ kJ}$$



(*b*) If there were no spring, we would have a constant pressure process at P = 100 kPa. The work done during this process is

$$W_{\text{b,out,no spring}} = \int_1^2 P\,dV = P(V_2 - V_1)$$
$$= (100\text{ kPa})(0.45 - 0.15)\text{m}^3/\text{kg}\left(\frac{1\text{ kJ}}{1\text{ kPa}\cdot\text{m}^3}\right)$$
$$= 30\text{ kJ}$$



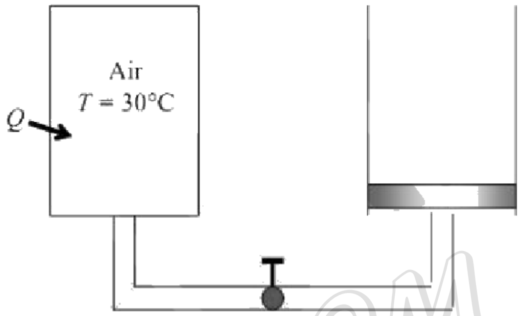
Thus,

$$W_{\text{spring}} = W_b - W_{\text{b,no spring}} = 135 - 30 = \mathbf{105\ kJ}$$

جواب ۴

Properties The gas constant of air is $R = 0.287$ kPa.m^3/kg.K (Table A-1).

Analysis We take the entire air in the tank and the cylinder to be the system. This is a closed system since no mass crosses the boundary of the system. The energy balance for this closed system can be expressed as



$$\underbrace{E_{in} - E_{out}}_{\substack{\text{Net energy transfer} \\ \text{by heat, work, and mass}}} = \underbrace{\Delta E_{system}}_{\substack{\text{Change in internal, kinetic,} \\ \text{potential, etc. energies}}}$$

$$Q_{in} - W_{b,out} = \Delta U = m(u_2 - u_1) = 0$$

$$Q_{in} = W_{b,out}$$

since $u = u(T)$ for ideal gases, and thus $u_2 = u_1$ when $T_1 = T_2$. The initial volume of air is

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2} \longrightarrow V_2 = \frac{P_1}{P_2}\frac{T_2}{T_1}V_1 = \frac{400 \text{ kPa}}{200 \text{ kPa}} \times 1 \times (0.4 \text{ m}^3) = 0.80 \text{ m}^3$$

The pressure at the piston face always remains constant at 200 kPa. Thus the boundary work done during this process is

$$W_{b,out} = \int_1^2 P\,dV = P_2(V_2 - V_1) = (200 \text{ kPa})(0.8 - 0.4)\text{m}^3\left(\frac{1 \text{ kJ}}{1 \text{ kPa}\cdot\text{m}^3}\right) = 80 \text{ kJ}$$

Therefore, the heat transfer is determined from the energy balance to be

$$W_{b,out} = Q_{in} = \mathbf{80\ kJ}$$

جواب ۵

الف- kg۱۰۷.۱

ب- kJ۱۸۲۵