a.) Given: $P_1 = 300 \, \text{psi} = 2,068,427 \, \text{Pa}$
$T_1 = 22^\circ \text{C} = 295.15 \, \text{K}$
$T_2 = 27^\circ \text{C} = 300.15 \, \text{K}$

Concepts Used: $PV = RT$; State of a system: $W = \int P \, dv$

Given two properties for initial conditions, therefore state is defined.

$V_1 = \frac{RT_1}{P_1}$
$R_{co_2} = \frac{R}{M_W} = \frac{8.314}{44.0} = 0.18895 \, \frac{\text{kJ}}{\text{kg} \cdot \text{K}}$

$V_1 = \frac{(0.18895 \times 10^3)(295.15)}{2,068,427} = 0.02696 \, \frac{\text{m}^3}{\text{kg}}$

Given path to final state (Rigid Tank $\Rightarrow \Delta V = 0$)

$P_1$
$\uparrow$
$\uparrow$
$\uparrow$
$V$
$\downarrow$
$P_2$
$\downarrow$
$\downarrow$
$\begin{align*}
\Delta V &= 0 \\
\text{So } V_2 &= V_1 = 0.0269625 \, \frac{\text{m}^3}{\text{kg}}
\end{align*}$

And given final temperature.

$\frac{P_2}{V_2} = \frac{RT_2}{V_2}$

$\frac{2.103 \, \text{MPa}}{0.02696} = 305.1 \, \text{psi}$

b.) $Sp \, dv = 0$ since $dv = 0$

$\therefore \boxed{\text{No Work Was Done}}$

c.) Given: $P_3 = 230 \, \text{psi} = 1,585,794 \, \text{Pa}$

$\frac{dP}{dv} = 1 \times 10^5 \, \frac{\text{MPa}}{\text{m}^3/\text{kg}}$

Concepts Used:

Here, a new path is specified. Instead of $v = \text{constant}$, we have $\frac{dP}{dv} = -1 \times 10^5 \, \frac{\text{MPa}}{\text{m}^3}$

Integrate $Sp \, dv = \int 1 \times 10^5 \, dv$

$P = 10^5 \, v + C$
Using initial conditions to solve for $C$

\[ P_2 = 10^5 v_2 + C \]

\[ (2.103 \text{ MPa} = 10^5 (0.02696) + C \]

\[ \Rightarrow C = -2.694 \text{ MPa} \]

\[ P = 1 \times 10^5 \frac{\text{MPa}}{\text{m}^3/\text{kg}} \cdot v - 2.694 \text{ MPa} \]

\[ \text{New Path} \]

\[ \text{Fully Defined} \]

Given $P_3 = 230 \text{ psi} = 1.5858 \text{ MPa}$, this equation can be used to solve for $v_3$.

\[ P_3 = 1.5858 = 1 \times 10^5 v_3 - 2.694 \text{ MPa} \]

\[ \Rightarrow v_3 = 0.0269573 \text{ m}^3/\text{kg} \]

Using ideal gas equation

\[ T_3 = \frac{P_3 v_3}{R} \text{ (units Pa)} \]

\[ = \frac{(1.5858 \times 10^6)(0.0269573)}{188.95} = 226.238 \text{ K} \]

\[ \therefore T_3 = 226 \text{ K} = -47.15 ^\circ \text{C} \]

d.) \[ W = \int_{V_2}^{V_3} P \, dv = \int_{V_2}^{V_3} \left( 1 \times 10^5 \frac{\text{MPa}}{\text{m}^3/\text{kg}} \cdot v - 2.694 \text{ MPa} \right) \, dv \]

\[ W = \frac{1 \times 10^{11} v^2}{2} - 2.694 \times 10^6 v \bigg|_{V_2}^{V_3} \]

\[ W = -9.549 \text{ J/kg} \]