Chap 20  P30

a) \[ \Delta E = Q - \dot{W}_{\text{by gas}} \]

\[ W = \text{Area under PV curve} = \frac{1}{2} \times \text{base} \times \text{height} \]

\[ W = \frac{1}{2} \times (4 \text{ m}^3) \times (6 \text{ kPa}) = 12 \text{ kPa m}^3 = 12 \times 1000 \text{ N m} \cdot \text{m}^3 = 12000 \text{ J} \]

For a closed cycle like this one

\[ \Delta E = 0 \]

\[ Q = \dot{W}_{\text{by gas}} = 12000 \text{ J} \]

This means 12,000 more joules flowed into than out of the system.

If the cycle is reversed

\[ \dot{W}_{\text{by gas}} = -12000 \text{ J} \quad Q = -12000 \text{ J} \]

Then 12,000 more joules flowed out of than into the system.
This is the same
\[ \Delta G = Q - W \]

\[ W = \text{Area} = \text{base} \times \text{height} \]

\[ \text{Area} = (3V_i - V_f) \times (3P_i - P_f) \]

a) \[ W_{\text{gas}} = \text{Area} = 4P_iV_i \]

b) \[ Q = 4P_iV_i \]

c) \[ P_iV_i = nRT_i \]

\[ Q = 4\left( nRT_i \right) \]

\[ Q = 4\left( 1\text{ mol} \right) \left( 8.31 \text{ J/mol} \cdot \text{K} \right) \left( 273 \text{ K} \right) \]

\[ Q = 9075 \text{ J} \]
P 58

a)

\[ W_{\text{by gas}} = -(\text{area}) = -(\text{base}) \times \text{height} \]

\[ = -(\frac{V_i}{2})(P_i) = -\frac{P_i V_i}{2} \]

\[ W_{\text{orgas}} = \frac{P_i V_i}{2} \]

b)

Isobaric

\[ PV = nRT \]

\[ V \propto \frac{1}{P} \]

So \[ \frac{V_f}{V_i} = \frac{1}{4} \]

\[ W_{\text{by gas}} = nRT \ln \frac{V_f}{V_i} \]

\[ nRT = P_i V_i \]

\[ \ln \frac{1}{4} = -\ln 4 \]

\[ W_{\text{by gas}} = P_i V_i \ln \frac{V_i}{V_i} \]

\[ = P_i V_i \ln \frac{1}{4} = -P_i V_i \ln 4 \]
\[ w_{\text{on}} = + P_{i} V_{i} \ln 4 \]

Diagram:

1. \( P_{i} \)
2. \( V_{i} \)
3. A vertical line
4. A horizontal line

\[ W = P \Delta V = 0 \]
Chap 20  P30

a) \[ \Delta E = Q - W_{\text{by gas}} \]

\[ W = \text{Area under PV curve} \]
\[ = \frac{1}{2} \times \text{base} \times \text{height} \]
\[ W = \frac{1}{2} \times (4 \text{ m}^3) \times (6 \text{ kPa}) \]
\[ = 12 \text{ kPa m}^3 = 12 \times 1000 \frac{N}{m^2} \cdot m^3 = 12000 \text{ J} \]

For a closed cycle like this one
\[ \Delta E = 0 \]
\[ Q = W_{\text{by gas}} = 12000 \text{ J} \]

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