5. (10 points)
One mole of an ideal gas is taken around the cycle $A \rightarrow B \rightarrow C \rightarrow A$ as shown on the $PV$ diagram above.

(a) Calculate the temperature of the gas at point $A$.

\[ PV = nRT \]

\[ (2\text{m})(20) = 1(8.31)(T) \]

\[ T = 481.34 \text{ Kelvin} \]

(b) Calculate the net work done on the gas during one complete cycle.

\[ W = \text{Area enclosed by graph} \]

\[ \frac{1}{2} (200)(40) = 4000 \text{ J} \]

(c) i. Is heat added to or removed from the gas during one complete cycle?

___ added to the gas  ___ removed from the gas

ii. Calculate the heat added to or removed from the gas during one complete cycle.

\[ \Delta U = Q + W \]

\[ Q = 4000 \text{ J} \]

\[ Q = -4000 \text{ J} \]
(d) After one complete cycle, is the internal energy of the gas greater, less, or the same as before?

___ greater       ___ less       X the same

Justify your answer.

Internal energy is dependent upon temperature alone.
After a complete cycle ABCA, the gas returns to
Point A, at the same temperature. \( U \) is the same.

(e) After one complete cycle, is the entropy of the gas greater, less, or the same as before?

___ greater       ___ less       X the same

Justify your answer.

Entropy is the measure of the disorder or randomness of a system. If the internal energy remains the same,
then the random motion of the gas will remain at the
same value. \( \therefore \) Entropy is the same.
5. (10 points)
One mole of an ideal gas is taken around the cycle $A \rightarrow B \rightarrow C \rightarrow A$ as shown on the $PV$ diagram above.

(a) Calculate the temperature of the gas at point $A$.

We know, $PV = nRT.$

At $A$, $200 \times 20 = 1 \times 8.31 \times T$.

Hence, $T = 481.35 K$.

(b) Calculate the net work done on the gas during one complete cycle.

\[ \text{Work done} = \text{Work done in CA} + \text{Work done in AB} + \text{Work done in BC} \]

\[ \text{Work done} = -(200 \times 40) + \left( \frac{200 + 400}{2} \right) \times 40 \]

\[ = -8000 + 12000 \]

\[ = 4000 J \]

(c) Is heat added to or removed from the gas during one complete cycle?

\[ \text{_____ added to the gas} \quad \text{_____ removed from the gas} \]

ii. Calculate the heat added to or removed from the gas during one complete cycle.

At $C$, temp $= T_c = \frac{20 \times 400}{1 \times 8.31} = 962.69 K$.

At $B$, temp $= T_B = \frac{200 \times 60}{1 \times 8.31} = 1444.04 K$.

Total heat = Heat in $CA$ + Heat in $AB$ + Heat in $BC$

\[ = nC_p(481.35) - nC_p(962.69) + \]

GO ON TO THE NEXT PAGE.
(d) After one complete cycle, is the internal energy of the gas greater, less, or the same as before?

___ greater ___ less  ___ the same

Justify your answer.

As the cycle repeats back to the same position as it started from, with the original pressure \( P = 400 \text{ N/m}^2 \) and volume \( V = 20 \text{ m}^3 \), the internal energy is the same as temperature is the original one, i.e., \( T = 481.35 \text{ K} \).

(e) After one complete cycle, is the entropy of the gas greater, less, or the same as before?

___ greater ___ less  ___ the same

Justify your answer.

After one complete cycle, the entropy is the same as before.

Entropy measures the disorder in a system. At a constant pressure, volume, and temperature as that of \( A \), when the cycle is completed, entropy must be the same. This is because temperature measures the internal energy of a gas.