A system can be taken from state $a$ to state $b$ along any of the three paths shown in the $pV$ diagram.

If state $b$ has greater internal energy than state $a$, along which path is the absolute value $|Q|$ of the heat transfer the greatest?

A. path 1  
B. path 2  
C. path 3  
D. $|Q|$ is the same for all three paths.  
E. not enough information given to decide
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A system can be taken from state $a$ to state $b$ along any of the three paths shown in the $pV$ diagram.

If state $b$ has greater internal energy than state $a$, along which path is there a net flow of heat out of the system?

A. path 1  
B. path 2  
C. path 3  
D. all of paths 1, 2, and 3  
E. none of paths 1, 2, or 3
A system can be taken from state \(a\) to state \(b\) along any of the three paths shown in the \(pV\) diagram.

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A. path 1  
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This $pV$ diagram shows two ways to take a system from state $a$ (at lower left) to state $c$ (at upper right):

" via state $b$ (at upper left), or
" via state $d$ (at lower right)

For which path is $W > 0$?

A. path $abc$ only
B. path $adc$ only
C. both path $abc$ and path $adc$
D. neither path $abc$ nor path $adc$
E. The answer depends on what the system is made of.
This $pV$ diagram shows two ways to take a system from state $a$ (at lower left) to state $c$ (at upper right):

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E. The answer depends on what the system is made of.
Q19.4

In an isothermal expansion of an ideal gas, the amount of heat that flows into the gas

A. is greater than the amount of work done by the gas.
B. equals the amount of work done by the gas.
C. is less than the amount of work done by the gas, but greater than zero.
D. is zero.
E. is negative (heat flows out of the gas).
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D. is zero.

E. is negative (heat flows out of the gas).
Q19.5

An ideal gas is taken around the cycle shown in this $pV$ diagram, from $a$ to $b$ to $c$ and back to $a$. Process $b \rightarrow c$ is isothermal.

For this complete cycle,

A. $Q > 0$, $W > 0$, and $\Delta U = 0$.
B. $Q > 0$, $W > 0$, and $\Delta U > 0$.
C. $Q = 0$, $W > 0$, and $\Delta U < 0$.
D. $Q = 0$, $W < 0$, and $\Delta U > 0$.
E. $Q > 0$, $W = 0$, and $\Delta U > 0$. 
A19.5

An ideal gas is taken around the cycle shown in this $pV$ diagram, from $a$ to $b$ to $c$ and back to $a$. Process $b \rightarrow c$ is isothermal.

For this complete cycle,

A. $Q > 0$, $W > 0$, and $\Delta U = 0$.
B. $Q > 0$, $W > 0$, and $\Delta U > 0$.
C. $Q = 0$, $W > 0$, and $\Delta U < 0$.
D. $Q = 0$, $W < 0$, and $\Delta U > 0$.
E. $Q > 0$, $W = 0$, and $\Delta U > 0$. 
An ideal gas is taken around the cycle shown in this $pV$ diagram, from $a$ to $b$ to $c$ and back to $a$. Process $b \rightarrow c$ is isothermal.

For process $a \rightarrow b$,

A. $Q > 0$ and $\Delta U > 0$.
B. $Q > 0$ and $\Delta U = 0$.
C. $Q = 0$ and $\Delta U > 0$.
D. $Q = 0$ and $\Delta U < 0$.
E. $Q < 0$ and $\Delta U < 0$. 
An ideal gas is taken around the cycle shown in this $pV$ diagram, from $a$ to $b$ to $c$ and back to $a$. Process $b \rightarrow c$ is isothermal.

For process $a \rightarrow b$,

- A. $Q > 0$ and $\Delta U > 0$.
- B. $Q > 0$ and $\Delta U = 0$.
- C. $Q = 0$ and $\Delta U > 0$.
- D. $Q = 0$ and $\Delta U < 0$.
- E. $Q < 0$ and $\Delta U < 0$.
Q19.7

An ideal gas is taken around the cycle shown in this $pV$ diagram, from $a$ to $b$ to $c$ and back to $a$. Process $b \rightarrow c$ is isothermal.

For process $b \rightarrow c$,

A. $Q > 0$ and $\Delta U > 0$.
B. $Q > 0$ and $\Delta U = 0$.
C. $Q = 0$ and $\Delta U > 0$.
D. $Q = 0$ and $\Delta U < 0$.
E. $Q < 0$ and $\Delta U < 0$. 
An ideal gas is taken around the cycle shown in this $pV$ diagram, from $a$ to $b$ to $c$ and back to $a$. Process $b \rightarrow c$ is isothermal.

For process $b \rightarrow c$,

A. $Q > 0$ and $\Delta U > 0$.

B. $Q > 0$ and $\Delta U = 0$.

C. $Q = 0$ and $\Delta U > 0$.

D. $Q = 0$ and $\Delta U < 0$.

E. $Q < 0$ and $\Delta U < 0$.

✓
An ideal gas is taken around the cycle shown in this $pV$ diagram, from $a$ to $b$ to $c$ and back to $a$. Process $b \rightarrow c$ is isothermal.

For process $c \rightarrow a$,

A. $Q > 0$ and $\Delta U > 0$.
B. $Q > 0$ and $\Delta U = 0$.
C. $Q = 0$ and $\Delta U > 0$.
D. $Q = 0$ and $\Delta U < 0$.
E. $Q < 0$ and $\Delta U < 0$. 
An ideal gas is taken around the cycle shown in this $pV$ diagram, from $a$ to $b$ to $c$ and back to $a$. Process $b \to c$ is isothermal.

For process $c \to a$,

- A. $Q > 0$ and $\Delta U > 0$.
- B. $Q > 0$ and $\Delta U = 0$.
- C. $Q = 0$ and $\Delta U > 0$.
- D. $Q = 0$ and $\Delta U < 0$.
- E. $Q < 0$ and $\Delta U < 0$.

The correct answer is E.
Q19.9

An ideal gas begins in a thermodynamic state $a$. When the temperature of the gas is raised from $T_1$ to a higher temperature $T_2$ at a constant volume, a positive amount of heat $Q_{12}$ flows into the gas. If the same gas begins in state $a$ and has its temperature raised from $T_1$ to $T_2$ at a constant pressure, the amount of heat that flows into the gas is

A. greater than $Q_{12}$.

B. equal to $Q_{12}$.

C. less than $Q_{12}$, but greater than zero.

D. zero.

E. negative (heat flows out of the system).
An ideal gas begins in a thermodynamic state $a$. When the temperature of the gas is raised from $T_1$ to a higher temperature $T_2$ at a constant *volume*, a positive amount of heat $Q_{12}$ flows into the gas. If the same gas begins in state $a$ and has its temperature raised from $T_1$ to $T_2$ at a constant *pressure*, the amount of heat that flows into the gas is

A. greater than $Q_{12}$.

B. equal to $Q_{12}$.

C. less than $Q_{12}$, but greater than zero.

D. zero.

E. negative (heat flows *out of* the system).
An ideal gas is taken around the cycle shown in this $pV$ diagram, from $a$ to $c$ to $b$ and back to $a$. Process $c \rightarrow b$ is adiabatic.

For process $c \rightarrow b$,

A. $Q > 0$, $W > 0$, and $\Delta U = 0$.
B. $Q > 0$, $W > 0$, and $\Delta U > 0$.
C. $Q = 0$, $W > 0$, and $\Delta U < 0$.
D. $Q = 0$, $W < 0$, and $\Delta U > 0$.
E. $Q < 0$, $W < 0$, and $\Delta U = 0$. 
An ideal gas is taken around the cycle shown in this $pV$ diagram, from $a$ to $c$ to $b$ and back to $a$. Process $c \rightarrow b$ is adiabatic.

For process $c \rightarrow b$,

A. $Q > 0$, $W > 0$, and $\Delta U = 0$.
B. $Q > 0$, $W > 0$, and $\Delta U > 0$.
C. $Q = 0$, $W > 0$, and $\Delta U < 0$.
D. $Q = 0$, $W < 0$, and $\Delta U > 0$.
E. $Q < 0$, $W < 0$, and $\Delta U = 0$.
Q19.11

When an ideal gas is allowed to expand *isothermally* from volume $V_1$ to a larger volume $V_2$, the gas does an amount of work equal to $W_{12}$.

If the same ideal gas is allowed to expand *adiabatically* from volume $V_1$ to a larger volume $V_2$, the gas does an amount of work that is

A. equal to $W_{12}$.

B. less than $W_{12}$.

C. greater than $W_{12}$.

D. either A., B., or C., depending on the ratio of $V_2$ to $V_1$. 

When an ideal gas is allowed to expand *isothermally* from volume $V_1$ to a larger volume $V_2$, the gas does an amount of work equal to $W_{12}$.

If the same ideal gas is allowed to expand *adiabatically* from volume $V_1$ to a larger volume $V_2$, the gas does an amount of work that is

A. equal to $W_{12}$.

✓ B. less than $W_{12}$.

C. greater than $W_{12}$.

D. either A., B., or C., depending on the ratio of $V_2$ to $V_1$.  

A19.11