CONCEPT: CYCLIC THERMODYNAMIC PROCESSES

● Cyclic process: System completes a series of steps, returns to its ____________________. Two important properties:

1) The total work done in a cyclic process is the area enclosed ______________ the loop.

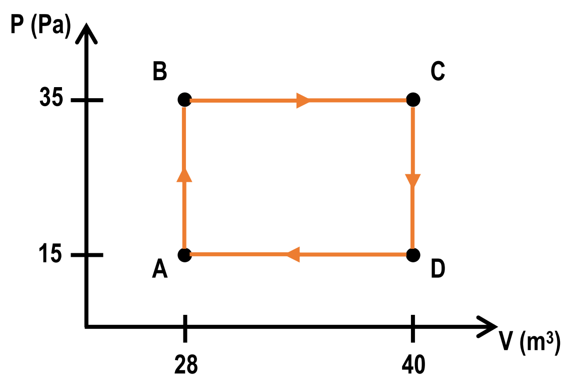
- IF the loop runs clockwise, W_{cyc} = [+ | –]
- IF the loop runs counter-clockwise, W_{cyc} = [+ | –]

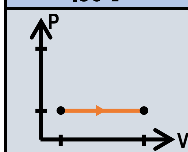
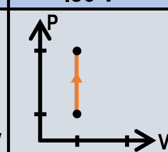
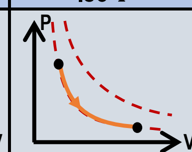
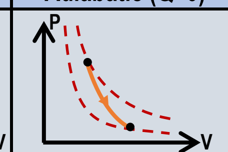
● Instead of using $\Delta E_{OF} = Q_{TO} - W_{BY}$ for each process, use _______ = ____________ multiple processes or cycles.

2) Because Internal Energy depends *only* on initial & final state and *not* the path taken, ΔE = ___ over a CYCLE

- If ΔE_{cyc} = ___, then _____ = ______

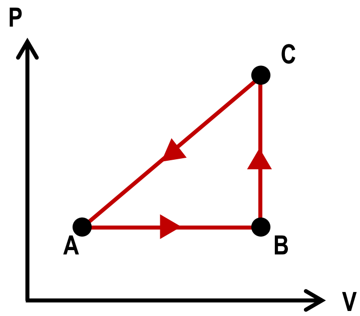
EXAMPLE: An ideal gas goes through a cyclic process shown below. **a)** Calculate the work done by the gas over the cycle. **b)** Calculate the area enclosed within the loop. **c)** If Q_{AB} = 800J, Q_{BC} = 340J, Q_{CD} = –600J, Q_{DA} = –300J calculate the change in Internal Energy for the cycle.



	Iso-P	Iso-V	Iso-T	Adiabatic (Q=0)
				
ΔE_{int}	$Q - W$	$\Delta E_{int} = Q$	0	$\Delta E_{int} = -W$
Q	$nC_P\Delta T$	$nC_V\Delta T$	$Q = W$	0
W	$P\Delta V$	0	$nRT \cdot \ln\left(\frac{V_f}{V_i}\right)$	$-nC_V\Delta T$ OR $\frac{1}{\gamma-1}(P_iV_i - P_fV_f)$
				$P_iV_i^{\gamma} = P_fV_f^{\gamma}$ $T_iV_i^{\gamma-1} = T_fV_f^{\gamma-1}$

THERMO CONSTANTS
$R = 8.314 \frac{J}{mol \cdot K}$

PROBLEM: A thermodynamic system is taken from state ***A*** to state ***B*** to state ***C***, and then back to ***A***, as shown in the PV diagram**.** Complete the table by inserting either a plus sign, a minus sign, or a zero in each indicated cell**.**



	Q	W	ΔE_{int}
A → B			+
B → C	+		
C → A			

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	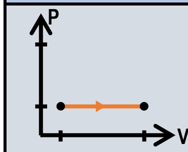		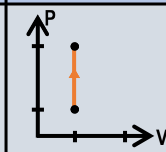	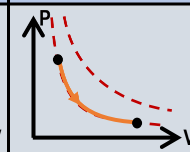	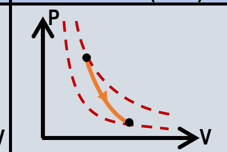
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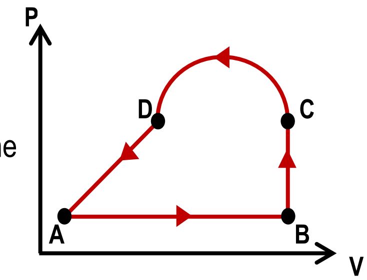
PROBLEM: An ideal gas is taken through the four processes shown below. The changes in internal energy for three of these processes are as follows: ΔE_{AB} = +82 J; ΔE_{BC} = +15 J; ΔE_{DA} = –56 J. Find the change in internal energy for the process from C to D.

A) –153 J
B) 41 J
C) –41 J
D) Cannot determine



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	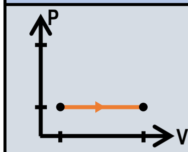	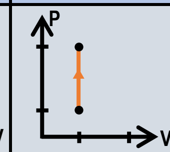	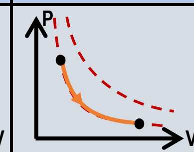	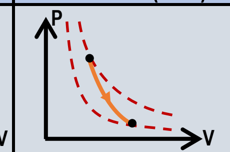
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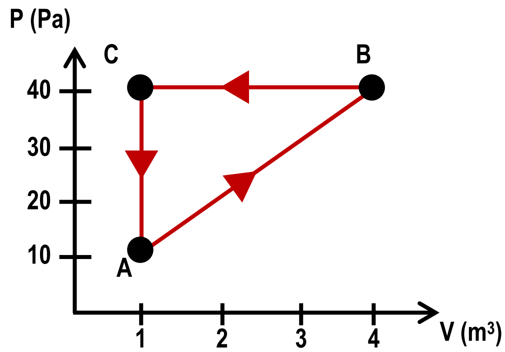
PROBLEM: A gas in a closed container undergoes the cycle shown in the PV diagram. Calculate the total amount of heat added over a complete cycle.



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	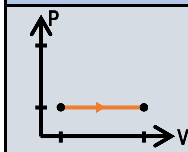	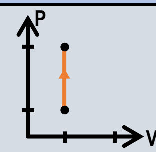	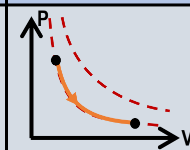	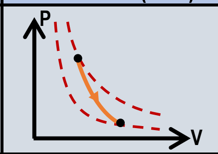
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