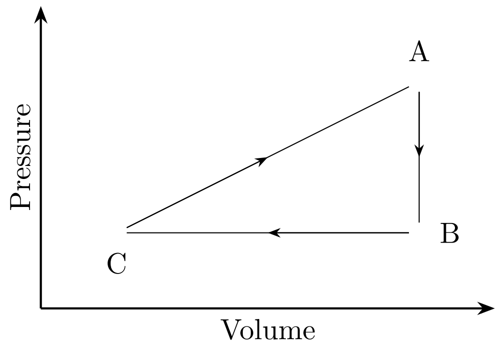
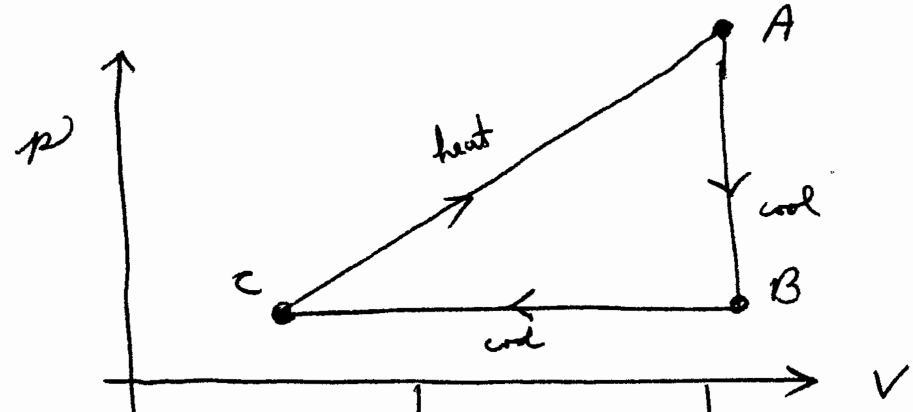
Physics 151: Accelerated Physics I—Mechanics and Thermodynamics
First Law of Thermodynamics

Problem 1: An ideal gas is taken through the three processes shown in the figure. Fill in the missing entries in the following table:

	Q (J)	**W (J)**	**Δ U (J)**
$A \to B$	-53		
$B \to C$	-280	-130	
$C \to A$		150	



1.8.11



	Q	W	ΔU
A→B	−53 J	0 (a)	−53 (b)
B→C	−280 J	−130 J	−150 (c)
C→A	353 (e)	150 J	203 (d)
A-B-C-A	20 J (f)	20 J	0

$Q = W + \Delta U$

(a) $W = 0$ since $p\Delta V = 0$

Then (b) apply 1st law, $\Delta U = -53$ J.

(c) $\Delta U = Q - W = -150$

(d) $\Delta U = ?$

what is net temperature change $A \to B \to C \to A$? 0

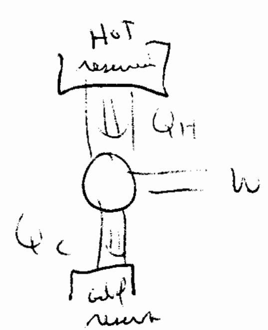
∴ " " " ΔU for the full cycle ? 0

∴ $\Delta U_{C\to A} = +203$ J

(e) $Q = W + \Delta U = 353$

(f) $Q_{net} = 20$ J.

Overall: This sequence of processes ~~did~~ took in ~~20~~ 353 J of heat, ~~(heat)~~ ~~and~~ did 20 J of work, and exhausted 333 J of waste heat.



$|Q_H| = |Q_C| + |W|$.

$e = \frac{20 \text{ J}}{353 \text{ J}} = 5.7\%$