212 Midterm II Solutions

① $C_V = 6$ cal/mol·K

$n = 7$ moles, $\Delta T = 25$ K

$Q = W + \Delta U$ $\quad \underline{\Delta K = \frac{3}{2} kT}$/molecule $= \frac{3}{2} RT$/mole.

a) Constant V

$W = \int p dV = 0 \Rightarrow Q = \Delta U$

$Q = cm\Delta t = \frac{6\ cal}{mol\,K}\ 7_{mol} \times 25\,K = 1050$ cal }

$\Delta K = \frac{3}{2} nR\Delta T = \frac{3}{2}(7)\left(\frac{8.31\,J}{mole\,K}\right)\frac{1\,cal}{4.186\,J}\,25K = 521$ cal

b) Constant P

$W = \int p dV = p\,\Delta V$

yet $pV = nRT \Rightarrow p\Delta V = nR\Delta T$

$\Rightarrow W = nR\Delta T = 7\,mole\ \frac{8.31\,J}{mol\,K}\ \frac{1\,cal}{4.186\,J}\ 25K = 347$ cal

ΔU same as constant V (only depends on T) $= 1050$ cal

$Q = W + \Delta U = 347 + 1050 = 1397$ cal

or $Q = c_p \Delta T = (C_V + R) n \Delta T = \left(6 + \frac{8.31}{4.186}\right) 7 \cdot 25 = 1397$ cal ✓

	Q	W	ΔU	ΔK (in cal)
a) Const V	1050	0	1050	521
b) Const P	1397	347	1050	521
c) adiabatic	0	−1050	1050	521

c) Adiabatic $\Rightarrow Q = 0$

ΔU is the same as ΔT is the same

$Q = W + \Delta U$

$0 = W + \Delta U \Rightarrow W = -\Delta U = -1050$ cal