Secret Code **20:**

3.1 A)

	q_{carnot}	W
Isothermal Expansion	$nRT_H \ln(V_A/V_B) = q_{in}$	$nRT_H \ln(V_A/V_B)$
Adiabatic expansion	0	~~$C_V(T_H - T_C)$~~
Isothermal Compression	$nRT_C \ln(V_C/V_D)$	$nRT_C \ln(V_C/V_D)$
Adiabatic Compression	0	~~$C_V(T_C - T_H)$~~

$$q_{out\,CT_H} = nRT_H \ln(V_A/V_B) = -q_{in}$$

$$\boxed{q_{in} = 182.7\ J}$$

3.1 B) $W_{tot} = nRT_H \ln(V_A/V_B) + nRT_C \ln(V_C/V_D)$

$= -52.99\ J$

$\boxed{= 52.99\ J \text{ done by system}}$

3.1 C) Total Area: (assuming axes the same as above)

$(0.0005\ m^3)(2.0 \times 10^6\ pa) = 1000\ J$

$\therefore$ Paper energy density: $\frac{1000\ J}{1467.8\ mg} = 0.6813\ J/mg$

Carnot weight = 78.7 mg

Carnot energy = $0.6813\ \frac{J}{mg} \times 78.7\ mg = \boxed{53.62\ J}$

3.1 D) Isothermal ΔS: $nR \ln(V_F/V_1) = S_F - S_1$

given $S_1 = 0.3\ J/K$

$S_F = nR \ln(V_F/V_1) + S_I$

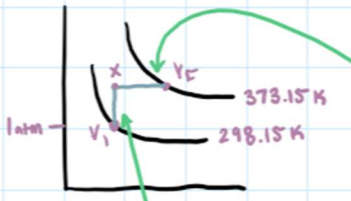
Adiabatic ΔS: 0 $\quad \Delta T = T_H - T_C$

3.1E) $A = \Delta S \times \Delta T$

$= (S_F - S_1) \cdot (T_H - T_C) \quad = [J/K \cdot K]$

$= \boxed{52.8\ J = W \text{ done by cycle}}$

3.2)



ΔS is state Function so break into

$\Delta S = \Delta S_{\text{isochoric heating}} + \Delta S_{\text{isobaric expansion}}$

$\Delta S = C_V \ln(T_F/T_1) + C_P \ln(V_F/V_1)$

$C_V = \frac{3}{2} nR$

$C_P = C_V + nR$

$n = \frac{P_1 V_1}{R T_1}$

$\boxed{\Delta S = 0.352\ J/K}$

3.4A) $dB = e\,dK - J\,dL$

$\boxed{dB = \left(\frac{\partial B}{\partial K}\right) dK - \left(\frac{\partial B}{\partial L}\right) dL}$

3.4B) $e = \left(\frac{\partial B}{\partial K}\right)$

$J = \left(\frac{\partial B}{\partial L}\right)$

$dB = e\,dK + -J\,dL$

$\parallel \qquad \frac{\partial e}{\partial K} \qquad \frac{-\partial J}{\partial K}$

$e\,dK$

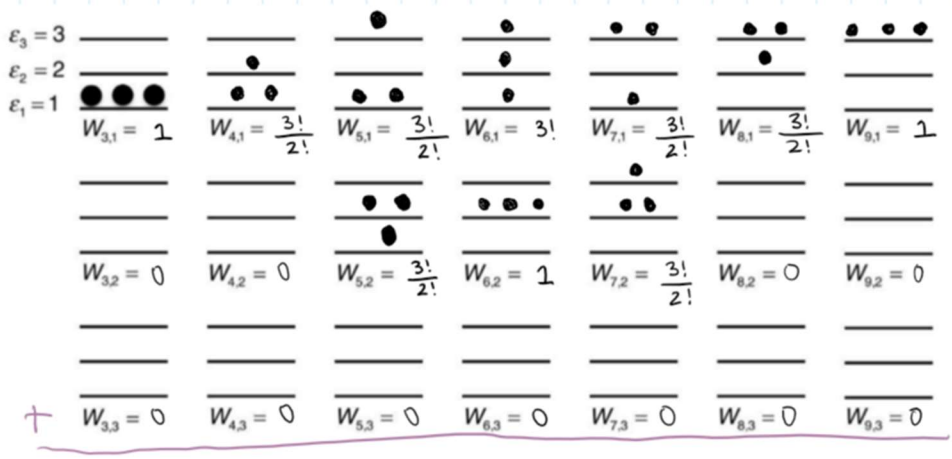
$+$

$-J\,dL \qquad \frac{\partial e}{\partial K} \qquad \frac{-\partial J}{\partial L}$

3.4C)

$\left(\frac{\partial e}{\partial L}\right)_K = \left(\frac{-\partial J}{\partial K}\right)_L$

3.5A)



$E_{tot} = 3$ $E_{tot} = 4$ $E_{tot} = 5$ $E_{tot} = 6$ $E_{tot} = 7$ $E_{tot} = 8$ $E_{tot} = 9$

3.5B)

$W_{3,tot} = 1$ $W_{4,tot} = 3$ $W_{5,tot} = 6$ $W_{6,tot} = 7$ $W_{7,tot} = 6$ $W_{8,tot} = 3$ $W_{9,tot} = 1$