

Clase 19 14 octubre 2020

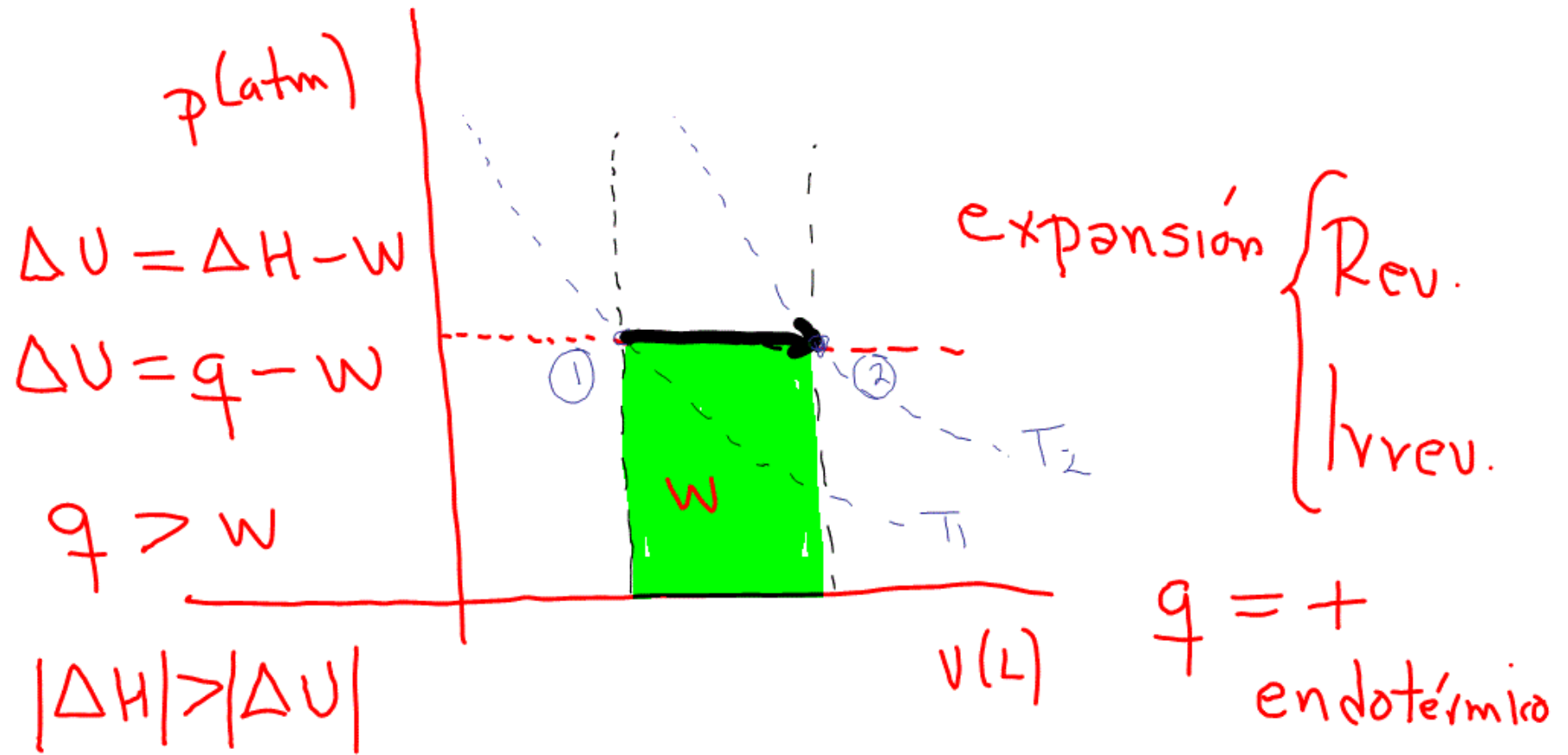
Título de la nota

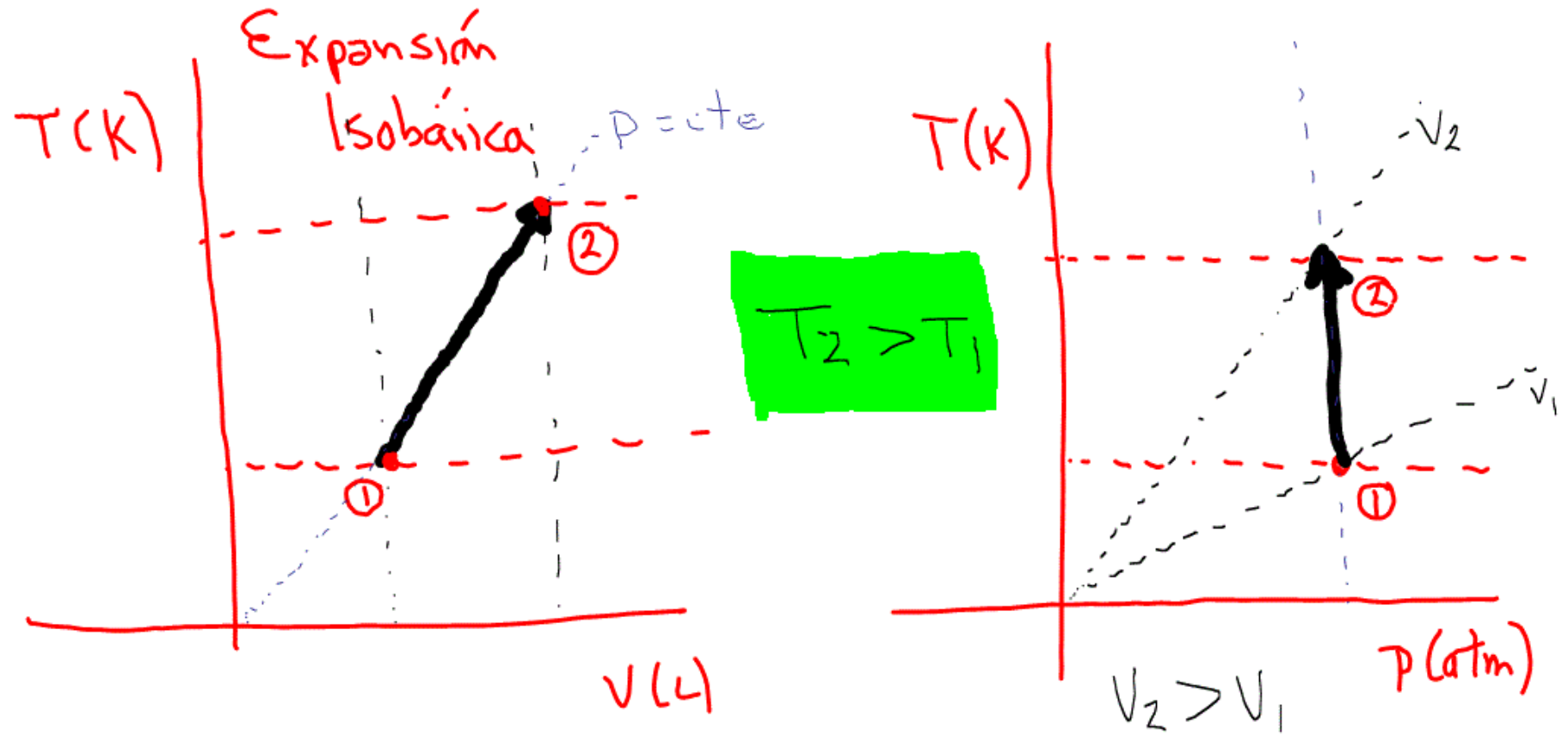
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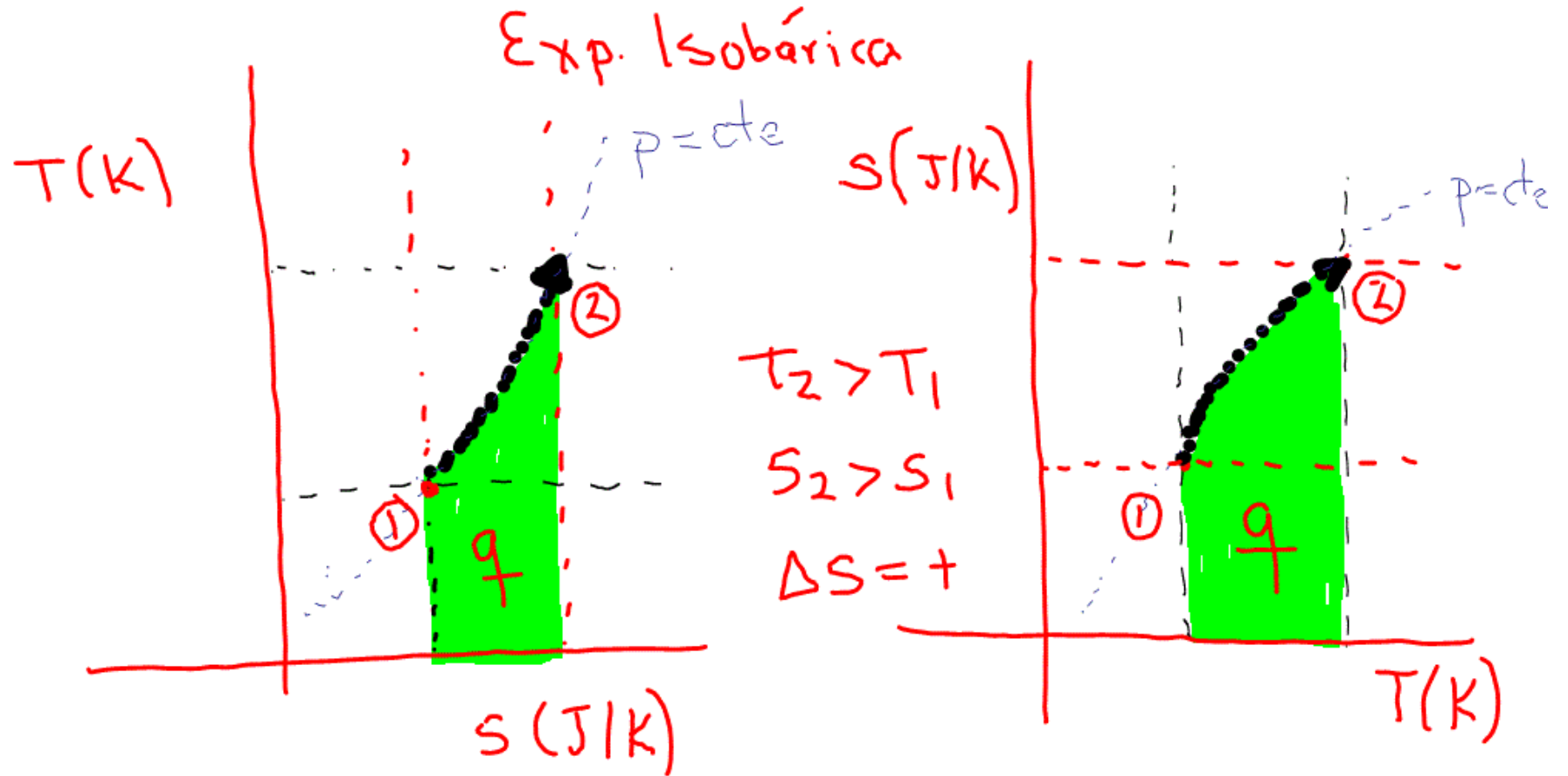
$$\int_1^2 \overline{dw} = p \int_{v_1}^{v_2} dv$$

$$W = p (v_2 - v_1)$$

$$W \begin{cases} + \text{ expansión} \\ - \text{ compresión} \end{cases}$$







Proceso isobárico en gases de comportamiento perfecto en sistemas cerrados					
Instrucción: Insertar en las celdas de color amarillo los valores correspondientes					
Calculando V_1		proceso	Calculando V_2		
p_1 (atm)	1.000	→	p_2 (atm)	1.000	Expansión
V_1 (L)	22.400	→	V_2 (L)	44.800	
T_1 (K)	273.150	→	T_2 (K)	546.300	
n_1 (mol)	1.000	→	n_2 (mol)	1.000	
	R (J/molK)	8.314			
c_v (J/molK)	20.785		Expansión	Temperatura	aumenta
c_p (J/molK)	29.099				
Elegir tipo de gas		Diatómico		Volumen	aumenta



Expansión		
ΔH (J)	7948.392	
ΔU (J)	5677.423	
ΔS (J/K)	20.170	
q (J)	7948.392	
w (J)	2269.680	
w (J)	2270.969	
q	> 0	Endotérmico
w	> 0	Aumento de volumen
ΔS	> 0	Aumento de entropía

$$P_1 \rightarrow P_2 = cte$$

$$n_1 \rightarrow n_2 = cte \text{ cerrado}$$

$$T_1 \rightarrow T_2 \quad T_2 > T_1 \quad T_2 = 2T_1$$

$$V_1 \rightarrow V_2 \quad V_2 > V_1 \quad V_2 = 2V_1$$

Compartamiento perfecto \bar{C}_p y $\bar{C}_v = ctes$

$$\text{Diatómico} \quad \bar{C}_p = \frac{7}{2} R \quad \bar{C}_v = \frac{5}{2} R$$

$$R = \frac{8.314 \text{ J}}{\text{mol K}}$$

$$\bar{C}_p = 29.099 \text{ J/molK}$$

$$\bar{C}_v = 20.785 \text{ J/molK}$$

$$\begin{aligned} \Delta H &= n \bar{C}_p (T_2 - T_1) \\ &= (1 \text{ mol}) \left(\frac{29.099 \text{ J}}{\text{molK}} \right) (546.3 - 273.15) \text{ K} \\ &= 7948.39 \text{ J} \end{aligned}$$

$$\begin{aligned} \Delta U &= n \bar{C}_v (T_2 - T_1) \\ &= (1 \text{ mol}) \left(\frac{20.785 \text{ J}}{\text{molK}} \right) (546.3 - 273.15) \text{ K} \\ &= 5677.42 \text{ J} \end{aligned}$$

$$\Delta H \rightarrow \Delta U$$

$$q = \Delta H = 7948.39 \text{ J}$$

$$\Delta S = n \bar{C}_p \ln \frac{T_2}{T_1}$$

$$= (1 \text{ mol}) (29.99 \text{ J/molK}) \left(\ln \frac{546.3 \text{ K}}{273.15 \text{ K}} \right)$$

$$\Delta S = + = 20.170 \text{ J/K}$$

$$w = p (v_2 - v_1) = 1 \text{ atm} (44.8 - 22.4) \text{ L}$$

$$= (22.4 \text{ atmL}) \left(\frac{1.01325 \times 10^5 \text{ N/m}^2}{\text{atm}} \right) \left(\frac{1 \text{ m}^3}{10^3 \text{ L}} \right)$$

$$W = 2269.68 \text{ J}$$

$$\Delta U = q - W$$

$$\Delta U = \Delta H - W$$

$W = +$,
expansion


$$W = \Delta H - \Delta U = 7948.39 \text{ J} - 5677.42 \text{ J}$$

$$= 2270.97 \text{ J}$$

Proceso isobárico en gases de comportamiento perfecto en sistemas cerrados					
Instrucción: Insertar en las celdas de color amarillo los valores correspondientes					
Calculando V_1		proceso	Calculando V_2		
p_1 (atm)	1.000	→	p_2 (atm)	1.000	Expansión
V_1 (L)	22.400	→	V_2 (L)	44.800	
T_1 (K)	273.150	→	T_2 (K)	546.300	
n_1 (mol)	1.000	→	n_2 (mol)	1.000	
	R (J/molK)	8.314			
C_v (J/molK)	20.850			Temperatura	aumenta
C_p (J/mol/K)	29.170			Expansión	
Especificar el gas empleado	Oxígeno			Volumen	aumenta



Expansión		
ΔH (J)	7967.786	
ΔU (J)	5695.178	
ΔS (J/K)	20.219	
q (J)	7967.786	
w (J)	2269.680	
w (J)	2272.608	
q	> 0	Endotérmico
w	> 0	Aumento de volumen
ΔS	> 0	Aumento de entropía

Proceso isobárico en gases de comportamiento perfecto en sistemas cerrados						
Instrucción: Insertar en las celdas de color amarillo los valores correspondientes						
Calculando V_1		proceso	Calculando V_2			
p_1 (atm)	1.000	→	p_2 (atm)	1.000	Expansión	
V_1 (L)	22.400	→	V_2 (L)	44.800		
T_1 (K)	273.150	→	T_2 (K)	546.300		
n_1 (mol)	1.000	→	n_2 (mol)	1.000		
	R (J/molK)	8.314				
Especificar el gas empleado		Oxígeno	Expansión	Temperatura	aumenta	
Cp como función de T (cal/molK)				Volumen	aumenta	
Cp=a+bT+cT ² +dT ³ (300-2500)K		Expansión	a	b	c	d
			6.713	-8.79e-7	4.17e-6	-2.54e-9
ΔH (J)	8283.387					
ΔU (J)	6012.418					
ΔS (J/K)	32.080					
q (J)	8283.387					
w (J)	2269.680					
w (J)	2270.969					
q	>	0	Endotérmico			
w	>	0	Aumento de volumen			
ΔS	>	0	Aumento de entropía			

$$\begin{aligned}
 \int_1^2 dH &= n \int_{T_1}^{T_2} C_p dT \\
 &= 1 \text{ mol} \left[a \int_{T_1}^{T_2} dT + b \int_{T_1}^{T_2} T dT + c \int_{T_1}^{T_2} T^2 dT + d \int_{T_1}^{T_2} T^3 dT \right] \\
 &= 1 \text{ mol} \left[6.713 \int_{T_1}^{T_2} dT - 8.79 \times 10^{-7} \int_{T_1}^{T_2} T dT + 9.17 \times 10^{-6} \int_{T_1}^{T_2} T^2 dT - 2.54 \times 10^{-9} \int_{T_1}^{T_2} T^3 dT \right] \\
 &= 1 \text{ mol} \left[6.713 (546.3 - 273.15) - \frac{8.79 \times 10^{-7}}{2} (546.3^2 - 273.15^2) + \frac{9.17 \times 10^{-6}}{3} (546.3^3 - 273.15^3) - \frac{2.54 \times 10^{-9}}{4} (546.3^4 - 273.15^4) \right] = 1978.8310 = \\
 &\quad \text{Cal}
 \end{aligned}$$

$$\int_{T_1}^{T_2} T^3 dT = \frac{T^4}{4}$$

$$= \frac{T_2^4 - T_1^4}{4}$$

$$(1978.8310 \text{ cal}) \left(\frac{4.186 \text{ J}}{\text{cal}} \right) = 8283.38 \text{ J}$$

$$\Delta H = 1 \text{ mol} \left[\frac{\text{cal}}{\text{mol K}} K + \frac{\text{cal}}{\text{mol K}^2} K^2 + \frac{\text{cal}}{\text{mol K}^3} K^3 + \frac{\text{cal}}{\text{mol K}^4} K^4 \right]$$

$$= \text{cal.}$$

$$\int_1^2 du = n \bar{c}_v \int_{T_1}^{T_2} dT$$

$$\Delta U = 1 \text{ mol} \left[(a-R) \int_{T_1}^{T_2} dT + b \int_{T_1}^{T_2} T dT + c \int_{T_1}^{T_2} T^2 dT + d \int_{T_1}^{T_2} T^3 dT \right]$$

$$R = \frac{1.9886 \text{ cal}}{\text{mol K}}$$

$$a-R = \bar{C}_V - R$$

$$\Delta U = 1 \text{ mol} \left[(6.713 - 1.9886)(546.3 - 273.15) - \frac{8.79 \times 10^{-7}}{2} (546.3^2 - 273.15^2) + \frac{4.17 \times 10^{-6}}{3} (546.3^3 - 273.15^3) - \frac{2.54 \times 10^{-9}}{4} (546.3^4 - 273.15^4) \right]$$

$$= 1435.64 \text{ (cal)} \left(\frac{4.186 \text{ J}}{1 \text{ cal}} \right) = 6009.60 \text{ J}$$

$$W = \Delta H - \Delta U$$

$$= 2269.8 \text{ J}$$

$$\int_1^2 ds = n \bar{C}_p \int_{T_1}^{T_2} \frac{dT}{T}$$

$$\Delta S = n \left[\frac{a + bT + cT^2 + dT^3}{T} dT \right]_{T_1}^{T_2}$$

$$\Delta S = n \left[a \int_{T_1}^{T_2} \frac{dT}{T} + b \int_{T_1}^{T_2} \frac{T}{T} dT + c \int_{T_1}^{T_2} \frac{T^2}{T} dT + d \int_{T_1}^{T_2} \frac{T^3}{T} dT \right]$$

$$\Delta S = n \left[a \int_{T_1}^{T_2} \frac{dT}{T} + b \int_{T_1}^{T_2} dT + c \int_{T_1}^{T_2} T dT + d \int_{T_1}^{T_2} T^2 dT \right]$$

$$= n \left[a \ln \frac{T_2}{T_1} + b(T_2 - T_1) + \frac{c}{2} (T_2^2 - T_1^2) + \frac{d}{3} (T_2^3 - T_1^3) \right]$$

$$= \frac{\text{cal}}{\text{K}}$$

$$= 1 \text{ mol} \left[6.713 \ln \frac{546.3}{273.15} - 8.79 \times 10^{-7} (546.3 - 273.15) + \frac{4.17 \times 10^{-6}}{2} (546.3^2 - 273.15^2) - \frac{2.54 \times 10^{-9}}{3} (546.3^3 - 273.15^3) \right]$$

$$= 4.9987 \text{ cal/K} = 20.924 \text{ J/K}$$