

signature: _____

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version number

Practice Exam 4

Thermodynamic Data at 25°C

Substance	ΔH_f° kJ/mol	S° J/mol K
CH ₄ (g)	-75	186
C ₃ H ₈ (g)	-104	270
C ₅ H ₁₂ (l)	-174	263
C ₁₂ H ₂₂ O ₁₁ (s)	-2222	360
CO (g)	-111	198
CO ₂ (g)	-394	214
COCl ₂ (g)	-220	284
Cl ₂ (g)	—	223
H ₂ O (l)	-286	70
H ₂ O (g)	-242	189
NO ₂ (g)	33	240
N ₂ H ₄ (l)	50	12
N ₂ O (g)	82	220
O ₂ (g)	—	205

(values are rounded to the nearest integer)

Single Bond Energies (kJ/mol)

	H	C	N	O	S	Br
H	436					
C	413	346				
N	391	305	163			
O	463	358	201	146		
S	347	272	—	—	226	
Br	366	285	—	201	217	193

Multiple Bond Energies (kJ/mol)

C=C	602	C=N	615	C=O	799
C≡C	835	C≡N	887	C≡O	1072
N=N	418	O=O	498	N≡N	945

$$\Delta U = q + w \quad H = U + PV$$

$$w = -P\Delta V \quad w = -\Delta nRT$$

$$\Delta U = \Delta H - P\Delta V$$

$$\Delta U = \Delta H - \Delta nRT$$

$$\Delta U = q_v = n C_v \Delta T$$

$$\Delta H = q_p = n C_p \Delta T$$

$$q_{\text{cal}} = q_{\text{water}} + q_{\text{hardware}} \quad q_{\text{sys}} = -q_{\text{cal}}$$

$$\Delta S = q_{\text{rev}}/T \quad S = k \ln W$$

$$\Delta S = n C \ln \left(\frac{T_2}{T_1} \right) \quad C_p = C_v + R$$

$$\Delta H_{\text{rxn}} = \Delta H_1 + \Delta H_2 + \Delta H_3 + \dots$$

$$\Delta H_{\text{rxn}}^\circ = \sum n \Delta H_f^\circ (\text{prod}) - \sum n \Delta H_f^\circ (\text{react})$$

$$\Delta H_{\text{rxn}} = \sum BE_{\text{reactants}} - \sum BE_{\text{products}}$$

$$\Delta G_{\text{rxn}}^\circ = \sum n \Delta G_f^\circ (\text{prod}) - \sum n \Delta G_f^\circ (\text{react})$$

$$\Delta S_{\text{rxn}}^\circ = \sum n S^\circ (\text{prod}) - \sum n S^\circ (\text{react})$$

$$G = H - TS \quad \Delta G = \Delta H - T\Delta S$$

$$\Delta S_{\text{trans}} = \Delta H_{\text{trans}}/T_{\text{trans}}$$

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