

Final exam of thermodynamics

Course question

Define the principles of thermodynamics

Exercise 1

I-

Consider the following reaction: $\text{CH}_4(\text{g}) + \text{NH}_3(\text{g}) \longrightarrow \text{HCN}(\text{g}) + 3\text{H}_2(\text{g})$

1- calculate the enthalpy of the reaction at 298 K. Give the nature of the reaction

2- calculate the heat of this reaction at constant volume

3- we heat to 393 K, calculate the enthalpy of the reaction at this temperature

Data :

Compounds	$\text{NH}_3(\text{g})$	$\text{CH}_4(\text{g})$	HCN	$\text{H}_2(\text{g})$
$\Delta H^\circ_f (\text{KJ.mol}^{-1})$	-46.2	-74.9	130	.
$C_p (\text{J.mol}^{-1} \text{K}^{-1})$	34.30	35.57	77.84	28.80

II- the heat of combustion of $\text{C}_2\text{H}_4(\text{g})$ is -1387.4 KJ and knowing that the heat of formation of CO_2 and H_2O are respectively: -392.5 KJ/mol and -285.8 KJ/mol.

1- write the combustion reaction of C_2H_4

2- deduce the standard enthalpy of formation of $\text{C}_2\text{H}_4(\text{g})$

Exercise 2

Given an ideal **diatomic** gas in an initial state A(P_A , T_A , V_A), this gas undergoes the following successive reversible transformations:

- isochoric heating to state B

- adiabatic expansion to state C

- isobaric cooling to its initial state A

1- complete the following table

	A	B	C
P (atm)	1	3.5	
V (L)	2		
T (K)	300		

2- represent the transformation cycle on the Clapeyron diagram (P,V)

- what does the area of the cycle in the diagram represent?

3- calculate the work W, the heat Q, the internal energy change ΔU , the enthalpy change ΔH , and the entropy change ΔS for each transformation.

Data: $R=0.082 \text{ L.atm.mol}^{-1}.\text{K}^{-1} = 8.314 \text{ J.mol}^{-1}.\text{K}^{-1}$

Good Luck