

KEY

CHEM-111(Ch #16)
QUIZ-5

23 NOV. 2004

Attempt three questions, question no. 3 is compulsory. [10]

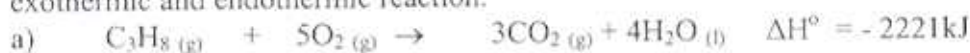
2.0

Q.1 Which of the following statement is always true for a spontaneous process.

- I) $\Delta G_{\text{sys}} < 0$ II) $\Delta S_{\text{surr}} > 0$ III) $\Delta S_{\text{univ}} > 0$ IV) $\Delta G_{\text{sys}} > 0$
 a) I b) III c) IV **d) I and III** e) II and IV

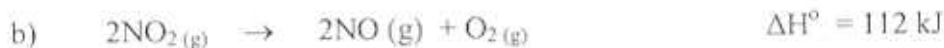
3.0

Q.2 Calculate ΔS_{surr} for the following reaction at 25 °C and 1 atm. Which one is exothermic and endothermic reaction.



$$\Delta S_{\text{surr}} = -\frac{\Delta H}{T} = \frac{-(-2221)\text{kJ}}{298\text{K}} = 7.45 \times 10^3 \text{J/K}$$

Exothermic



$$\Delta S_{\text{surr}} = -\frac{112}{298} = -0.376\text{kJ/K} = -376\text{J/K}$$

Endothermic

5 points

Q.3. a) Predict the sign for ΔS° for each of the following equations. [1.5]
equation only.

- | Equation | Sign |
|---|------------------------|
| a) $\text{Ag}^+(\text{aq}) + \text{Cl}^-(\text{aq}) \rightarrow \text{AgCl}(\text{s})$ | $\Delta S^\circ = (-)$ |
| b) $2\text{H}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{H}_2\text{O}(\text{l})$ | $\Delta S^\circ = (+)$ |
| c) $\text{I}_2(\text{g}) \rightarrow 2\text{I}(\text{g})$ | $\Delta S^\circ = (+)$ |

b) Calculate the standard entropy change ΔS° for the following reaction at 25 °C [3.5]
 $\text{Al}_2\text{O}_3(\text{s}) + 3\text{H}_2(\text{g}) \rightarrow 2\text{Al}(\text{s}) + 3\text{H}_2\text{O}(\text{g})$ $\Delta S^\circ = 179\text{J/K}$

The absolute entropy of products and reactants are given below.

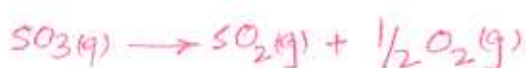
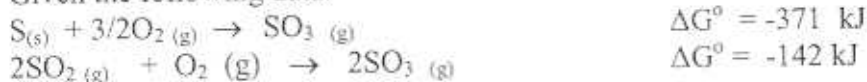
Substance	Abs. S°
$\text{Al}_2\text{O}_3(\text{s})$	51
$\text{H}_2(\text{g})$	131
$\text{Al}(\text{s})$	28
$\text{H}_2\text{O}(\text{g})$	189

$\Delta S^\circ = \sum n_p S_p^\circ - \sum n_r S_r^\circ$
 $= 2S_{\text{Al}(\text{s})}^\circ + 3S_{\text{H}_2\text{O}(\text{g})}^\circ - 3S_{\text{H}_2(\text{g})}^\circ - S_{\text{Al}_2\text{O}_3(\text{s})}^\circ$
 $= 2\text{mol}(28\text{J/K}\cdot\text{mol}) + 3\text{mol}(189\text{J/K}\cdot\text{mol}) - 3\text{mol}(131\text{J/K}\cdot\text{mol}) - 1\text{mol}(51\text{J/K}\cdot\text{mol})$

2.0

Q.4 Calculate standard free-energy changes ΔG° for the following reaction
 $\text{S}(\text{s}) + \text{O}_2(\text{g}) \rightarrow \text{SO}_2(\text{g})$

Given the following data.



$\Delta G^\circ = -1/2(-142\text{kJ})$



$\Delta G^\circ = -371\text{kJ}$



$\Delta G^\circ = +71\text{kJ} - 371\text{kJ}$

$\Delta G^\circ = -300\text{kJ}$