CONCEPT: ENTROPY CALCULATIONS

Entropy of the Universe

● The _____ Entropy change in the universe, and is represented by the formula:

Total Entropy Formula

$$\Delta S_{Total} = \Delta S_____ + \Delta S_____$$

● units of ΔS in _____

$\Delta S_{tot} = $ ____, Rxn:_____

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EXAMPLE: Calculate the total entropy change for a reaction with $\Delta S_{surr} = 2.7$ J/K and $\Delta S°_{rxn} = -450.0$ kJ/K.

Is this reaction spontaneous?

Entropy of the Surroundings

● We can also calculate the ΔS_{surr} if we know the _____ at which the reaction is taking place

□ Conditions: constant _____ and _____

Entropy of Surroundings Formula

$$\Delta S_{surr} = \frac{-\Delta H_{rxn}}{T}$$

● ΔH_{rxn}= Enthalpy of reaction in _____

● T = Temperature in _____

EXAMPLE: Determine change in entropy of the universe for the following reaction at 32ºC.

$$2 A (g) + 5 B (s) \longrightarrow AB (g) + 2 C (g) \quad \Delta H_{rxn} = -140 \text{ kJ}, \Delta S_{rxn} = 3.6 \text{ J/K}$$
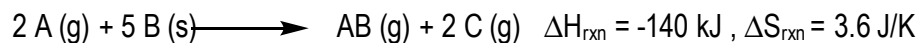
<u>**CONCEPT:**</u> ENTROPY CALCULATIONS

Entropy of the System

● Each substance has a standard _____ _____ ($S°$) associated with it.

  □ These values will always be provided.

  □ Unlike standard molar _____ for substances in natural state, $S°$ does not equal to _____.
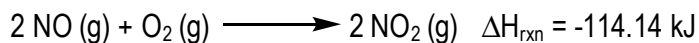

Entropy of Reaction Formula

$\Delta S°_{rxn} = [\ \sum nS° (\ _____\ ) - \sum nS° (\ _____\ )\ ]$

● $\Delta S°_{rxn}$ = Standard Entropy of reaction in _____
● $\sum$ = sigma or sum of
● n = _____ of substance
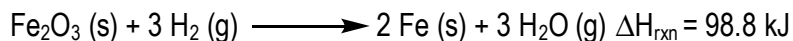● $S°$ = Standard molar Entropy of substance in _____

  - Standard conditions: _____ and _____ pressure

EXAMPLE: Calculate $\Delta S°_{rxn}$ for the following reaction at 25ºC.

  2 NO (g) + O_2 (g) ⟶ 2 NO_2 (g) ΔH_{rxn} = -114.14 kJ

Substance	S° (J/mol•K)
NO (g)	210.8
O_2 (g)	205.2
NO_2 (g)	240.1

PRACTICE: For the following reaction at 27ºC, calculate $\Delta S°_{rxn}$, ΔS_{surr}, and ΔS_{tot}. Determine if reaction is favorable.

  Fe_2O_3 (s) + 3 H_2 (g) ⟶ 2 Fe (s) + 3 H_2O (g) ΔH_{rxn} = 98.8 kJ

Substance	S° (J/mol•K)
Fe_2O_3 (s)	87.4
H_2 (g)	130.7
Fe (s)	27.3
H_2O (g)	188.8