Assignment for the course on Chemical and Biological thermodynamics: Principles to applications

Assignments for WEEK-3

Assignment 1

A spontaneous process occur in the direction of

(A) more disorder

(B) less disorder

(C) increase in internal energy

(D) increase in temperature

Assignment 2

n_1 moles of an ideal gas A initially at pressure p_1 and volume V_1 are mixed isothermally with n_2 moles of another ideal gas B initially at pressure p_2 and volume V_2 (final pressure of the mixture = p_T). Derive an expression for the entropy change of mixing

Answer options:

(A) $\Delta S = -n_1 R \ln \frac{x_1 p_T}{p_1} - n_2 R \ln \frac{x_2 p_T}{p_2}$

(B) $\Delta S = -n_1 R \ln \frac{x_1 p_1}{p_T} - n_2 R \ln \frac{x_2 p_2}{p_T}$

(C) $\Delta S = n_1 R \ln \frac{x_1 p_T}{p_1} + n_2 R \ln \frac{x_2 p_T}{p_2}$

(D) $\Delta S = -n_1 R \ln \frac{p_T}{p_1} - n_2 R \ln \frac{p_T}{p_2}$

Assignment 3

Calculate the entropy change involved in an isothermal reversible expansion of 5 moles of an ideal gas from 10 litres to 100 litres at 300 K.

Answer options:

(A) 96 J K^{-1}

(B) 48 J K^{-1}

(C) 24 J K^{-1}

(D) 192 J K^{-1}

Assignment 4

Calculate ΔS for the isobaric heating of 1 mole of nitrogen from 300^{o} to 1000^{o} K.

$C_p = (6.45 + 1.4 \times 10^{-3} T)$ cal K^{-1} mol^{-1}

Answer options:

(A) 10.5 cal K-^{1}

(B) 8.75 cal K-^{1}

(C) 5.25 cal K-^{1}

(D) 100.5 cal K-^{1}

Assignment 5

Calculate ΔS for the process

1 mole water (l, 20°C, 1 atm) ----> 1 mole water (g, 250°C, 1 atm)

C_p, $H_2O(1)$ = 75.3 J K^{-1} mol^{-1} ; C_p, $H_2O(g)$ = 36.0 J K^{-1} mol^{-1}

$\Delta_{vap}H$ (H_2O) at 100°C and 1 atm = 40.688 kJ mol^{-1}

Answer options

(A) 240 J K^{-1} mol^{-1}

(B) 439 J K^{-1} mol^{-1}

(C) 390 J K^{-1} mol^{-1}

(D) 139 J K^{-1} mol^{-1}

Assignment 6

A block of copper (500 g) initially at 20°C is in thermal contact with a electric heater of resistance 1000 Ω and negligible mass. An electric current of 1 amp is passed for 15 sec. What is the entropy change of copper? (For copper, $C_{p,m}$ = 24.4 JK^{-1} mol^{-1}).

Answer options:

(A) 90 J K^{-1}

(B) 45 J K^{-1}

(C) 80 J K^{-1}

(D) 200 J K^{-1}

Assignment 7

Criterion of spontaneity in terms of change in Helmholtz Free Energy is that the value should be negative at

(A) constant T and p

(B) constant T and V

(C) constant T and S

(D) constant p and T

Assignment 8

Choose correct statement(s) about the variation of Gibbs energy of a substance with pressure at constant temperature

Answer options:

(A) Slope will be highest for the substance when it is in its solid state because its entropy is less

(B) Slope will be highest for the substance when it is in its liquid state because its volume is small

(C) Slope will be highest for the substance when it is in its gaseous state because its volume is high

(D) Slope will be highest for the substance when it is in its solid state because its volume is less

Assignment 9

A system can do work more than the change in its internal energy when

(A) entropy change in the system is positive

(B) entropy change in the system is positive

(C) entropy change in the system is positive

(D) entropy change in the system is zero

Assignment 10

The correct statement about entropy change is

(A) The total entropy change for system and surroundings for an isothermal reversible process is always positive

(B) The total entropy change for system and surrounding for an adiabatic reversible process is always zero

(C) The total entropy change for system and surroundings for an isothermal irreversible process is always zero

(D) The total entropy change for system and surroundings for an adiabatic irreversible process is always zero