BSK1133 PHYSICAL CHEMISTRY

PRACTICE 7

PREPARED BY:
DR. YUEN MEI LIAN AND DR. SITI NOOR HIDAYAH MUSTAPHA
Faculty of Industrial Sciences & Technology
yuenm@ump.edu.my and snhidayah@ump.edu.my

1. Define entropy (S) and Gibbs free-energy (G).

2. Choose the correct answer of the entropy of a system change for the following processes.
   (Circle your answer)

i. A solid melts	Increase / Decrease
ii. Liquid boils	Increase / Decrease
iii. Solid sublimes	Increase / Decrease
iv. Urea dissolves in water	Increase / Decrease
v. Liquid freezes	Increase / Decrease

3. Calculate the ΔS°_{rxn} for the following reaction at 25 °C.

   $2Al\ (s) + 3ZnO\ (s) \rightarrow Al_2O_3\ (s) + 3Zn\ (s)$

   (Given: S° Al (s) = 28.3 J/K·mol, S° ZnO (s) = 43.9 J/K·mol, S° Al_2O_3 (s) = 50.99 J/K·mol and S° Zn (s) = 41.6 J/K·mol)

4. Calculate ΔG°_{rxn} for the following reactions at 25°C.

$2C_2H_2\ (g) + 5O_2\ (g) \longrightarrow 4CO_2\ (g) + 2H_2O\ (l)$

(Given: $\Delta G^{\circ}_f C_2H_2\ (g) = 209.2$ kJ/mol, $\Delta G^{\circ}_f O_2\ (g) = 0$, $\Delta G^{\circ}_f CO_2\ (g) = -394.4$ kJ/mol and $\Delta G^{\circ}_f H_2O\ (l) = -237.2$ kJ/mol)

5. The molar heats of fusion and vaporization of gas X are 1.8 kJ/mol and 6.9 kJ/mol, respectively. Meanwhile, gas X melting point and boiling point are -180 °C and -176 °C, respectively. Calculate

(i) ΔS_{fusion}

(ii) $\Delta S_{vaporization}$

ANSWERS:

1. Entropy (S) is measurement of dispersion energy of a system. Gibbs free-energy (G) is free energy in a system to do work.

2. i., ii, iii, iv Increase v. Decrease

3. $\Delta S^{\circ}_{rxn} = -12.5$ J/K·mol

4. $\Delta G^{\circ}_{rxn} = -2470$ kJ/mol

5. i. $\Delta S_{fusion} = \frac{\Delta H_{fus}}{T_f} = \frac{\left(1.8\frac{kJ}{mol}\right) \times 1000J/1kJ}{(-180 + 273.15)K} = 19.3237 \text{ J K}^{-1} \text{ mol}^{-1}$

ii. $\Delta S_{vaporization} = \frac{\Delta H_{vap}}{T_{bp}} = \frac{\left(6.9\frac{kJ}{mol}\right) \times 1000J/1kJ}{(-176 + 273.15)K} = 71.0242 \text{ J K}^{-1} \text{ mol}^{-1}$

AUTHOR INFORMATION

DR. YUEN MEI LIAN (SENIOR LECTURER)

INDUSTRIAL CHEMISTRY PROGRAMME
FACULTY OF INDUSTRIAL SCIENCES & TECHNOLOGY
UNIVERSITI MALAYSIA PAHANG
yuenm@ump.edu.my
Tel. No. (Office): +609 549 2764

DR. SITI NOOR HIDAYAH MUSTAPHA (SENIOR LECTURER)

INDUSTRIAL CHEMISTRY PROGRAMME
FACULTY OF INDUSTRIAL SCIENCES & TECHNOLOGY
UNIVERSITI MALAYSIA PAHANG
snhidayah@ump.edu.my
Tel. No. (Office): +609 549 2094