逢甲大學100學年度碩士班招生考試試題 編號：011 科目代碼：204

科 目	化學反應工程及化工熱力學	適用系所	化學工程學系	時間	100 分鐘

※請務必在答案卷作答區內作答。

1. (20%) Derive a rate equation for a catalytic reaction: $A \rightarrow B$.
The suggested reaction mechanism is described as follows: Assume the Langmuir-Hinshelwood Model is applied.

$A + S \xleftrightarrow{K_A} AS$

$AS \xrightarrow{ks} B$ (Rate determining step)

Where K_A are equilibrium constant of adsorption and desorption steps. k_s is the rate constant of surface reaction. S is an active site on the catalyst.

2. (15%) An isothermal and isobaric first order gas reaction (300K, 1atm), $A \rightarrow 3B$, the rate equation – $r_A = 2.0\, C_A$ mol/m^3-hr, if the feedstock consist of 60% A and 40% inert, the volumetric flow rate is 5 m^3/hr, in a 100 m^3 CSTR reactor, what is the conversion X_A ?

3. (15%) A first order irreversible gas reaction $A \rightarrow P$, the reaction rate of temperature 300°C is 300% faster than the temperature of 30°C. How fast is the reaction rate of temperature 150°C than the rate of temperature of 30°C?

4. (30%) In a power plant superheated steam generated at a pressure of 8,000 kPa (T^{sat} = 294.97℃) and a temperature of 500℃ from a boiler is fed to a turbine. Exhaust from the turbine enters a condenser at 20 kPa, where it is condensed to saturated liquid, which can be assumed to be incompressible and then is pumped to the boiler.

(a) What is the thermal efficiency of a Rankine cycle operating at these conditions if both of the turbine and the pump operate isentropically? (20%)

(b) In accordance with (a), please plot a corresponding T-S diagram which shows each operation stage. (10%)

Data given:

Superheated steam at 8,000 kPa and 500℃:

H = 3398.8 kJ/kg; S = 6.7262 kJ/kg·K.

Saturated vapor and water at 20 kPa (T = 60.09℃)

H^V = 2609.9 kJ/kg; S^V = 7.9094 kJ/kg·K; V^V = 7649.8 cm^3/g.

H^L = 251.453 kJ/kg; S^L = 0.8321 kJ/kg·K; V^L = 1.017 cm^3/g.

5. (20%) A well-insulated vessel is divided into two compartments by a partition. The volume of each compartment is 0.1 m^3. One compartment initially contains 400 moles of argon (Ar) at 20℃ (293.15 K), and the other compartment is initial evacuated. The partition is then removed, and the gas is allowed to equilibrate. What is the final temperature in degree of Kelvin? Note that under these conditions argon is not an ideal gas and you may assume that the van der Waal equation is valid:

$$(P+\frac{a}{V^2})(V-b)=RT$$

where a = 0.1362 J m^3/mol^2 and b = $3.215^{x}10^{-5}$ m^3/mol. Assume that C_v = 12.56 J/mol·K, independent of temperature and the mass of the walls can be neglected.