淡江大學九十四學年度碩士班招生考試試題 94-1

系別：化學工程與材料工程學系　科目：化工熱力學 50%

准帶項目請打「V」	
V	簡單型計算機

本試題共 1 頁

1. A reversible cyclic device does work, while exchanging heat with three constant temperature reservoirs. The three reservoirs 1, 2, and 3 are at temperatures of 1,000K, 300K, and 500K, respectively. It is known that 400 kJ of heat are transferred from reservoir 1 to the device, and the total work done by the cyclic device is 100 kJ. Determine the magnitude an direction of the heat transfer with the other two reservoirs. (10%)

2. A reversible and isothermal compressor is used to continuously compress helium initially at 540°R and 12 atm, to a final pressure of 180 atm. Calculate the work per mole of helium to be removed from the compressor if helium is assumed to behave as an ideal gas. (20%)

3. A certain steel containing 0.7 weight-percent carbon is in equilibrium with a methane-hydrogen gas mixture containing 99% hydrogen and 1% methane by volume at 1,173K and 1atm. Fing the activity of carbon in the steel and the equilibrium volume percentages of a carbon monoxide-carbon dioxide mixture at equilibrium with the steel at the same conditions. Use the following data to solve the problem and assume all gases are ideal. (20%)

Data:

$C_{(s,\ graphite)} + 2\ H_{2(g)} \Leftrightarrow CH_{4(g)} \qquad \Delta G^o = -21{,}600 + 26.2\ T \quad cal$

$CO_{2(g)} + C_{(s,\ graphite)} \Leftrightarrow 2\ CO_{(g)} \qquad \Delta G^o = 40{,}800 - 41.7\ T \quad cal$

本試題雙面印製

◀注意背面尚有試題▶

淡江大學九十四學年度碩士班招生考試試題 94-2

系別：化學工程與材料工程學系　科目：化學反應工程 50%

准帶項目請打「V」	
V	簡單型計算機

本試題共 1 頁

本試題雙面印製

1. A liquid-phase reaction $A + B \rightarrow C + D$ follows an elementary rate law and is carried out isothermally in a flow system. The feed stream contains A and B and the molar feed rate of B is five times that of A. The concentration of A in the feed stream is 0.2 lbmol/ft^3 The specific reaction rate is 12 ft^3/lbmol · h. There is a 134-ft^3 CSTR available.

(a) Determine the exit conversion of the available reactor if you were to produce 20 lbmol/h of C. (10%)

(b) What CSTR volume would be necessary to achieve a conversion of 85% for a molar feed rate of A of 60 lbmol/h? (10%)

(c) Compare your results for part (b) with those of the PFR necessary to achieve 85% conversion. (10%)

2. A catalytic reaction mechanism of $A + B \rightarrow C + D$ is believed to be

$$A + S \leftrightarrow A \cdot S$$
$$B + S \leftrightarrow B \cdot S$$
$$A \cdot S + B \cdot S \rightarrow C \cdot S + D \cdot S$$
$$C \cdot S \leftrightarrow C + S$$
$$D \cdot S \leftrightarrow D + S$$

where S represents the active site on the catalyst surface.

Derive a rate law assuming:

(a) The adsorption of B is rate-limiting. (10%)

(b) The surface reaction is rate-limiting. (10%)