

# 國立臺北科技大學 100 學年度碩士班招生考試

系所組別：3510 化學工程研究所甲組

第二節 化工熱力學與反應工程 試題

第一頁 共一頁

## 注意事項：

1. 本試題共八題，配分共 100 分。
2. 請標明大題、子題編號作答，不必抄題。
3. 全部答案均須在答案卷之答案欄內作答，否則不予計分。

### Chemical Reaction Engineering:

- 一、Terms definition: (a) elementary reaction (b) molecularity (c) space-velocity (d) fractional life (e) residence time distribution (15%)
- 二、There are two methods, integral method and differential method, for the analysis of chemical reaction data. Describe the general procedures for the methods. (10%)
- 三、When material is to be processed to some fixed final conversion in a recycle reactor, reflection suggests that there must be a particular recycle ratio which is optimum in that it minimizes the reactor volume or space-time. If the relationship between reaction rate and conversion is known. Please describe how to get the recycle ratio. (10%)
- 四、Please derive the performance equation for second order kinetics with varied volume in a plug flow reactor. (10%)
- 五、Please give a graphical procedure for finding compositions in a series of three mixed flow reactors. (5%)

### Chemical Engineering Thermodynamics:

- 六、A ideal gas mixture of 8 g hydrogen, 28g nitrogen, and 64g oxygen fill a constant volume container at 25 °C. A spark is passed through the mixture, oxygen and hydrogen combined to give water, and the container gets hot. How much heat must be removed to bring the container back to 25 °C, at which temperature all the water condenses? The volume of the formed liquid water is negligible. The standard heats of combustion is  
$$\text{H}_{2(g)} + 1/2\text{O}_{2(g)} \rightarrow \text{H}_2\text{O}_{(l)} \dots \Delta H_c = -285840\text{J} \quad (10\%)$$
- 七、Theory has it that Earth's atmosphere in the carboniferous period was at a much higher pressure than it is today, and that it consisted primarily of CO<sub>2</sub>. Plants loved it, gorged themselves on the CO<sub>2</sub>, grew profusely worldwide, died, and thereby produced the vast

coal deposits that we see today.

We are running an experiment today to check this theory by growing plants in a perfectly insulated high pressure vessel containing 1 m<sup>3</sup> of 96% CO<sub>2</sub> and 4% O<sub>2</sub> at 5 bar and 27 °C. To clean the unit we want to lower the pressure to 1 bar by opening the valve. But this would cool the gas (adiabatic reversible expansion). To counter this we switch on a 150W light when we let the gas out. A controller adjusts the flow rate of gas so as to keep the temperature unchanged.

- (a) To keep the vessel at 27 °C what should be the flow rate of gas from the vessel?(15%)
- (b) How long would it take us to lower the pressure from 5 bar to 1 bar? (10%)

- 八、A large unused exhibition hall (50m × 40m × 10m) is to be prepared for a show and has to be heated from 0 to 27 °C. How many 1.5 kW portable heaters operating for 24 hours would be needed for this job? Note: The pressure stays at 1 bar during the heating process, air leaks out of the hall, so the amount of air that needs to be heated changes with time. Only account for the heating of air, not walls, fixtures, and furniture and suppose the air is ideal gas. (15%)