

系別：化學工程與材料工程學系三年級 科目：質能均衡

可否使用計算機			
可	<input checked="" type="checkbox"/>	否	<input type="checkbox"/>

本試題共 12 大題，二頁

本試題雙面印製

1. (25%)

The following dimensionless equation correlates the values of variables in a system in which solid particles are suspended in a flowing gas.

$$\frac{k_g d_p y}{D} = 2.00 + 0.600(\mu / \rho D)^{1/3} (d_p v \rho / \mu)^{1/2}$$

Both $(\mu / \rho D)$ and $(d_p v \rho / \mu)$ are dimensionless groups. k_g is a coefficient that expresses the rate at which a particular species transfers from the gas to the solid particles.

The values of k_g is needed to design a catalytic reactor. Since this coefficient is difficult to determine directly, values of other variables are measured or estimated, and k_g is calculated from the given correlation. The variable values are as follows:

$$d_p = 5.00 \text{ mm}$$

$$y = 0.100 \text{ (dimensionless)}$$

$$D = 0.100 \text{ cm}^2 / \text{s}$$

$$\mu = 1.00 \times 10^{-3} \text{ N} \cdot \text{s} / \text{m}^2$$

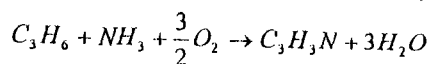
$$\rho = 1.00 \times 10^{-3} \text{ g} / \text{cm}^3$$

$$v = 10.0 \text{ m} / \text{s}$$

What is the estimated value of k_g ? (Show units)

2. (25%)

Acrylonitrile is produced in the reaction of propylene, ammonia, and oxygen:



The feed contains 12.0 mol% propylene, 15.0 mol% ammonia, and 73.0 mol% air. A fractional conversion of 40.0% of the limiting reactant is achieved. Taking 100 mol of feed as a basis, determine which reactant is limiting, the percentage by which each of the other reactants is in excess, and the molar amounts of all product gas constituents for a 40% conversion of the limiting reactant.

3. (25%)

Methane is burned with air in a continuous steady-state combustion reactor to yield a mixture of carbon monoxide, carbon dioxide, and water. The reactions taking place are



The feed to the reactor contains 8.20 mol% CH_4 , 19.30 mol% O_2 , and 72.50 mol% N_2 . The percentage conversion of methane is 90.0%, and the gas leaving the reactor contains 8 mol CO_2 / mol CO . Carry out a degree-of-freedom analysis on the process. Then calculate the molar composition of the product stream.

淡江大學 97 學年度轉學生招生考試試題

系別：化學工程與材料工程學系三年級 科目：質能均衡

可否使用計算機	
可	否

本試題共 四 大題，二 頁

4. (25%)

Fresh air containing 5.00 mol% water vapor is to be cooled and dehumidified to a water content of 2.50 mol% H_2O . A stream of fresh air is combined with a recycle stream of previously dehumidified air and passed through the cooler. The blended stream entering the unit contains 3.00 mol% H_2O . In the air conditioner, some of the water in the feed stream is condensed and removed as liquid. A fraction of the dehumidified air leaving the cooler is recycled and the remainder is delivered to a room. Taking 100 mol of dehumidified air delivered to the room as a basis of calculation, calculate the moles of fresh feed, moles of water condensed, and moles of dehumidified air recycled.

