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淡江大學 103 學年度日間部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

考試日期：7 月 20 日(星期日) 第 5 節　　本試題共 4 大題， 2 頁

本試題雙面印刷

1. Using dimensional equations, convert
   (a) 3 weeks to milliseconds. **(5%)**
   (b) 38.1 ft/s to miles/h. **(5%)**
   (c) 554 $m^4/(day \cdot kg)$ to $cm^4/(min \cdot g)$. **(5%)**
   (d) 32 lb_f to N. **(5%)**

2. Ammonia is burned to form nitric oxide in the following reaction:
   $4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$
   (a) Calculate the ratio (lb-mole O_2 react/lb-mole NO formed). **(5%)**
   (b) If ammonia is fed to a continuous reactor at a rate of 100.0 kmol NH_3/h, what oxygen feed rate (kmol/h) would correspond to 40.0% excess O_2? **(5%)**
   (c) If 50.0 kg of ammonia and 100.0 kg of oxygen are fed to a batch reactor, determine the limiting reactant **(5%)**, the percentage by which the other reactant is in excess **(5%)**, and the extent of reaction (mol) **(5%)** and mass of NO produced (kg) if the reaction proceeds to completion **(5%)**.

3. The **Reynolds number** is a dimensionless group defined for a fluid flowing in a pipe as $\boldsymbol{Re = Du\rho/\mu}$ where D is pipe diameter, u is fluid velocity, ρ is fluid density, and μ is fluid viscosity. When the value of the Reynolds number is less than about 2100, the flow is *laminar*—that is, the fluid flows in smooth streamlines. For Reynolds numbers above 2100, the flow is *turbulent*, characterized by a great deal of agitation.
   Liquid methyl ethyl ketone (MEK) flows through a pipe with an inner diameter of 2.067 inches at an average velocity of 0.48 ft/s. At the fluid temperature of 20℃ the density of liquid MEK is 0.805 g/cm^3 and the viscosity is 0.43 centipoise [1 centipoise = 1 cP = 1.00×10^{-3} $kg/(m \cdot s)$]. Determine whether the flow is laminar or turbulent. Show your calculations. **(25%)**

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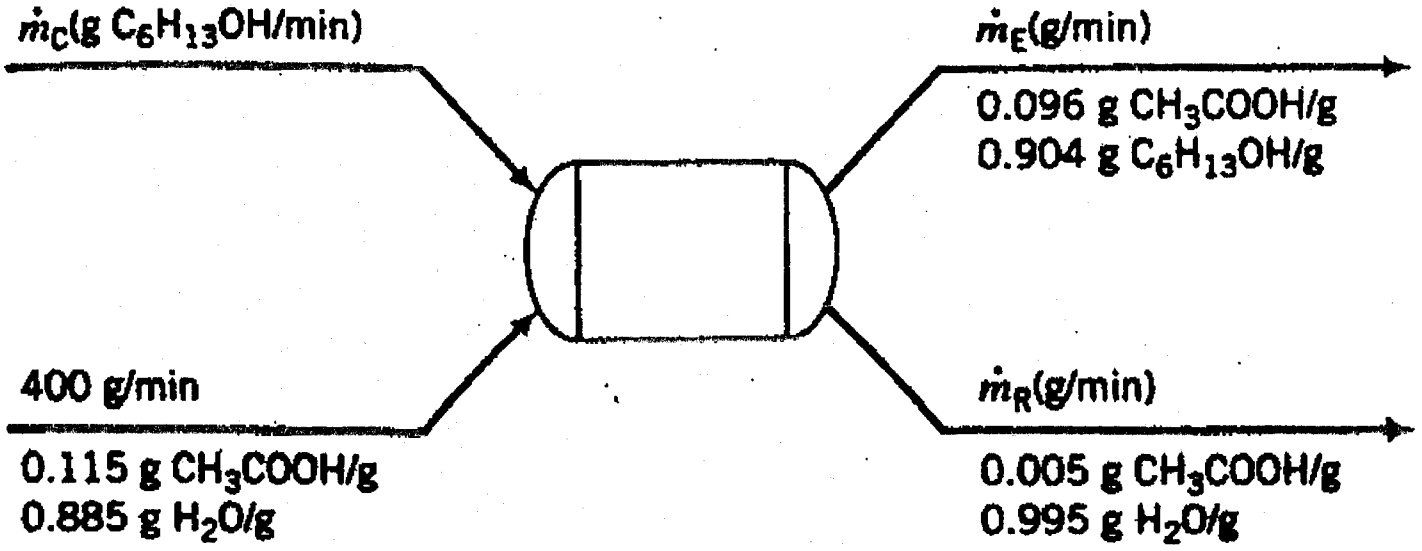
4. *Liquid extraction* is an operation used to separate the components of a liquid mixture of two or more species. In the simplest case, the mixture contains two components: a solute (A) and a liquid solvent (B). The mixture is contacted in an agitated vessel with a second liquid solvent (C) that has two key properties: A dissolves in it, and B is immiscible or nearly immiscible with it. (For example, B may be water, C a hydrocarbon oil, and A a species that dissolves in both water and oil.) Some of the A transfers from B to C, and then the B-rich phase (the raffinate) and the C-rich phase (the extract) separate from each other in a settling tank. If the raffinate is then contacted with fresh C in another stage, more A will be transferred from it. This process can be repeated until essentially all of the A has been extracted from the B.

Shown below is flowchart of a process in which acetic acid (A) is extracted from a mixture of acetic acid and water (B) into 1-hexanol (C), a liquid immiscible with water.



Calculate $\dot{m}_C$, $\dot{m}_E$, and $\dot{m}_R$, using the given mixture feed rate as a basis and writing balances in an order such that you never have an equation that involves more than one unknown variable. **(25%)**