

# 淡江大學 105 學年度日間部寒假轉學生招生考試試題

15-1

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：12月3日(星期六) 第1節

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1. According to Archimedes' principle the mass of a floating object equals the mass of the fluid displaced by the object.
  - (a) A wooden cylinder 30.0 cm high floats vertically in a tub of water (density = 1.00 g/cm<sup>3</sup>). The top of the cylinder is 14.1 cm above the surface of the liquid. What is the density of the wood? (10 pt)
  - (b) The same cylinder floats vertically in a liquid of unknown density. The top of the cylinder is 20.7 cm above the surface of the liquid. What is the liquid density? (10 pt)
2. Liquid benzene and liquid *n*-hexane are blended to form a stream flowing at a rate of 700 lb<sub>m</sub>/h. An on-line *densitometer* (an instrument used to determine density) indicates that the stream has a density of 0.850 g/mL. The specific gravities of benzene and *n*-hexane are 0.879 and 0.659, respectively. Please estimate the mass and volumetric feed rates of the two hydrocarbons to the mixing vessel. (20 pt)
3. Water enters a 2.00-m<sup>3</sup> tank at a rate of 6.00 kg/s and is withdrawn at a rate of 3.00 kg/s. The tank is initially half full.
  - (a) Is the process continuous, batch or semibatch? Is it transient or steady state? (10 pt)
  - (b) How long will the tank take to overflow? (10 pt)
4. Ammonia is burned to form nitric oxide in the following reaction:
$$4\text{NH}_3 + 5\text{O}_2 \rightarrow 4\text{NO} + 6\text{H}_2\text{O}$$
  - (a) Calculate the ratio (lb-mole O<sub>2</sub> react/lb-mole NO formed). (10 pt)
  - (b) If ammonia is fed to a continuous reactor at a rate of 100.0 kmol NH<sub>3</sub>/h, what oxygen feed rate (kmol/h) would correspond to 40.0% excess O<sub>2</sub>? (10 pt)
  - (c) If 50.0 kg of ammonia and 100.0 kg of oxygen are fed to a batch reactor, determine the limiting reactant, the percentage by which the other reactant is in excess, and the extent of reaction (mol) and mass of NO produced (kg) if the proceeds to complete. (20 pt)