

# 淡江大學八十七學年度日間部轉學生入學考試試題

系別：化學工程學系三年級

科目：質能均衡

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1. The following equation is dimensionally inconsistent in the units specified. Insert appropriate dimensional conversion factors: [20 pts]

$$W = CA \sqrt{\frac{2\rho - (-\Delta P)}{1 - \left(\frac{D_2}{D_1}\right)^4}}$$

$W$  = flow rate,  $\text{lb}_m/\text{s}$

$A$  = area,  $\text{ft}^2$

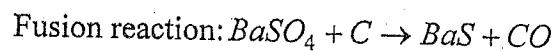
$\rho$  = density,  $\text{lb}_m/\text{ft}^3$

$-\Delta P$  = pressure loss,  $\text{lb}_f/\text{ft}^2$

$D_1, D_2$  = diameters, ft

$C$  = dimensionless constant.

2. A balloon on the surface of a swimming pool has a volume of  $2 \text{ ft}^3$ . If it is brought down to the bottom of the pool at a depth of 16 ft, what will the volume of the balloon be? (Assume temperature remains constant.) [20 pts]
3. A baryte composed of 100%  $\text{BaSO}_4$  is fused with carbon in the form of coke containing 6 wt% ash (which is infusible). The composition of the fusion mass is  $\text{BaSO}_4$  11.1 wt%,  $\text{BaS}$  72.8 wt%,  $\text{C}$  13.9 wt%, and ash 2.2 wt%.



Find the excess reactant, the percentage of excess reactant and the fractional conversion. (Molecular weight:  $\text{BaSO}_4$  233.4,  $\text{BaS}$  169.4) [20 pts]

4. Write the simplified energy balances for the following changes:
- (a) A fluid is allowed to flow through slightly opened valve from a region where its pressure is 15 atm and 628 K to a region where its pressure is 3 atm, the whole operation being adiabatic. [10 pts]
- (b) 1  $\text{lb}_m$  of gas at 100 psia and 370 °F, enclosed in a cylinder fitted with a movable frictionless piston, is kept at a constant volume until the temperature has fallen to 250 °F. [10 pts]
5. One thousand kilograms per hour of benzene and toluene that contains 50% benzene by mass are separated by distillation into two fractions. The mass flow rate of benzene in the top stream is 450 kg/hr, and that of toluene in the bottom stream is 475 kg/hr. The operation is at steady state. Calculate the unknown component flow rates in the output streams. [20 pts]