

國立臺北科技大學

九十二學年度生物科技研究所入學考試

反應工程試題

填准考證號碼

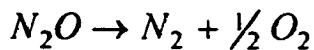
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注意事項：

1. 本試題共【6】題，配分共100分；第1題為10分，第2~6題每題為18分。
2. 請按順序標明題號作答，不必抄題。
3. 全部答案均須答在答案卷之答案欄內，否則不予計分。

1. Experiment shows that the primary reaction in the homogeneous decomposition of nitrous oxide proceeds with stoichiometry



and rate

$$-r_{N_2O} = \frac{k_1 [N_2O]^2}{1 + k_2 [N_2O]}, \quad \text{mol/L}\cdot\text{min}$$

where

$$k_1 = 10^{19.39} e^{-81800/RT}$$

$$k_2 = 10^{8.69} e^{-28400/RT}$$

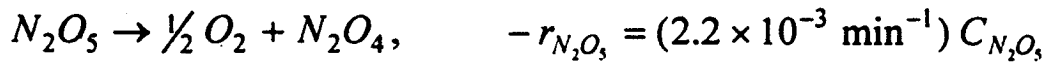
What is the activation energy for this reaction ?

2. The aqueous reaction $A \rightarrow R + S$ proceeds as follows,

Time, min	0	36	65	100	160	∞
C_A , mol/L	0.1823	0.1453	0.1216	0.1025	0.0795	0.0494

with $C_{A0} = 0.1823$ mol/L, $C_{R0} = 0$, $C_{S0} = 55$ mol/L. Find the rate equation for this reaction.

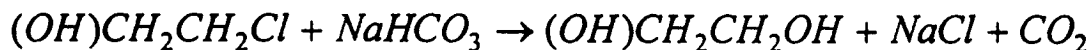
3. Nitrogen pentoxide decomposes as follows:



Find the partial pressures of the contents of a constant-volume bomb after 6 hours if we start with pure N_2O_5 at atmospheric pressure.

4. The homogeneous gas reaction $A \rightarrow 3 R$ follows second-order kinetics. For a feed rate of $5 \text{ m}^3/\text{hr}$ of pure A at 6 atm and 300°C , an experimental reactor consisting of a 2.5 cm ID pipe 2 m long gives 60% conversion of feed. A commercial plant is to treat $360 \text{ m}^3/\text{hr}$ of feed consisting of 50% A, 50% inerts at 30 atm and 300°C to obtain 80% conversion. Assume plug flow in the pipe, negligible pressure drop, and ideal gas behavior. How many 2-m lengths of 2.5 cm ID pipe are required ?

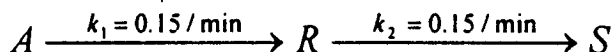
5. It has been reported that the reaction



is elementary with rate constant $k = 5.2 \text{ L/mol}\cdot\text{hr}$ at 82°C . On the basis of this information we wish to construct a pilot plant to determine the economic feasibility of producing ethylene glycol from two available feeds, a 12 wt% aqueous solution of sodium bicarbonate and a 25 wt% aqueous solution of ethylene chlorhydrin. Assume all operations at 82°C , at which temperature the specific gravity of the mixed reacting fluid is 1.02.

- What volume of tubular (plug flow) reactor will produce 15 kg/hr ethylene glycol at 95% conversion of an equimolar feed produced by intimately mixing appropriate quantities of the two feed streams.
- What size CSTR is needed for the same feed, conversion, and production rate as in part (a) ?

6. Under appropriate conditions A decomposes as follows:



R is to be produced from 900 L/hr of feed in which $C_{A0} = 1 \text{ mol/L}$, $C_{R0} = C_{S0} = 0$.

- What size plug flow reactor will maximize the yield of R, and what is the concentration of R in the effluent stream from this reactor ?
- What size CSTR will maximize the yield of R, and what is $C_{R,\text{max}}$ in the effluent stream from this reactor ?