

國立高雄大學 109 學年度研究所碩士班招生考試試題

科目：化工動力學

系所：化學工程及材料工程學系

考試時間：100 分鐘

(無組別)

是否使用計算機：是

本科原始成績：100 分

1. **(a)** Please write down the *Arrhenius* equation, and explain physical meaning of each term. **(10 points)** **(b)** Why is there an activation energy? **(5 points)**
2. Please use Levenspiel plots for adiabatic reactors in series to discuss the sequence of the reactors (e.g. 2 CSTRs, 2 PFRs, 1 CSTR + 1 PFR, or ...) to give the highest overall conversion? **(10 points)**
3. A mixture of 28 mol% sulfur dioxide and 72 mol% air is charged to a flow reactor in which sulfur dioxide is oxidized to produce sulfur trioxide. Please

 - (a) construct the stoichiometric table for this reaction **(10 points)**, and
 - (b) find the concentration expression of each component **(5 points)**.
 - (c) What would be the above concentrations when the reaction occurred at 500K with total pressure of 15 atm? **(5 points)**
 - (d) What would be the rate law of this reaction when the rate constant is $0.2 \text{ m}^3/\text{mole}$? **(5 points)**
4. There is a two components reversible reaction $\text{CH}_3\text{COOC}_2\text{H}_5 + \text{C}_4\text{H}_9\text{OH} \rightleftharpoons \text{CH}_3\text{COOC}_4\text{H}_9 + \text{C}_2\text{H}_5\text{OH}$, in which $\text{C}_4\text{H}_9\text{OH}$ is fed to a vat containing $\text{CH}_3\text{COOC}_2\text{H}_5$ initially. This reaction is first order for both reactants. Please

 - (a) find the expression of conversion as a function of time **(10 points)**,
 - (b) the expression of conversion (X_e) at equilibrium **(5 points)**.
5. In the uncompetitive inhibition of enzyme reactions, please **(a)** list the reaction steps in terms of enzyme (E), substrate (S), product (P), inhibitor (I) and reaction rates **(5 points)**, and **(b)** apply the pseudo-steady-state hypothesis (PSSH) to the intermediate (I·E·S) to find the expression of rate law **(5 points)**. Then, **(c)** discuss the difference between no, competitive, uncompetitive and noncompetitive enzyme inhibitions **(5 points)**.

國立高雄大學 109 學年度研究所碩士班招生考試試題

科目：化工動力學
考試時間：100 分鐘

系所：化學工程及材料工程學系
(無組別)
本科原始成績：100 分

是否使用計算機：是

6. For the electrodes preparation of electrochemical biosensors (in **Fig. Q6**), aniline (AN), consisting of a phenyl group attached to an amino group, and *m*-amino-benzenesulfonic acid (MSAN) were dissolved in water at 57 mM (each) to prepare AN:MSAN mole ratio 1:1, and various concentrations (0-0.5 wt%) of 17 β -estradiol (E2, template) were added. Electropolymerization was performed by immersing screen-printed electrodes (4 mm diameter) in the AN:MSAN mixture, with or without template molecules (for 17 β -estradiol- and non-imprinted electrodes, respectively) and with various concentrations of the two dimensional doping materials (e.g. tungsten disulfide, 0-0.5 wt%). Then, a potentiostat, the electronic hardware, was connected to the three electrodes and cyclic potential (-0.6 to 0.6 V vs Ag/AgCl at a scan rate of 0.1 V/s) was applied for 20 cycles. (Ref: doi: [10.1016/j.bios.2019.111901](https://doi.org/10.1016/j.bios.2019.111901)). Please
- translate this question into Chinese (**10 points**), and
 - write down possible electropolymerization reactions to produce the conductive polymers (poly(AN-*co*-MSAN)) (**5 points**).
 - Please also indicate the possible interactions between the template molecule (E2) and the conductive polymers (poly(AN-*co*-MSAN)) (**5 points**).

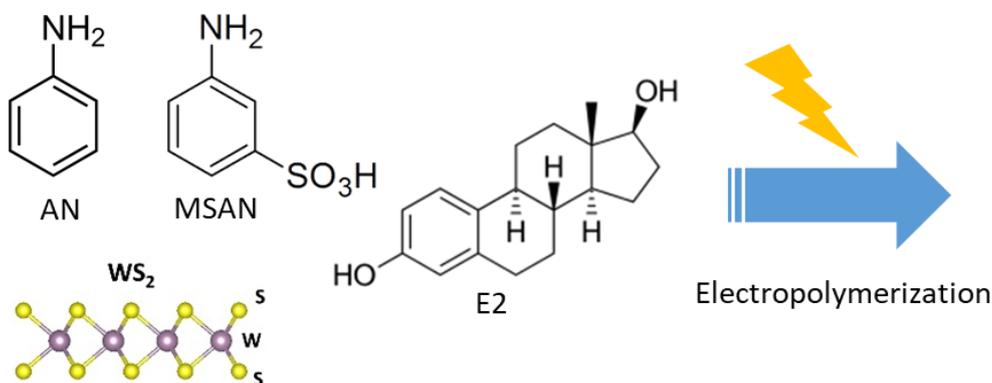


Fig. Q6. Scheme of electrodes preparation for electrochemical biosensors.