

## 國立臺灣科技大學 108 年度產業碩士專班招生(秋)試題

班 別：新穎材料暨分離薄膜

科 目：高分子化學、有機暨物理化學、熱力暨動力學 (三科擇一科目作答)

(總分為 100 分)

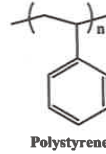
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作答前請詳閱注意事項：

1. 「高分子化學」、「有機暨物理化學」、「熱力暨動力學」三科擇一科目作答。
2. 若作答兩個以上科目，將採計得分最高之科目(其餘科目不予計分)。
3. 作答時請先寫下作答科目之名稱。

**考科：高分子化學**

1. Outline a general method for the synthesis of each of the following polymers by radical polymerization. Show the monomers that you would use. (10%)



2. Please describe that how to prepare the following polymer(10%)



3. Which of the following is a thermoplastic polymer? (10%)
  - (a) Phenolic resin
  - (b) Nylon
  - (c) Melamine formaldehyde
  - (d) Vulcanized rubber
4. When more than one type of monomer is involved in the polymer reaction it is called \_\_\_\_\_.(10%)
  - (a) copolymer
  - (b) homopolymer
  - (c) oligomer
  - (d) macromer
5. The mechanical properties of the synthesized polymers increase with \_\_\_\_\_ in molecular weight. (10%)
  - (a) increase
  - (b) no change
  - (c) decrease
  - (d) slightly decrease
6. Which of the following is an example of amorphous polymer? (10%)
  - (a) Polyethylene
  - (b) Polypropylene
  - (c) Polyethylene glycol
  - (d) Polymethyl methacrylate

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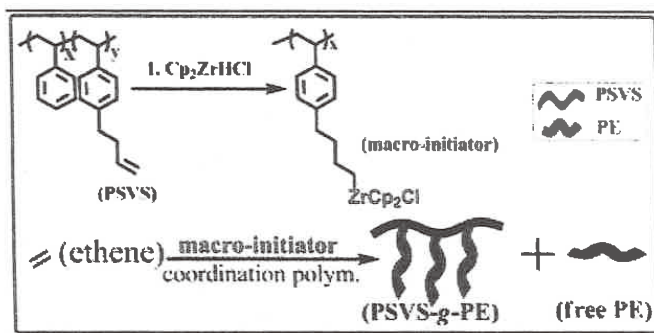
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7. Which of polymerization can be precise control of molecular weight(10%)
- Condensation polymerization
  - Ring opening polymerization
  - Emulsion polymerization
  - Living polymerization
8. Which polymer belong as hydrophilic polymer (10%)
- Polystyrene
  - Polyethylene
  - Polyethylene glycol
  - Polypropylene
9. How to prepare the isotactic polystyrene? Which of the following reagent must be added into reaction? (10%)
- Chain transfer agent
  - Catalyst
  - Inhibitor
  - Dye
10. To characterization of polymers and its structure as shown below, which of following instrument is not able to give information of final products (PSVS-PE)? (10%)



- Nuclear Magnetic Resonance Spectroscopy, (NMR)
- Thermal gravimetric analysis, (TGA)
- Fourier-transform infrared spectroscopy, (FT-IR)
- Gel Permeation Chromatography, (GPC)

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不得使用計算器**考科：有機暨物理化學**

1. Please drive  $P_i V_i^\gamma = P_f V_f^\gamma$  for the adiabatic reversible process, where  $P_i$ ,  $V_i$ ,  $P_f$ , and  $V_f$  represent the pressure and volume in the initial and final state, respectively.  $\gamma = C_{p,m}/C_{v,m}$  for an ideal gas, where  $C_{p,m}$  and  $C_{v,m}$  are molar heat capacity at constant pressure and volume (10 points)

2. An ideal gas undergoes a single-stage expansion against a constant external pressure  $P_{external} = P_f$  at constant temperature from  $T$ ,  $P_i$ ,  $V_i$  to  $T$ ,  $P_f$ ,  $V_f$ .

(a) What is the largest mass  $m$  that can be lifted through the height  $h$  in this expansion? (10 points)

(b) The system is restored to its initial state in a single-stage compression. What is the smallest mass  $m'$  that must fall through the height  $h$  to restore the system to its initial state? (10 points)

3. Please drive

(a)  $\left(\frac{\partial A}{\partial T}\right)_V = -S$  and  $\left(\frac{\partial A}{\partial V}\right)_T = -P$  (10 points)

(b)  $\left(\frac{\partial S}{\partial V}\right)_T = \left(\frac{\partial P}{\partial T}\right)_V$  (10 points).

where  $A$ ,  $S$ ,  $T$ ,  $P$ , and  $V$  are represented Helmholtz energy, entropy, temperature, pressure and volume.

4. Propose structures for compounds that fit the following  $^1\text{H}$  NMR data: (4 points each, 8 points)

(1)  $\text{C}_{10}\text{H}_{14}$

1.30  $\delta$  (9H, singlet)

7.30  $\delta$  (5H, singlet)

(2)  $\text{C}_5\text{H}_{10}\text{O}$

0.95  $\delta$  (6H, doublet,  $J = 7\text{Hz}$ )

2.10  $\delta$  (3H, singlet)

2.43  $\delta$  (1H, multiplet)

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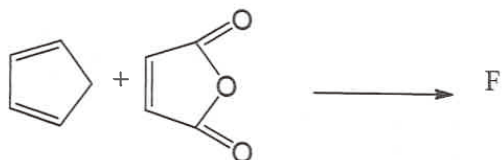
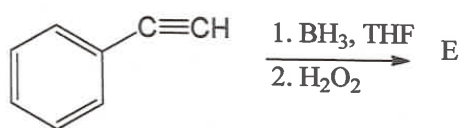
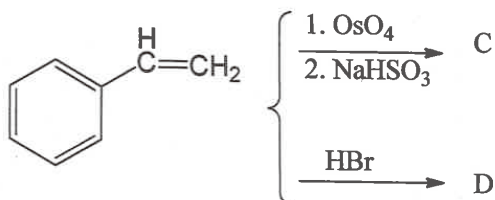
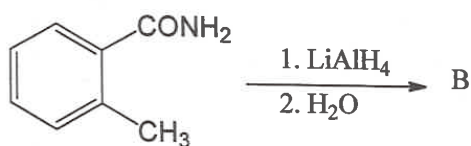
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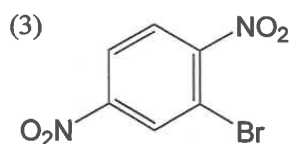
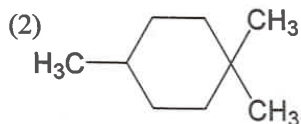
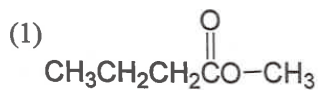
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5. Give the chemical structure of the major products (A to G) of the following reactions.  
(5 points each, 30 points)

2,2,4-Trimethyl-3-hexene + HI  $\longrightarrow$  A



6. Write IUPAC names for the following structures. (4 points each, 12 points)



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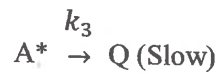
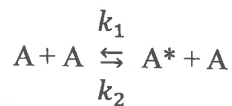
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**考科：熱力暨動力學**

1. (20 points) The reaction  $A \rightarrow Q$  is proceeded by the following steps



Where  $A^*$  is a free radical. Please derive an expression for the rate of product formation.

2. (20 points) The following irreversible-first order series reactions occur in a batch system:



At the initial stage of reaction, the concentration of A is  $C_{A0}$ , and there is no R and S in the reactor. Derive an equation to express the concentration of A as a function of  $C_{A0}$  and reaction time t.

3. (10 points) Please explain the differences between Batch and CSTR reactors.

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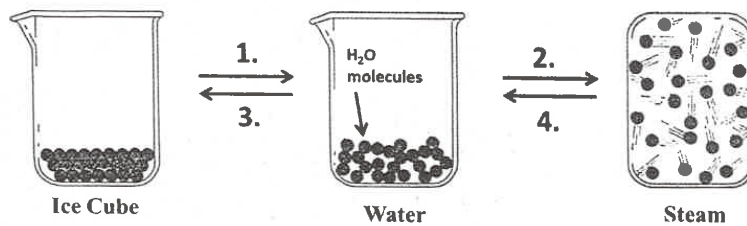
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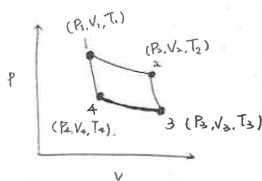
4. (20 points) Please estimate the magnitude of  $\Delta S$  ( $\Delta S >$  or  $< 0$ ) and their corresponding  $\Delta G$  ( $\Delta G >$  or  $< 0$ ) at room temperature condition for Arrow 1, 2, 3, and 4.



5. (10 points) Please define the infinitesimal change in entropy.

6. (20 points) Please answer the following questions about a Carnot cycle of one mole idea gas where the point "1" is the starting point:

(a) (10 points) What are the answers for  $W_{12}$ ,  $\Delta U_{23}$ ,  $\Delta U_{\text{cycle}}$ .



	q	W	$\Delta U$	PVT Relationship
$S_{12}$	$q_{12} ?$	$W_{12} ?$	$\Delta U_{12} ?$	$R_{12} ?$
$S_{23}$	$q_{23} ?$	$W_{23} ?$	$\Delta U_{23} ?$	$R_{23} ?$
$S_{34}$	$q_{34} ?$	$W_{34} ?$	$\Delta U_{34} ?$	$R_{34} ?$
$S_{41}$	$q_{41} ?$	$W_{41} ?$	$\Delta U_{41} ?$	$R_{41} ?$
$S_{\text{cycle}}$	$q_{\text{cycle}} ?$	$W_{\text{cycle}} ?$	$\Delta U_{\text{cycle}} ?$	-----

(b) (10 points) What is the temperature of  $T_{\text{low}}$  reservoir of a process that has an efficiency of 0.44 and a  $T_{\text{high}}$  reservoir at  $150^{\circ}\text{C}$  ?  
(Hint :  $e = 1 - T_{\text{low}}/T_{\text{high}}$ )