

可使用電子計算機

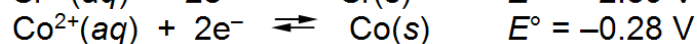
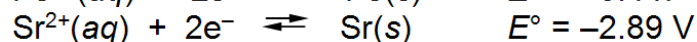
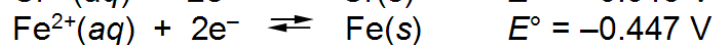
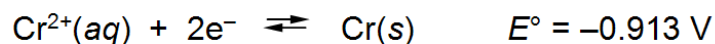
單選題(共 30%)

1. Consider the equilibrium reaction:  $\text{H}_2(\text{g}) + \text{Br}_2(\text{g}) \rightleftharpoons 2\text{HBr}(\text{g})$ . Which of the following correctly describes the relationship between  $K_c$  and  $K_p$  for the reaction?
  - A.  $K_p = K_c$
  - B.  $K_p = (RT)K_c$
  - C.  $K_p = (RT)^2K_c$
  - D.  $K_p = K_c/RT$
2. Which measurement is expressed to 4 significant figures?
  - A. 0.423 kg
  - B. 62.40 g
  - C. 82,306 m
  - D. 1300 K
3. Which of the following has an effect on the magnitude of the equilibrium constant?
  - A. removing products as they are formed
  - B. adding more of a reactant
  - C. change in temperature
  - D. adding a catalyst
4. Select the correct relationship among the concentrations of species present in a 1.0 M aqueous solution of the weak acid represented by HA.
  - A.  $[\text{H}_2\text{O}] > [\text{A}^-] \sim [\text{H}_3\text{O}^+] > [\text{HA}] > [\text{OH}^-]$
  - B.  $[\text{H}_2\text{O}] > [\text{HA}] > [\text{A}^-] > [\text{H}_3\text{O}^+] > [\text{OH}^-]$
  - C.  $[\text{HA}] > [\text{H}_2\text{O}] > [\text{A}^-] > [\text{H}_3\text{O}^+] > [\text{OH}^-]$
  - D.  $[\text{H}_2\text{O}] > [\text{HA}] > [\text{A}^-] \sim [\text{H}_3\text{O}^+] > [\text{OH}^-]$
5. The hydrated  $\text{Al}^{3+}$  ion,  $\text{Al}(\text{H}_2\text{O})_6^{3+}$ , is a weak acid in water. What are the products of its reaction with  $\text{H}_2\text{O}$ ? ( $\text{Al}(\text{H}_2\text{O})_6^{3+}(\text{aq}) + \text{H}_2\text{O}(\text{l}) \rightarrow ?$ )
  - A.  $\text{Al}(\text{H}_2\text{O})_5\text{OH}^{2+}(\text{aq}) + \text{H}_3\text{O}^+(\text{aq})$
  - B.  $\text{Al}(\text{H}_2\text{O})_6\text{H}^{4+}(\text{aq}) + \text{OH}^-(\text{aq})$
  - C.  $\text{Al}(\text{H}_2\text{O})_5^{3+}(\text{aq}) + 2\text{H}_2\text{O}(\text{l})$
  - D.  $\text{Al}(\text{H}_2\text{O})_6\text{OH}^{2+}(\text{aq}) + \text{H}_3\text{O}^+(\text{aq})$
6. When a weak acid is titrated with a strong base, the pH at the equivalence point
  - A. is equal to 7.0.
  - B. is greater than 7.0.
  - C. is less than 7.0.
  - D. is equal to the  $\text{p}K_a$  of the acid.
7. Which of the following aqueous mixtures would be a buffer system?
  - A. HCl, NaCl
  - B.  $\text{HNO}_3$ ,  $\text{NaNO}_3$
  - C.  $\text{H}_3\text{PO}_4$ ,  $\text{H}_2\text{PO}_4^-$
  - D.  $\text{H}_2\text{SO}_4$ ,  $\text{CH}_3\text{COOH}$
8. Calculate  $E^\circ_{\text{cell}}$  for the reaction of nickel(II) ions with cadmium metal at 25°C.  $K = 1.17 \times 10^5$ . ( $\text{Ni}^{2+}(\text{aq}) + \text{Cd}(\text{s}) \rightarrow \text{Cd}^{2+}(\text{aq}) + \text{Ni}(\text{s})$ )
  - A. 0.075 V
  - B. 0.10 V

C. 0.12 V

D. 0.15 V

9. Examine the following half-reactions and select the strongest oxidizing agent among the species listed.



A.  $\text{Cr}^{2+}(\text{aq})$

B.  $\text{Co}^{2+}(\text{aq})$

C.  $\text{Sr}^{2+}(\text{aq})$

D.  $\text{Fe}(\text{s})$

10. The difference between a student's experimental measurement of the density of sodium chloride and the known density of this compound reflects the \_\_\_\_\_ of the student's result.

A. accuracy

B. precision

C. random error

D. systematic error

### 問答及申論題(共 70%)

#### Molecular Mass Spectrometry (20%)

1. How do the spectra for electron-impact, field ionization, and chemical ionization sources differ from one another?
2. What mass differences can just be resolved at  $m$  values of 100, and 500 if the mass spectrometer has a resolution of (a) 500, and (b) 1000?

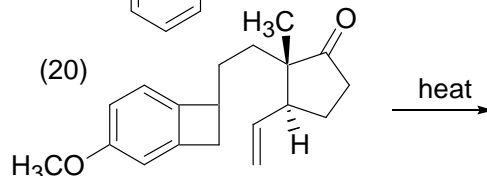
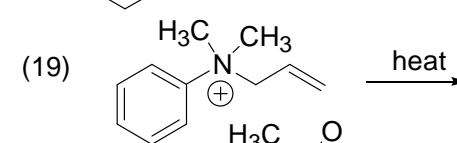
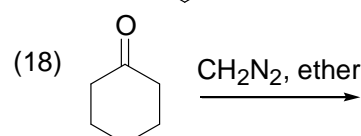
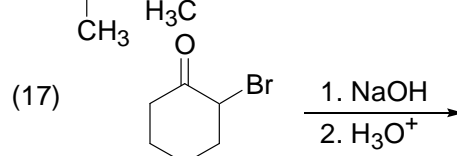
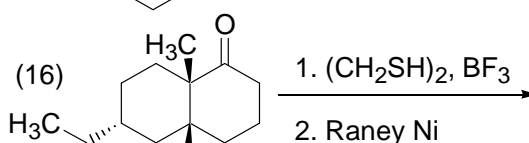
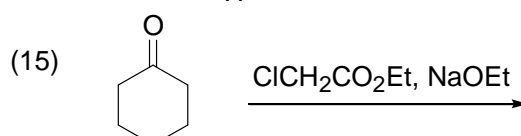
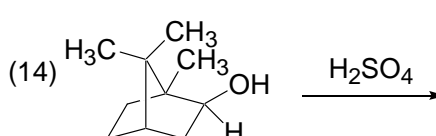
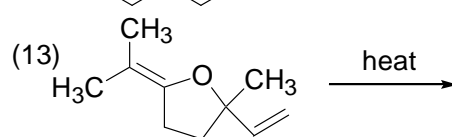
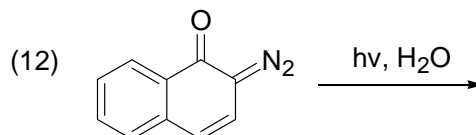
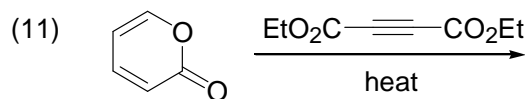
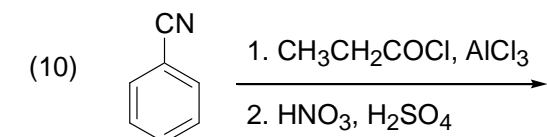
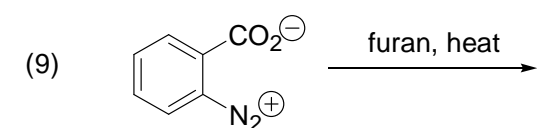
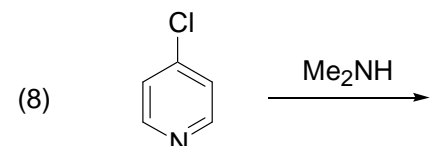
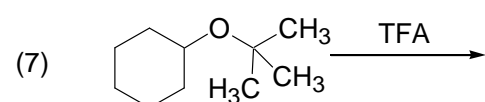
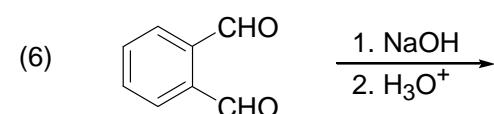
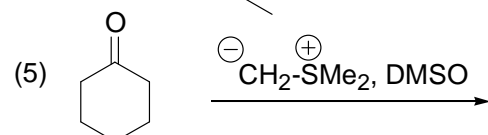
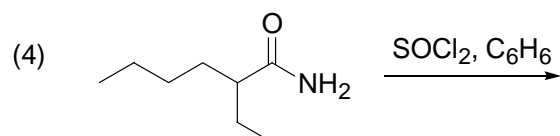
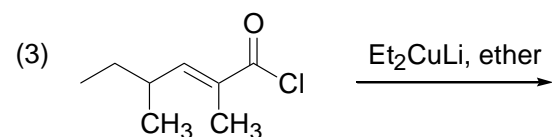
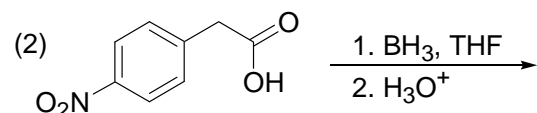
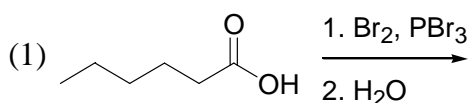
#### Electroanalytical Chemistry (30%)

1. Calculate the electrode potential of the following half-cell at 298 K.  
 $\text{HCl}(1.76 \text{ M})|\text{H}_2(0.98 \text{ atm}),\text{Pt} \quad (R=8.314 \text{ J} \cdot \text{K}^{-1} \cdot \text{mol}^{-1})$
2. Define junction potential. Explain how junction potential occurs and how junction potential influences with a potentiometric measurement.
3. Define faradaic current and nonfaradaic current.

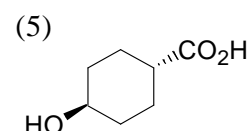
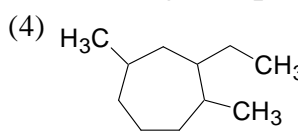
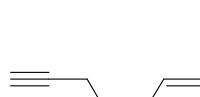
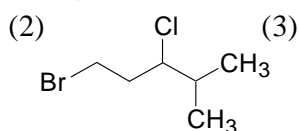
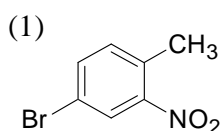
#### Separation Methods (20%)

1. You are asked to use column chromatography to separate two compounds from their mixtures and both GC and HPLC are available. If only one of the two methods is suitable for the separation, please explain the reason based on the properties of the two compounds. If both methods are suitable for the separation, which one should be chosen and why.
2. Differentiate FID (flame ionization detector) and TCD (thermal ionization detector).

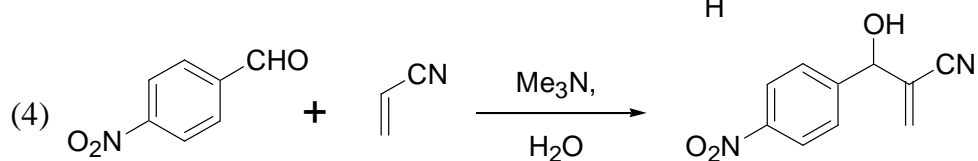
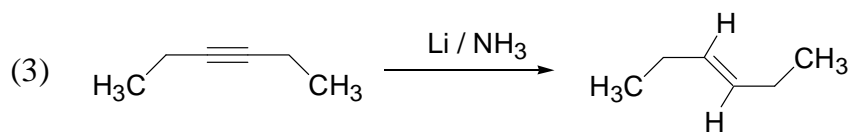
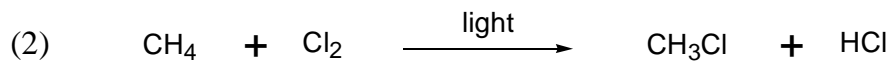
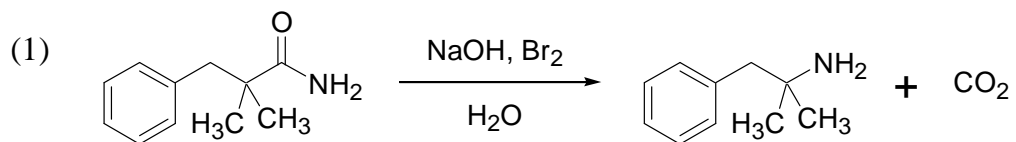
1. (60%) Give the major product of each of the following reactions.



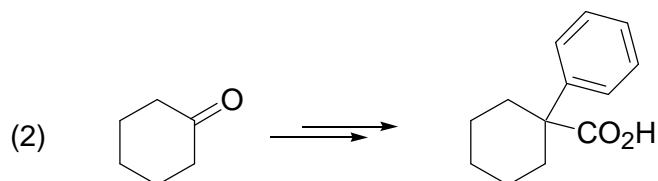
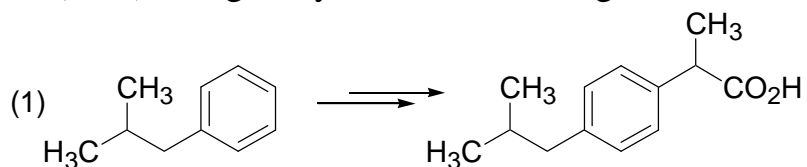
2. (10%) Give the systematic name for each of the following compounds.



3. (20%) Propose a reasonable mechanism for the following reactions.



4. (10%) Design a synthesis for the target molecule from the indicated starting material.



一，解釋名詞：每題 3 分，共 30 分。

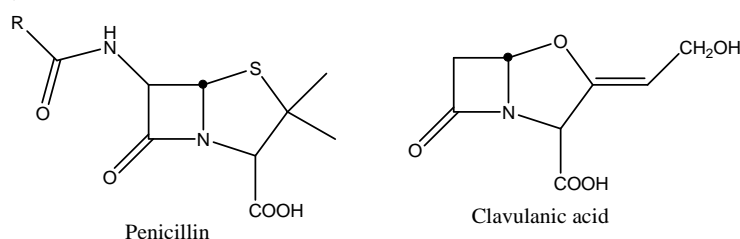
1. Induced fit model
2. Hairpin
3. FRET(fluorescence resonance energy transfer)
4. De novo pathway
5. Ketone bodies
6. Chemiosmotic coupling
7. Leucine zipper
8. miRNA
9. Telomerase
10. Transamination reaction

二，簡答題：每題 5 分，共 30 分。

1. Steroid hormones 如何影響 gene expression?
2. 說明 *E. coli* 在 protein synthesis 中的 polypeptide chain elongation 過程。
3. 解釋 the fluid mosaic model: 其如何來描述 biological membranes 的組成結構?
4. 說明在休息及激烈運動中有關 pyruvate metabolism。
5. 說明 the Sanger method: 如何定 DNA sequence?
6. 說明 mitochondria 中的 the electron transport process。

三，問答題：共 40 分。

1. 抗生素 Penicillin 會破壞細菌細胞壁中之 peptidoglycan 的合成，但過度使用抗生素會造成細菌的抗藥性，此時會給 clavulanic acid 來治療。已知 penicillin 及 clavulanic acid 的結構如下：



請回答下列相關問題並寫出其作用之化學機制：(共 15 分)

- (A) 抗生素 penicillin 如何破壞細菌細胞壁中之 peptidoglycan 的合成? (4 分)
- (B) 抗藥性細菌如何 inactive penicillin 的功能? (4 分)
- (C) Clavulanic acid 治療此抗藥性細菌的化學機制為何? (4 分)
- (D) Penicillin 及 clavulanic acid 屬於下列何屬之抑制劑(可複選):

(a) reversible inhibitor (b) irreversible inhibitor (c) competitive inhibitor (d) noncompetitive inhibitor (e) uncompetitive inhibitor (f) mix inhibitor (g) suicide inhibitor (3 分)

2. Myoglobin 及 hemoglobin 與  $O_2$  結合，以提供生理上對  $O_2$  的需求。

請回答下列相關問題: (共 15 分)

(A) Myoglobin 及 hemoglobin 結構上的差異? (2 分)

(B) 活化位置上之何物質參與  $O_2$  結合? (2 分)

(C) 與  $O_2$  結合後, 對 myoglobin 及 hemoglobin 結構上, 有何影響? (3 分)

(D) 劃出 myoglobin 及 hemoglobin 之  $\theta$  (the fraction of ligand binding sites) 與  $O_2$  結合之關係圖 ( $\theta$  vs.  $pO_2$ ), 並解釋其生理上功能。(5 分)

(E) 何謂 Bohr Effect? (3 分)

3. Glucagon 如何促進肝臟中 glycogen 的分解? (10 分)