

# 東吳大學 103 學年度碩士班研究生招生考試試題

第 1 頁，共 2 頁

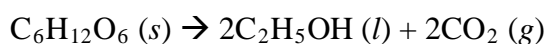
系級	化學系碩士班	考試時間	100 分鐘
科目	物理化學暨分析化學	本科總分	100 分

## 壹、物理化學

1. (10%) Explain the following terms:

- (A) Tunneling effect,
- (B) Ideal gas law,
- (C) Enthalpy,
- (D) Work function,
- (E) Heat capacity.

2. (5%) Calculate the mass of glucose ( $C_6H_{12}O_6$ ) required to produce 2.0 L of  $CO_2$  measured at  $T = 200\text{ K}$  and  $P = 1.0\text{ atm}$  with an alcoholic fermentation process. The net reaction is:



3. (5%) The temperature of 1.5 moles of an ideal gas increases from  $10^\circ C$  to  $60^\circ C$  as the gas is compressed adiabatically. Calculate  $q$ ,  $w$ ,  $\Delta U$  and  $\Delta H$  for this process assuming that  $C_{v,m} = 3R/2$ .

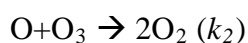
4. (5%) Derive the following expression for calculating the isothermal change in the constant volume heat capacity:  $(\frac{\partial C_v}{\partial V})_T = T(\frac{\partial^2 P}{\partial T^2})_V$

5. (5%) What is the kinetic energy and velocity of electrons that can be emitted if one potassium metal of work function 2.4 eV absorbs a radiation with 300 nm wavelength? (1 eV =  $1.602 \times 10^{-19}\text{ J}$ )

6. (5%) Identify which of the following functions are eigenfunctions of the operator  $d/dx$  and give the corresponding eigenvalue where appropriate. (a)  $e^{ikx}$ , (b)  $\cos kx$ , (c)  $k$ , (d)  $e^{-ax^2}$ , (e)  $e^{ikx} + e^{-ikx}$ .

7. (5%) The equilibrium constant for the isomerization of *cis*-2-butene to *trans*-2-butene is  $K = 2.07$  at 400 K. Calculate the standard reaction Gibbs energy.

8. (5%) Derive the rate law for the decomposition of ozone in the reaction  $2O_3 (g) \rightarrow 3O_2 (g)$  on the basis of the following proposed mechanism:



9. (5%) Please draw a P-V diagram of 'Carnot cycle' and explain.

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第 2 頁，共 2 頁

系級	化學系碩士班	考試時間	100 分鐘
科目	物理化學暨分析化學	本科總分	100 分

貳、分析化學

依題號作答

- (30%) Define the following term:
  - FTIR spectroscopy
  - UV/Vis spectroscopy
  - fluorescence spectroscopy
  - gas chromatography
  - mass spectrometry
- (10%) Calculate the pH of 0.1M HA solution  
(HA:  $K_a = 4 \times 10^{-6}$ )
- (10%) Calculate the pH of solution that is 0.1M in  $\text{NH}_3$  and 0.15M in  $\text{NH}_4\text{Cl}$   
( $K_a$  of  $\text{NH}_4^+$  is  $6 \times 10^{-10}$ )