東吳大學 103 學年度碩士班研究生招生考試試題

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 K and P = 1.0 atm with an alcoholic fermentation process. The net reaction is:
   $C_6H_{12}O_6$ (*s*) → $2C_2H_5OH$ (*l*) + $2CO_2$ (*g*)

3. (5%)The temperature of 1.5 moles of an ideal gas increases from 10°C to 60°C as the gas is compressed adiabatically. Calculate *q*, *w*, $\triangle U$ and $\triangle H$ 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 x 10^{-19} 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) → $3O_2$ (g) on the basis of the following proposed mechanism:
   $O_3 \leftrightarrows O_2 + O$ (forward k_1, reverse k_1')
   $O+O_3 \rightarrow 2O_2$ (k_2)

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

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貳、分析化學

依題號作答

1. (30%) Define the following term:
   (1) FTIR spectroscopy
   (2) UV/Vis spectroscopy
   (3) fluorescence spectroscopy
   (4) gas chromatography
   (5) mass spectrometry

2. (10%) Calculate the pH of 0.1M HA solution
   (HA: Ka= 4×10^{-6})

3. (10%) Calculate the pH of solution that is 0.1M in NH_3 and 0.15M in NH_4Cl
   (Ka of NH_4^+ is 6×10^{-10})