中原大學 102 學年度 **碩士班** 入學考試

102/3/2 13:30 ~ 15:00 化學系

誠實是我們珍視的美德，
我們喜愛「拒絕作弊，堅守正直」的你！

科目：物化、分析 （共 2 頁第 1 頁）

■可使用計算機，惟僅限不具可程式及多重記憶者 □不可使用計算機

(part A: 物化)

1. What is the time constant for the second order reaction $2A \rightleftarrows A_2$? $[A]_0$ is the initial concentration of A and k is the rate constant. (**10%**)
2. Write down the permitted j values for an *f* electron. (**10%**)
3. Are the following transitions in helium allowed or forbidden? (A) $3d^3D \rightarrow 5p^3P$ (B) $2p^3P \rightarrow 2p^1P$ (C) $3s^1S \rightarrow 2s^1S$ (D) $4s^1S \rightarrow 3d^3D$ (E) $5p^1P \rightarrow 3d^3D$ (**10%**)
4. Consider the following photochemical reaction mechanism,

$$HBr + h\nu \rightarrow H + Br$$
$$H+HBr \rightarrow H_2 + Br \qquad k_1$$
$$Br+Br \rightarrow Br_2 \qquad k_2$$

   What is the steady-state concentration for H? (**10%**) What is the steady-state concentration of Br? (**10%**) What is the overall quantum yield ϕ based on reactant HBr? (**10%**)
5. If enzyme [E] and substrate [S] are treated as adsorbate and surface, respectively, and K_M is the Michaelis constant ($K_M = \frac{[E][S]}{[ES]}$), then using the concept of Langmuir isotherm, express the surface coverage θ in terms of [E], [S], and [ES]. (**5%**)
6. What is the efficiency for a Carnot cycle with high temperature = 500°C and low temperature = 380°C? (**5%**)
7. As the pressure is increased at –45℃, ice I is converted to ice II. Which of these phases has the lower density? (**5%**)

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(part B: 分析)

8. Explain the origin of the rule of thumb that indicator color changes occur at $pK_{HIn} \pm 1$. (10%).

9. Compare the differences in (a) type of species can be determined, (b) detection limit, and (c) interference type for the three spectrometric methods (graphite-furnace AAS, ICP-AES and ICP-MS). Please make a brief explanation for your answer. (15 %)

10. List the types of substances to which each of the following chromatographic methods are most applicable: (15%)
    (a) Gas chromatography
    (b) Liquid chromatography
    (c) Capillary electrophoresis

11. Calculate the fraction of association (α) for (a) $1.0*10^{-2}$M and (b) $1.0*10^{-12}$M potassium acetate. (c) Does α increase or decrease with dilution?($K_a=1.75*10^{-4}$ for acetic acid) (15%)

12. Explain why the following atom optical spectrometry do not identify and determine all elements in periodic table: (10%)
    (a) flame AAS
    (b) hydride generation AAS

13. Why must the slit width of a prism monochromator be varied to provide constant effective bandwidths but a nearly constant slit width provides constant bandwidth with a grating monochromator? (10%)