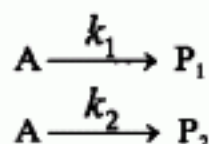


九十一學年度 化學系(所) 化學、應用化學 組碩士班研究生招生考試  
科目\_物理化學及分析化學\_科號\_0603, 0703\_共\_2\_頁第\_1\_頁 \*請在試卷【答案卷】內作答

- The angular momentum of a rigid rotor is measured to be  $\sqrt{6}\hbar$ . Immediately after this measurement, the angular momentum component along a specific direction ( $L_z$ ) is measured. What are the possible outcomes of the second measurement. (5%)
- Consider a particle of mass  $\mu$  that is confined to move freely on a 2-D ring of constant radius  $R$ ,  
(1) write down the Schrödinger equation for this system. (3%)  
(2) determine the wave function for this system. (5%)
- In a continuous flow experiment designed to measure the rate constant of a reaction  $A+B \rightarrow P$ , the concentration of  $B$  is made much greater than that of  $A$ , such that a pseudo-second-order kinetic is observed for  $A$ . The concentration of  $A$  at the mixing chamber after complete mixing is  $10^{-3}$  mol/L and the concentration of  $A$  at 10 cm from the mixing chamber is  $0.5 \times 10^{-3}$  mol/L. Given that the solution flow speed is 500 cm/s, find the apparent rate constant of this reaction. (7%)

- For a parallel reaction mechanism



derive an expression for the time dependence of the  $P_1$  formation (i.e.  $[P_1](t)$ ). (5%)

- About heat capacity : (8%)  
(a) What is the ratio of  $C_p/C_v$  for an ideal ozone gas if it is a nonlinear molecule?  
(b) Calculate the composition of a Pb-Ag alloy given that  $C_v = 0.0383$  cal/deg-g (Atomic weights: 207 for Pb and 107 for Ag)
- Calculate the maximum work obtained by the adiabatic expansion of 2 moles of ideal  $N_2$  gas, initially at 25 °C, from 10 L to 20 L. Assume  $C_v = 2.5R$ . (4%)
- At 1 atm, 100 grams of benzene is vaporized at its boiling point of 80.2 °C. Calculate  $W_{rev}$ ,  $q$ ,  $\Delta E$ , and  $\Delta H$ . The heat of vaporization is 94.4 cal/g. (7%)
- Iodine crystals sublime at 25 °C. Find the temperature at which solid iodine and gaseous iodine will exist in equilibrium. The enthalpy change for the reaction,  $I_2(s) \rightleftharpoons I_2(g)$ , is 9.41 kcal/mole and the change in entropy is 20.6 cal/mol-K. (6%)

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科目 物理化學及分析化學 科號 0603, 0703 共 2 頁第 2 頁 \*請在試卷【答案卷】內作答

9. Write down the step-by-step procedures for preparation of 1.0-L of 0.50 M phosphate buffer, pH 7.0.  
Notes: You don't need a calculator to provide the instruction. The instruction in your procedures should include types of glassware, chemical reagents (weight or volume), and possible instruments. For phosphates (potassium salts),  $pK_{a1}$ ,  $pK_{a2}$ , and  $pK_{a3}$  are  $7.11 \times 10^{-3}$ ,  $6.34 \times 10^{-8}$ , and  $4.5 \times 10^{-13}$ , respectively. Formula weights:  $H_3PO_4$ , 98.0;  $KH_2PO_4$ , 136.1;  $K_2HPO_4$ , 174.2; HCl, 36.5; NaOH, 40.0. Concentrated solutions:  $H_3PO_4$ , 86.0 % (w/w), specific gravity 1.71; HCl, 37.2 % (w/w), specific gravity 1.19. (15%)
10. Give examples to illustrate methods of calibration curves, standard addition, and internal standards. You should comment on (a) when they can be applied and (b) their difference. (15%)
11. Synchrotron radiation source, D, lamp, hollow cathode lamps, lasers (10%)  
Choose ONE light source from the above list and  
(a) describe how the light is generated,  
(b) answer whether it is continuum or line source, and  
(c) list their applications in at least two types of analytical instruments.
12. SIMS, SPME, ICP-AES, MALDI, STM, CE-LIF, EQCM (10%)  
Choose ONE method from the above list and  
(a) write the full name of the acronym,  
(b) write a general category for its applications,  
(c) draw block diagrams of components necessary for this method, and  
(d) describe the basic principles or mechanism.