

國立彰化師範大學 97 學年度碩士班招生考試試題

系所： 化學系碩士班

科目： 物理化學

☆☆請在答案紙上作答☆☆

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Please note that you need to provide detailed answers for the following questions as much as possible.

- (24%) Explain the differences between the following terms: (a) extensive property vs. intensive property, (b) most probable speed vs. root mean square speed of a gas molecule, (c) fugacity of a gas vs. activity of a solution, (d) azeotrope vs. eutectic mixture, (e) reaction order vs. molecularity in chemical kinetics, (f) eigenvalue vs. expectation value.
- (16%) For n moles of van der Waals gases, which follow the state equation $\{P + (n/V)^2 a\}(V-nb) = nRT$, perform an isothermal reversible expansion from V_1 to V_2 at a temperature T . Derive the work done by the gas in terms of n , T , V_1 , V_2 , a , b and other necessary constants.
- (15%) An elementary and one-half order reaction, $A \rightarrow P$, has a rate constant k and an initial concentration of $[A]_0$.
 - (5%) What is the integrated rate law for this reaction?
 - (5%) How will you construct a plot to determine the rate constant k ?
 - (5%) What is half-life for this reaction?
- (15%) Show that Joule-Thomson coefficient for the perfect gas is zero.
- (20%) The wave function for a particle in a box with a length L is $\Psi = (2/L)^{1/2} \sin(\pi x/L)$
 - (5%) Is this function an eigenfunction of the position operator?
 - (15%) Calculate the average value of the position $\langle x \rangle$. Rationalize your results. Given that $\int x[\sin(bx)]^2 dx = x^2/4 - [\cos(2bx)/8b^2] - [x\sin(2bx)]/4b$
- (10%) Correct the mistake(s) in the following statements by giving a correct statement
 - $S = \int dS/T$.
 - The value of the entropy change of a system should be greater than 0 for a spontaneous change.
 - As a more stable system has a lower Gibbs energy, a process with a higher tendency to occur should have a smaller G .
 - The work performed in a free expansion by a real gas is not zero because in the process the real gas has to overcome the intermolecular attraction.
 - The spontaneous mixing of N_2 and O_2 is driven by the enthalpy of mixing.