系所組別： 化學系

考試科目： 物理化學

考試日期：0219，節次：1

※ 考生請注意：本試題 ☑可 ☐不可 使用計算機 請勿在本試題紙上作答，否則不予計分

(I) Blank Filling: **50%**; 5% for each problem.

1. The thermodynamic property derived by the zeroth law is _____.

2. The work for a gas expanding from 1L to 3L at 2 atm is _____J,
the change of internal energy is _____J and q_p is _____J .

3. The work for a gas dropping pressure from 2 atm to 1 atm at 3L is _____J,
the change of internal energy is _____J and q_v is _____J.

4.** For **one mole** of an ideal gas undergoes **isothermal and reversible** expansion from 24L to 36L at 1 atm. The thermodynamic quantities of this process are:
q=_____, w=_____, ΔE=_____, ΔH=_____, and ΔS=_____.

5. The chemical property obtained by measuring rate constants at different temperatures is _____.

6. The physical properties obtained by measuring equilibrium constants at different temperatures are _____.

7. The Joule-Thomson and iosothermal Joule-Thomson coefficients, are defined by _____ and _____, respectively. The two coefficients can be correlated by the thermodynamic expression _____.

8. The operator for momentum and position are _____ and _____, respectively.

9. The origin of uncertainty principle based on operators is _____.

10. The origin of uncertainty principle based on duality of matters is _____.

(背面仍有題目,請繼續作答)

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II) Answer the following problems:50% **8% for each problem except for problem 7;**

$\int \sin^2 axdx = \frac{1}{2}x - (1/4a)\sin 2ax + Const.$ $\int x^n \exp(-ax)dx = n!/a^{n+1}$.

Please give your answers following the numbering of problems

1. (a) Derive $\lambda = h/p$ through quantum mechanic treatments of the "particle-in-a-box" model and (b)show that the expression, $\lambda = h/p$, given originally by de Broglie can rationalize the Bohr's assumption of quantization of angular momentum in Bohr atoms.

2. Employing the normalized wavefunction $\psi_{100} = (\pi a_o^3)^{-1/2}\exp(-r/a_o)$, find (1) expectation values of r and r^2, and (2)the value of uncertainty in r.

3. Give the plot of Gibbs energy against "the reaction process" for the reaction of the Reactants/Products system. Correlate G with the equilibrium constant (K).

4. Show that heat flow simultaneously from a high-temperature (T_h) heat reservoir to a low-temperature heat reservoir (T_l)

5. Derive the statistic definition of entroy, $S = k\ln\Omega$.

6. Derive the rate law for R→P following second order of R.
   And give the expression correlating $t_{1/2}$ with the rate constant.

7. Show that $1Latm \approx 101J$ (2%)