

科目：物理化學

適用：應化系

考生注意：

1. 依次序作答，只要標明題號，不必抄題。
2. 答案必須寫在答案卷上，否則不予計分。
3. 限用藍、黑色筆作答；試題須隨卷繳回。

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1. Derive the relation, $\left(\frac{\partial S}{\partial V}\right)_T = \frac{1}{T} \left[p + \left(\frac{\partial U}{\partial V}\right)_T \right]$, and evaluate the value $\left(\frac{\partial S}{\partial V}\right)_T$ for a perfect gas and a van-der Waals gas. (20%)
2. Given the standard reduction potentials of the Cu^{2+}/Cu and Cu^+/Cu couples are +0.340 V and +0.522V, respectively. Calculate the standard reaction Gibbs energy and the standard potential of the $\text{Cu}^{2+}/\text{Cu}^+$ couple. (20%)
3. One free-electron laser designed for the vacuum-ultraviolet and soft x-ray spectral regions can produce 1×10^{16} photon at 300 nm with a pulse duration of 100 ps. When such a laser beam is focused on a small target of area of 0.01 cm^2 and operated at a repetition rate of 10 MHz, calculate the pulse energy, peak power, average power, and the power flux density of the free-electron laser. (20%)
4. Set up and solve the Hückel secular equation for the π electrons of NO_3^- . Express the π energies in the (a) absence and (b) presence of resonance in terms of the Coulomb α_{O} and α_{N} and the resonance integral β . (20%)
5. The data given below are for the adsorption of Argon on carbon nanosheet at 300 K. Confirm that they fit the Langmuir isotherm, and find the equilibrium constant and volume corresponding to complete coverage. In each case V has been corrected to 1.00 atm. (20%)

p/ 10kPa		2	3
V/ m ³	0.1	0.033	0.04