

注意：考試開始鈴響前，不得翻閱試題，
並不得書寫、畫記、作答。


國立清華大學 113 學年度碩士班考試入學試題

系所班組別：分析與環境科學研究所

科目代碼：2803

考試科目：物理化學

—作答注意事項—

1. 請核對答案卷（卡）上之准考證號、科目名稱是否正確。
2. 考試開始後，請於作答前先翻閱整份試題，是否有污損或試題印刷不清，得舉手請監試人員處理，但不得要求解釋題意。
3. 考生限在答案卷上標記「由此開始作答」區內作答，且不可書寫姓名、准考證號或與作答無關之其他文字或符號。
4. 答案卷用盡不得要求加頁。
5. 答案卷可用任何書寫工具作答，惟為方便閱卷辨識，請儘量使用藍色或黑色書寫；答案卡限用 2B 鉛筆畫記；如畫記不清（含未依範例畫記）致光學閱讀機無法辨識答案者，其後果一律由考生自行負責。
6. 其他應考規則、違規處理及扣分方式，請自行詳閱准考證明上「國立清華大學試場規則及違規處理辦法」，無法因本試題封面作答注意事項中未列明而稱未知悉。

國立清華大學 113 學年度碩士班考試入學試題

系所班組別：分析與環境科學研究所碩士班

考試科目（代碼）：物理化學(2803)

共 1 頁，第 1 頁 *請在【答案卷】作答

1. Explain the following terms: (20%)
 - (a) Ideal gas law
 - (b) Mathematical statement of the second law of thermodynamics
 - (c) Ideal solution
 - (d) Boyle temperature
2. Considering a van der Waals gas $[P+a/(V_m^2)](V_m-b) = RT$,
 - (a) derive the slope of compression factor ($Z = PV_m/(RT)$) as a function of P as $P \rightarrow 0$.
 - (b) At what temperature does the slope of the Z versus P curve as $P \rightarrow 0$ have its maximum value?
 - (c) What is the value of the maximum slope?
 - (d) If the temperature is extremely high, what is the value of the slope? (20%)
3. One mole of an ideal gas expands isothermally and reversibly from 90 to 300 L at 300K. (a) Calculate q , w , ΔU , ΔH and ΔS for this system. (b) If the expansion is carried out irreversibly by allowing the gas to expand into an evacuated container, what are the values of q , w , ΔU , ΔH and ΔS for this process. (20%)
4. 50.0 L of dry air was slowly bubbled through a thermally insulated beaker containing 250 g of water initially at 25 °C. Calculate the final temperature. The vapor pressure of water is approximately constant at 3.17 kPa throughout, and its heat capacity is 75.5 J/(K mol). Assume that the air is not heated or cooled and that water vapor is a perfect gas. The molar enthalpy change of vaporization of water at 25 °C is equal to 44.02 kJ/mol. (20%)
5. Estimate the residual molar entropy of (a) CO₂, (b) ice by taking into account the distribution of hydrogen bonds and chemical bonds about the oxygen atom of one H₂O molecule, (c) HCF₃, (d) 1,2-difluorobenzene, and (e) 1,4-difluorobenzene on the assumption that the van der Waals radii of H and F are similar such that steric effects on molecular ordering in the crystal are minimal. Please list the descending order (sorted from highest to lowest). (20%)