

國立臺北科技大學
九十九學年度研究所碩士在職專班入學考試

化學工程研究所
乙組：物理化學試題

填准考證號碼

第一頁 共一頁

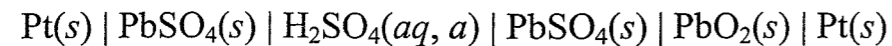
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注意事項：

1. 本試題共 5 題，配分共 100 分。第 1~5 題各 20 分。
2. 請按順序標明題號作答，不必抄題。
3. 全部答案均須答在試卷答案欄內，否則不予計分。

1. Two moles of an ideal gas, for which $C_{v,m} = 3R/2$, is subjected to two successive changes in state: (1) From 40 °C and 100 kPa, the gas is expanded isothermally against a constant pressure of 20 kPa to twice the initial volume. (2) At the end of the previous process, the gas is cooled at constant volume from 40 °C to -20 °C. Calculate q , w , ΔU , and ΔH for each of the stages. Also calculate q , w , ΔU , and ΔH for the complete process.

2. Harnet and Hamer report values for the potential of the cell



over a wide range of temperature and H_2SO_4 concentrations. In 1 *m* H_2SO_4 , their results were described by

$$E(\text{V}) = 1.91737 + 56.1 \times 10^{-6} t + 108 \times 10^{-8} t^2$$

where t is temperature on the Celsius scale. Calculate ΔG , ΔH , and ΔS for the cell reaction at 10 °C and 35 °C.

3. An electrical motor is used to operate a Carnot refrigerator with an interior temperature of 0 °C. Liquid water at 0 °C is placed into the refrigerator and transformed to ice at 0 °C. If the room temperature is 30 °C, what mass of ice can be produced in one hour by a 0.5-hp motor that is running continuously? Assume that the refrigerator is perfectly insulated and operates at the maximum theoretical efficiency.

4. The partial molar volumes of water and ethanol in a solution with $x_{\text{H}_2\text{O}} = 0.60$ at 25 °C are 17.0 and 57.0 $\text{cm}^3 \text{mol}^{-1}$, respectively. Calculate the volume change upon mixing sufficient ethanol with 2.00 mol of water to give this concentration. The densities of water and ethanol are 0.997 and 0.7893 g cm^{-3} , respectively, at this temperature.

5. $\text{Ca}(\text{HCO}_3)_2(s)$ decomposes at elevated temperatures according to the stoichiometric equation



If pure $\text{Ca}(\text{HCO}_3)_2(s)$ is put into a sealed vessel, the air is pumped out, and the vessel and its contents are heated, the total pressure is 0.235 bar. Determine K_p under these conditions. If the vessel initially also contains 0.101 bar $\text{H}_2\text{O}(g)$, what is the partial pressure of $\text{CO}_2(g)$ at equilibrium?