國立勤益技術學院九十五學年度研究所一般招生筆試試題卷
所別：材料與化工研究所 組別：材料、化工組
科目：物理化學
准考證號碼：□□□□□□□□□（考生自填）

考生注意事項：
一、考試時間 100 分鐘。
二、請考生自備準考證號碼。
三、可使用工程用計算機。

試題一：(18%, 2/each 1)
P: pressure; T: temperature; V: volume; W: work; Q: heat; U: internal energy; H: enthalpy; S: entropy; G: Gibbs energy; A: Helmholtz energy.
If a system just do the P-V work, please fill in the blanks.

<table>
<thead>
<tr>
<th></th>
<th>Spontaneous (irreversible) process</th>
<th>Equilibrium (reversible) process</th>
</tr>
</thead>
<tbody>
<tr>
<td>(dS)_W,U</td>
<td>&gt; 0</td>
<td>0</td>
</tr>
<tr>
<td>(dU)___</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>(dA)___</td>
<td>0</td>
<td>0</td>
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<tr>
<td>(dG)___</td>
<td>0</td>
<td>0</td>
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</tbody>
</table>

試題二：(12% 6/ each 1)
Na: 22.99; H: 1.008; C: 12.01; O: 16.00
2NaHCO₃(s) → Na₂CO₃(s) + H₂O(g) + CO₂(g)
Sodium bicarbonate(NaHCO₃) is called baking soda because when heated, it releases carbon dioxide gas, which causes cookies, doughnuts, and bread to rise during baking. Calculate (a) the amount (in moles) (b) the volume (in liters) of CO₂ produced by heating 5.0 g of NaHCO₃ at 180°C and 1.3 atm.

試題三：(10 %, 5/ each 1)
When the concentration of A in the reaction A → B was changed from 1.2 M to 0.60 M, the half-life increased from 2.0 min. to 4.0 min. at 25°C. Calculate the order of the reaction and the rate constant.
試題四：(10%)
A Dumas experiment to determine molar mass is conducted in which a gas sample’s P, T, and V are determined. If a 1.08 g sample is held in 0.250 dm³ at 303 K and 101.3 kPa.

試題五：(20%, 10% each 1)
A sample of liquid benzene weighing 0.633 g is burned in a bomb calorimeter at 25°C, and 26.54 kJ of heat are evolved. (a) Calculate ΔU per mole of benzene. (b) Calculate ΔH per mole of benzene.

試題六：(10%, 2% each 1)
For each of the following processes, state which of the quantities ΔU, ΔH, ΔS, ΔA, and ΔG are equal to zero:
(a) Isothermal reversible expansion of an ideal gas.
(b) Adiabatic reversible expansion of a nonideal gas.
(c) Vaporization of liquid water at 80°C and 1 bar pressure.
(d) Vaporization of liquid water at 100°C and 1 bar pressure.
(e) Reaction between H₂ and O₂ in a thermally insulated bomb.

試題七：(10%)
Derive expressions for (a) α (expansion coefficient) and (b) κ (isothermal compressibility coefficient) for an ideal gas.

試題八：(10%)
In a study of the osmotic pressure of hemoglobin at 276.15 K, the pressure was found to be equal to that of a column of water 3.51 cm in height. The concentration was 1 g per 0.100 dm³. Calculate the molar mass.