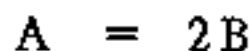


1. a) What is the fuel cell? b) Explain the economic advantage of fuel cells over the combustion engines. (10%)
2. Describe (a) the theory, (b) the essential components and (c) the information provided, for one of the following instruments generally used in characterization of solid samples:
XPS (X-ray Photo-spectroscopy), or XRD (X-ray Diffraction) or TEM (Transmission Electron Microscopy) (15%)
3. For an elementary reaction of $A \rightarrow B$ with a rate constant k and an initial concentration of reactant $[A]_0$. What is the half-life ($t_{1/2}$) of the reaction if it follows (a) first order, and (b) second order, chemical kinetics. (10%)
4. Benzene (B) and Toluene (T) form ideal solutions. The vapor pressure of the two liquids at 50°C is $P_T^* = 100$ Torr and $P_B^* = 200$ Torr, respectively.
 - (a) Construct a total vapor pressure ($P = P_T + P_B$) vs composition [$Z_B = n_B/(n_B + n_T)$] phase diagram for these solutions at an isothermal condition of 50°C ; (10%) and
 - (b) How many phases (including a description of these phases) will exist at $P = 150$ Torr and $Z_B = 0.75$? (5%)

5. (a) 一單原子理想氣體($C_v=3/2R$)其溫度為 T_1 ，體積為 V_1 ，進行絕熱可逆膨脹後體積變成 V_2 ，請問膨脹後氣體的溫度 T_2 、內能的改變 ΔE 、及所作之功 W 為何？，請導出其關係式。

(b) 如果膨脹為對外界壓力 P_2 進行絕熱不可逆膨脹，氣體的溫度 T_2 及所作之功 W 又為何？此時內能的改變 ΔE 如何估算？ 15%

6. 一氣體依下式進行可逆分解，



假設分解時，其自由能改變為 ΔG ，最後的平衡壓力為 P ，溫度為 T ，請計算平衡時 A 及 B 的分壓。 10%

7. 兩液體混合時，假設是理想溶液，其 ΔG 、 ΔH 、及 ΔS 之改變為何？如果不是理想溶液，其改變又為何？

10%

8. 您知道鹼錳電池、鎳鎘電池、鎳氫電池、及鋰電池嗎？其電極的化學反應、特性及優劣為何？ 8%

9. 空氣經壓縮後其溫度會改變嗎？如何分離空氣中的氮氣、氧氣、及氬氣？

7%