國立臺北科技大學九十六學年度碩士班招生考試

系所組別：3712 有機高分子研究所甲組

第二節 物理化學（選考）試題

注意事項：

1. 本試題共 10 題，配分共 100 分。
2. 請標明大題、子題編號作答，不必抄題。
3. 全部答案均須在答案卷之答案欄內作答，否則不予計分。

請依照考題前後次序作答

一、Please use kinetic theory to connect molecular speed with temperature. (10 %)

二、Estimate the mean free path of nitrogen molecule at 1×10^{-3} Torr. (10%)

三、Please explain the physical meaning of two correcting factors: a and b in van der Waals equation for real gases. (10%)

$$p = \frac{RT}{V_m - b} - \frac{a}{V_m^2}$$

四、 For the following combustion reaction: (10%)

$C_2H_5OH_{(l)} + O_{2(g)} \rightarrow CO_{2(g)} + H_2O_{(l)}$

The amount of heat produced, as measured in a bomb calorimeter, is 1364.47 kJ mol^{-1} at 25 °C. Please calculate ΔH for the reaction.

五、Explain why the internal pressure: $\pi_T = (\partial U/\partial V)_T$ of a ideal gas is zero. (10%)

六、1. What is Clausius inequality and its significance? 2. Prove Clausius inequality. (15%)

七、At 518 °C, the half-life for the decomposition of a sample of gaseous acetaldehyde (ethanol) initially at 363 Torr was 410 s. When the pressure was 169 Torr, the half-life was 880 s. Determine the order of reaction. (10%)

八、If a chemical reaction rate doubles with every 10 degree rise in temperature, calculate the activation energy of a reaction at 300 K that obeys this rule exactly. (5%)

九、The operator x is one-dimensional position operator, and $(h/2\pi i)(\partial/\partial x)$ is the one-dimensional momentum operator. Do these operators commute? (10%)

十、What is the degree of the degeneracy if the three quantum numbers n_1, n_2, and n_3, can have the values 1, 2, and 3? (10%)

Table 1.2 The gas constant in various units

R
8.314 47 J K^{-1} mol^{-1}
8.205 74 × 10^{-2} L atm K^{-1} mol^{-1}
8.314 47 × 10^{-2} L bar K^{-1} mol^{-1}
8.314 47 Pa m^3 K^{-1} mol^{-1}
62.364 L Torr K^{-1} mol^{-1}
1.987 21 cal K^{-1} mol^{-1}