中原大學 100 學年度 碩士班 入學考試

3 月 19 日 08:30~10:00　　　化學系　　　　　誠實是我們珍視的美德，
　　　　　　　　　　　　　　　　　　　　　　　我們喜愛「拒絕作弊，堅守正直」的你！
科目： __物理化學__　　　　　　　　　　　　　　（共 2 頁第 1 頁）

□可使用計算機，惟僅限不具可程式及多重記憶者　　☑不可使用計算機

請作答於答案卷

Part I : Multiple-choice questions (5 % each)：

1. Air pressure unit conversion : 1 torr equals to how much atm ?

   (a) 1/10000　　　　　(b) 1/14.6　　　　　(c) 1/760　　　　(d) 1

2. Activation-controlled reaction depends mostly on which factor ?

   (a) activation energy　　(b) diffusion　　　(c) pressure　　(d) solvent

3. What is the EPR signal multiplicity of the $C_6H_6^-$ radical anion ?

   (a) 2　　　　　　　(b) 3　　　　　　　(c) 7　　　　　　(d) 13

4. What is the special characteristic of a laser excimer ?

   (a) Boson energy level　(b) stabler high energy level　　(c) big energy gap between ground and excited state　　　(d) fast relaxation rate

5. Microwave can accelerate reaction rate by :

   (a) increase collision rate　　(b) lower activation energy　　(c) optimize the molecular geometry　　　　　　　(d) release heat

6. Perfect gas law is NOT composed by which of the following law ?

   (a) Boyer's law　　　　(b) Charles's law　　(c) Avogadrow's law　　(d) Dalton's law

7. What is the correct relationship between 3 kinds of speeds ?

   (a) $\mu_{rms} > \mu_{av} > \mu_{mp}$　　　(b) $\mu_{av} > \mu_{rms} > \mu_{mp}$　　　(c) $\mu_{rms} > \mu_{mp} > \mu_{av}$　　　(d) $\mu_{mp} > \mu_{av} > \mu_{rms}$

8. The powers in the rate law are determined by

   (a) the coefficients of the balanced chemical equation. (b) the physical states of the reactants and products.　　(c) the principle of detailed balance.　　(d) experiment.

9. Reaction rates can change with

   (a) temperature　　(b) the addition of a catalyst　(c) reactant concentrations　　(d) all of these

10. Which of the following will be a catalyst affect?

    (a) Activation Energy　　(b) Enthalpy of Reaction　(c) Final reaction concentrations　(d) all of the above

Part II : Concepts and calculated questions

1. Provide a molecular interpretation for the observation that the viscosity of a gas increases with temperature, whereas the viscosity of a liquid decreases with increasing temperature. (10%)

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2. Use the phase diagram to state what would be observed when a sample of carbon dioxide, initially at 1.0 atm and 298 K, is subjected to the following cycle : (a) isobaric (constant–pressure) heating to 320 K, (b) isothermal compression to 100 atm, (c) isobaric cooling to 210 K, (d) isothermal decompression to 1.0 atm, (e) isobaric heating to 298 K. (10%)
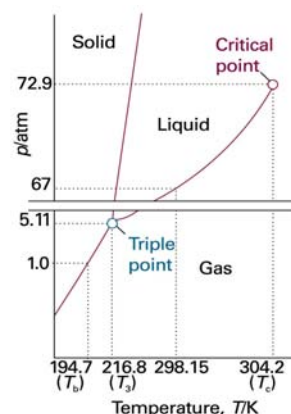
3. The diffusion coefficient for glucose in water is 6.81×10^{-10} m^2 s^{-1} at 25ºC. The viscosity η of water at 25ºC is 8.937×10^{-4} kg m^{-1} s^{-1}. Estimate the dynamic radius of glucose, assuming that Stokes's law ($D = k_BT/6\pi\eta r$) applies and that the molecule is spherical. (10%)

4. Show that for an electrochemical cell, the change in Gibbs free energy (dG) under constant temperature, pressure, and reversible conditions equals to the non-PV work. (10%)

5. What must be the relation between E_1^0 and E_2^0 if the species X^+ is to disproportionate spontaneously under standard conditions to X^{3+} and X(s) ? Write a balanced equation for the disproportionation. (10%)

$$X^{3+} \xrightarrow{\ E_1^0\ } X^+ \xrightarrow{\ E_2^0\ } X(s)$$
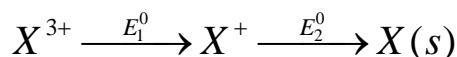
P.S.

Boltzmann's constant $k_B = 1.38 \times 10^{-23}$ J K^{-1}