

# 國立暨南國際大學九十二學年度碩士班研究生入學考試試題

第 1 節物理化學 適用：(應化所 444)

(本試題共 2 頁，第 1 頁)

考生注意：1. 依次序作答，只要標明題號，不必抄題。

2. 答案必須寫在答案卷上，否則不予計分，並限以藍黑色筆作答。

3. 試題隨卷繳回。(餘詳詳閱試場規則)

1. (25 pts) Write down the answers inside the parenthesis, which are correct. Note that sometimes there are more than one right answer.

- (5 pts) A reversible process is one that proceeds by a succession of very small incremental steps, all of which are at (equilibrium, spontaneous, enthalpically driven, entropically driven).
- (5 pts) ( $\Delta H$ ,  $\Delta S$ ,  $\Delta G$ ,  $\Delta E$ ) implies constant pressure.
- (5 pts) For a process that can be carried out by either a reversible or an irreversible path, the change in ( $P$ ,  $T$ ,  $V$ ,  $q$ ,  $E$ ,  $H$ ,  $w$ ) must be the same for both paths.
- (5 pts) When a sample of liquid is converted reversibly to its vapor at its normal boiling point, ( $q$ ,  $w$ ,  $\Delta P$ ,  $\Delta V$ ,  $\Delta T$ ,  $\Delta E$ ,  $\Delta H$ ,  $\Delta S$ ,  $\Delta G$ ) is equal to zero for the system.
- (5 pts) An ideal gas expands adiabatically into a vacuum.  $\Delta E$  for the system is (greater than zero, equal to zero, less than zero).

2. (15 pts) Consider a two-dimensional square box of length  $L$ , containing six non-interacting electrons with each mass as  $M$ . Given that the energy levels for electrons in 2-D box are

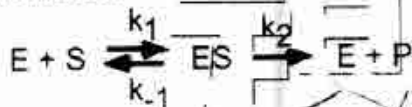
$$E_{nm} = (h^2/8ML^2)(n^2 + m^2).$$

- (5 pts) Calculate the energy of the ground state of this system, i.e. these six electrons, in terms of  $L$  and  $M$ .
- (5 pts) Calculate the energy of the transition from the ground state to the first excited state in terms of  $L$  and  $M$ .
- (5 pts) Calculate the wavelength of the transition in terms of  $c$  (speed of light),  $L$  and  $M$ .

3. (25 pts) For each of the following energies or wavelengths, which the type of molecular transition that most probably corresponds to this value, e.g., rotational, vibrational or electronic transition.

- a. 3 cm    b.  $10\mu\text{m}$     c.  $6.4 \times 10^{-19} \text{ J}$     d. 0.25 eV    e.  $6.626 \times 10^{-23} \text{ J}$

4. (20 pts) Consider the simple Michaelis-Menten mechanism for an enzyme-catalyzed reaction:



Assume  $k_1$  and  $k_{-1}$  are very fast. The equilibrium constant of first reaction  $K_m$  and reaction rate constant of  $k_2$  can be measured in different temperatures. Assume at temperature  $T_p$ ,  $k_2$  is  $k_p$  and  $K_m$  is  $K_p$ ; and at temperature  $T_q$ ,  $k_2$  is  $k_q$  and  $K_m$  is  $K_q$ .

# 國立暨南國際大學九十二學年度碩士班研究生入學考試試題

第 1 節物理化學 適用:(應化所 444 )

(本試題共 2 頁, 第 2 頁)

- 考生注意:
1. 依次序作答, 只要標明題號, 不必抄題。
  2. 答案必須寫在答案卷上, 否則不予計分, 並限以藍黑色筆作答。
  3. 試題隨卷繳回。(餘請詳閱試場規則)

- a. (10 pts) Express the activation energy  $E_a$  for  $k_2$  in terms of  $T_p$ ,  $k_p$ ,  $K_p$ ,  $T_q$ ,  $k_q$ , and  $K_q$ .
- b. (10 pts) Express the standard thermodynamic enthalpy ( $\Delta H^\circ$ ) for formation of ES from E and S?
5. (15 pts) Answer the questions below using the following terms.  
Fluorescence, internal conversion, intersystem crossing, phosphorescence, (excited state) vibrational relaxation.
- a. (5 pts) What molecular photophysical process(es) involves a change in spin multiplicity?
- b. (5 pts) List the non-radiative process(es).
- c. (5 pts) List the five photophysical processes in terms of relative rate, from slowest (top) to fastest (bottom).

國

試

題