

# 國立臺灣師範大學 100 學年度碩士班招生考試試題

科目：普通化學

適用系所：海洋環境科技研究所

注意：1.本試題共 2 頁，請依序在答案卷上作答，並標明題號，不必抄題。2.答案必須寫在指定作答區內，否則不予計分。

1. Bromine has two naturally-occurring isotopes.  $^{79}\text{Br}$  has a mass of 78.9 amu and accounts for 50.3% of bromine atoms. If the atomic mass of bromine is 79.9 amu, what is the mass of an atom of the second bromine isotope? ( 10 points )
2. What is the formula for (a) magnesium sulfide, (b) ferric oxide, and what is the name for (c)  $\text{KMnO}_4$  (d)  $\text{CaH}_2$  (e)  $\text{Na}_2\text{SO}_4$ ? ( 10 points )
3. (a) You are provided with a 250 mL volumetric flask, deionized water and solid NaOH. How much NaOH should be weighed out in order to make 250. mL of 0.100 M solution (Na = 23 amu)? (b) Analysis of a white solid produced in a reaction between chlorine and phosphorus showed that it contained 77.44% chlorine and 22.56% phosphorus. What is its empirical formula? ( 10 points )
4. 1.00 mol of an ideal gas (the system) is heated from 20.0°C to 100.0°C at a constant pressure of 1.00 atm. (a) Given that the internal energy of an ideal gas is  $E = (3/2)RT$ , calculate  $\Delta E$  for this change, in J. (b) Calculate  $w$  for this change, in J. (c) Hence, calculate  $q$  for this change, in J. ( 15 points )
5. The lattice energy of rubidium chloride is the energy change accompanying the process:  $\text{Rb}^+(\text{g}) + \text{Cl}^-(\text{g}) \rightarrow \text{RbCl}(\text{s})$   
Calculate the lattice energy of RbCl using the following data: ( 10 points )

$\text{Rb}(\text{s}) \rightarrow \text{Rb}(\text{g})$	$\Delta H^\circ (\text{kJ}) = 86$
$\text{Rb}(\text{g}) \rightarrow \text{Rb}^+(\text{g}) + \text{e}^-$	$\Delta H^\circ (\text{kJ}) = 409$
$\text{Cl}_2(\text{g}) \rightarrow 2\text{Cl}(\text{g})$	$\Delta H^\circ (\text{kJ}) = 242$
$\text{Cl}(\text{g}) + \text{e}^- \rightarrow \text{Cl}^-(\text{g})$	$\Delta H^\circ (\text{kJ}) = -355$
$\text{Rb}(\text{s}) + \frac{1}{2}\text{Cl}_2(\text{g}) \rightarrow \text{RbCl}(\text{s})$	$\Delta H^\circ (\text{kJ}) = -435$
6. Calculate the enthalpy change for the reaction  $\text{NO}(\text{g}) + \text{O}(\text{g}) \rightarrow \text{NO}_2(\text{g})$  from the following data: ( 10 points )

$\text{NO}(\text{g}) + \text{O}_3(\text{g}) \rightarrow \text{NO}_2(\text{g}) + \text{O}_2(\text{g}), \Delta H = -198.9 \text{ kJ}$
$\text{O}_3(\text{g}) \rightarrow 1.5\text{O}_2(\text{g}), \Delta H = -142.3 \text{ kJ}$
$\text{O}_2(\text{g}) \rightarrow 2\text{O}(\text{g}), \Delta H = 495.0 \text{ kJ}$
7. Determine the shape of the following compounds: (a)  $\text{PF}_5$  (b)  $\text{SeF}_4$  (c)  $\text{KrF}_2$  ( 15 points )

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8. The FM station KDUL broadcasts music at 99.1 MHz. Find the wavelength of these waves. ( 10 points )
  
9. Assuming that atoms are spherical, calculate the fraction of space which is occupied by atoms (i.e., the packing efficiency) in a metal with a face-centered cubic unit cell. ( 10 points )