

國立彰化師範大學 101 學年度碩士班招生考試試題

系所： 科學教育研究所

組別： 丙組

科目： 普通化學

☆☆請在答案卷上作答☆☆

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I. Multiple choice questions (choose only one answer) (25%)

- Atoms of the same element with different mass numbers are called
(A) ions. (B) neutrons. (C) allotropes. (D) chemical families. (E) isotopes.
- Which is the correct formula for copper(II) phosphate?
(A) Cu_2PO_4 (B) $\text{Cu}_3(\text{PO}_4)_2$ (C) Cu_2PO_3 (D) $\text{Cu}(\text{PO}_4)_2$ (E) $\text{Cu}(\text{PO}_3)_2$
- How many moles of HCl are represented by 1.0×10^{19} HCl molecules?
(A) 1.7×10^{-5} mol (B) 1.5×10^{-3} mol (C) 1.0×10^{19} mol (D) 36.5 mol (E) 6.02×10^4 mol
- Which of these compounds is a nonelectrolyte?
(A) NaF (B) HNO_3 (C) CH_3COOH (acetic acid) (D) NaOH (E) $\text{C}_6\text{H}_{12}\text{O}_6$ (glucose)
- Identify the oxidizing agent in the chemical reaction:
 $2\text{MnO}_4^- + 5\text{H}_2\text{SO}_3 \rightarrow 2\text{Mn}^{2+} + 5\text{SO}_4^{2-} + 4\text{H}^+ + 3\text{H}_2\text{O}$.
(A) MnO_4^- (B) H_2SO_3 (C) Mn^{2+} (D) SO_4^{2-} (E) H^+
- Alpha particles are identical to
(A) protons. (B) helium atoms. (C) hydrogen atoms. (D) helium nuclei. (E) electrons.
- The molecular property related to the ease with which the electron density in a neutral atom or molecule can be distorted is called
(A) a dipole moment. (B) polarizability. (C) a dispersion force.
(D) surface tension. (E) a van der Waals force.
- Which one of the following substances should exhibit hydrogen bonding in the liquid state?
(A) PH_3 (B) He (C) H_2S (D) CH_4 (E) CH_3OH
- Appropriate units for a first-order rate constant are
(A) M/s. (B) $1/\text{M}\cdot\text{s}$. (C) 1/s. (D) $1/\text{M}^2\cdot\text{s}$.
- According to the VSEPR theory, the molecular shape of ammonia is
(A) linear. (B) trigonal planar. (C) bent. (D) tetrahedral. (E) trigonal pyramidal.

II. Answer the following questions (75%)

- The percent composition by mass of a compound is 76.0% C, 12.8% H, and 11.2% O. The molar mass of this compound is 284.5 g/mol. What is the molecular formula of the compound? (C: 12.01 g/mol, H: 1.008 g/mol, O: 15.99 g/mol) (7%)
- Ideal formulas for the electrodes of the Li^+ ion battery are C_6Li (FM 79.01) and LiCoO_2 (FM 97.87). When the battery operates, C_6Li is consumed and LiCoO_2 is formed.
 - Write both of the half reaction (cathode and anode) from the total reaction: (6%)
 $\text{C}_6\text{Li} + \text{CoO}_2 \rightarrow \text{C}_6 + \text{LiCoO}_2$
 - Charge capacity of an electrode in a battery is expressed as $\text{mA}\cdot\text{h/g}$. How many coulombs are in 1 $\text{mA}\cdot\text{h}$. (3%)

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- (c) What is the theoretical capacity ($\text{mA}\cdot\text{h/g LiCoO}_2$) of the battery? (3%)
- (d) If a Li^+ ion battery can deliver $140 \text{ mA}\cdot\text{h/g LiCoO}_2$, what fraction of Li in the formula LiCoO_2 is available? (3%)
- (e) Express the energy storage as $\text{W}\cdot\text{h/g LiCoO}_2$ if a Li^+ ion battery can deliver $140 \text{ mA}\cdot\text{h/g LiCoO}_2$ at 3.7 V . (3%)
3. The boiling points for HF, HCl, HBr, HI are 20 , -85 , -67 and -35°C respectively. Explain why the boiling point for HF is much higher than others? (7%)
4. Give the oxidation states for Cl in the following compounds:
HOCl, HOClO, HOClO₂, HOClO₃. (12%)
5. An ancient plant fossil showed a ^{14}C decay rate of 3.9 counts per minute per gram of carbon. Assuming that the decay rate of ^{14}C in freshly cut wood is 14.6 counts per minute per gram of carbon, calculate the age of the ancient plant fossil. The half-life of ^{14}C is 5730 years. (10%)
6. Give the Lewis structures for the following organic compounds.
 C_3H_6 , 2-pentyne, 1,3-dibromobenzene, 2-butanone. (12%)
7. Give the 3 most abundant elements in the earth's crust, oceans and atmosphere. (9%)