

試題必須與答案卷一起交回，否則不予計分

I 選擇題，對的打「○」，錯的打「×」，答錯倒扣 (60%)

Example (A) ○ (B) ○ (C) × (D) ○ (E) ×

- Which of the following compounds is paramagnetic?  
(A)  $O_3$  (B)  $NO_2$  (C)  $Ti(H_2O)_6^{4+}$  (D)  $Fe(H_2O)_6^{2+}$  (E)  $Fe(CN)_6^{2-}$
- Which of the following substances would provide good conductivity in the aqueous solutions?  
(A)  $PCl_2$  (B)  $PCl_3$  (C)  $HClO_4$  (D)  $CaO$  (E)  $NH_4Br$
- Which of the following may be classified as soft acid?  
(A)  $Pt^{2+}$  (B)  $Ti^{2+}$  (C)  $H^+$  (D)  $OH^-$  (E)  $S^{2-}$
- Which of the following species may form polymeric structures?  
(A)  $SiO_2$  (B)  $C_{60}$  (C)  $BeCl_2$  (D)  $Na_3PO_4$  (E)  $Na_2Si_2O_5$
- Which of the following compound has coordination number = 4?  
(A)  $NaCl$  (B)  $CsCl$  (C) rutile  $TiO_2$  (D) fluorite  $CaF_2$   
(E) zinc blende ( $ZnS$ )
- Considering properties of  $CoCl_2$  in water, which of the following statement is correct?  
(A) the electronic configuration of cobalt ion is  $t_{2g}^6 e_g^4$   
(B) paramagnetic  
(C) labile kinetics  
(D) electrically conductive  
(E) there are two geometrical isomers
- Which of the following compounds does not have  $C_2$  symmetry?  
(A)  $BF_3$  (B)  $Co(en)_3^{3+}$  (C) diborane  $B_2H_6$  (D) borazine  $B_3N_3$  (E)  $XeO_4$
- Considering the atomic structure of hydrogen with Schrodinger's approach, which of the following statement is correct?  
(A) 3s and 3p are equal in energy  
(B) the electron in 3s is always closer to the nucleus than in 3p  
(C) transition between  $n = 3$  and 4 absorbs visible light  
(D)  $n = 0$  is not allowed  
(E) UV light can ionize the electron
- Which of the following compounds meets EAN rule?  
(A)  $PF_5$  (B)  $TaMe_5$  (C)  $Fe(CO)_5$  (D)  $Pt(PPh_3)_2Cl_2$  (E)  $CpFe(CO)_2Me$

- 10 Which set is in order of increasing radius?  
 (A)  $\text{Ca}^{2+}$ ,  $\text{K}^+$ ,  $\text{S}^{2-}$  (B)  $\text{O}^{2-}$ ,  $\text{S}^{2-}$ ,  $\text{Se}^{2-}$  (C)  $\text{Fe}^{3+}$ ,  $\text{Fe}^{2+}$ ,  $\text{Fe}$   
 (D)  $\text{F}$ ,  $\text{O}$ ,  $\text{N}$  (E)  $\text{Na}^+$ ,  $\text{F}^-$ ,  $\text{Ne}$
- 11 Which of the following compound is trigonal planar?  
 (A)  $\text{SO}_3$  (B)  $\text{SO}_3^{2-}$  (C)  $\text{CO}_3^{2-}$  (D)  $\text{PF}_3$  (E)  $\text{AlF}_3$
- 12 Considering the bond enthalpy, which of the following statement is correct?  
 (A) bond breaking is endothermic  
 (B) bond forming give off energy  
 (C) the bond energy of  $\text{Cl}_2$  is experimentally measurable  
 (D) the bond enthalpy of the sigma bond in  $\text{CO}$  is larger than those of the pi bonds  
 (E) the sum of bond enthalpies of the reactants always equals the sum of bond enthalpies of the products

**II Answer the following question by giving reasoning or calculations.**

- 13 Ozone can absorb ultraviolet light to decompose to oxygen. The rate law for this reaction has been determined as  $\text{Rate} = k[\text{O}_3]^2/[\text{O}_2]$   
 (a) Write the stoichiometric equation for this reaction. (3%)  
 (b) Derive a mechanism that explains this rate law. (7%)  
 (c) Draw an energy profile for this reaction and specify the activation energy in the profile. (5%)  
 (d) Explain why  $\text{NO}$  can accelerate the ozone depletion? (5%)
- 14 Compare the reaction of  $\text{LiN}_3$  and  $\text{KCH}_3\text{COO}$  with ammonia (10%)  
 (a) In water?  
 (b) Without the presence of water.
- 15 (a) Use the molecular orbital diagram to explain the paramagnetism of  $\text{C}_2$ . (5%)  
 (b) Predict the bond dissociation energy of  $\text{C}_2^+$  and  $\text{C}_2^-$ , and compare with  $\text{C}_2$  (5%)