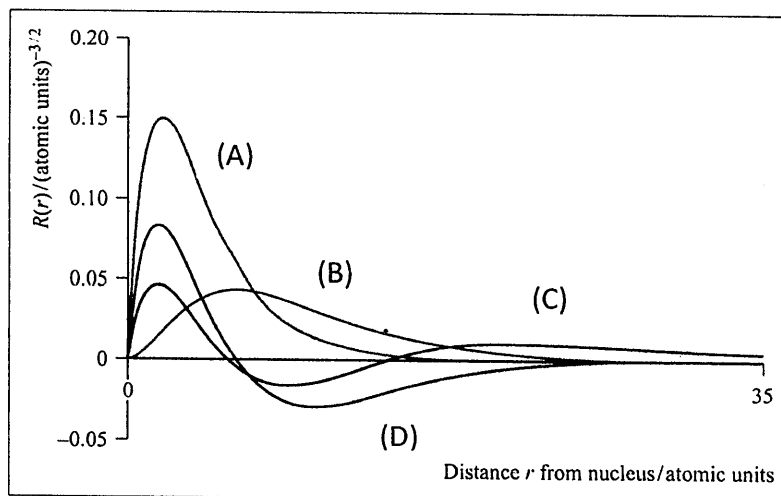


類組：化學類 科目：無機化學(1003)

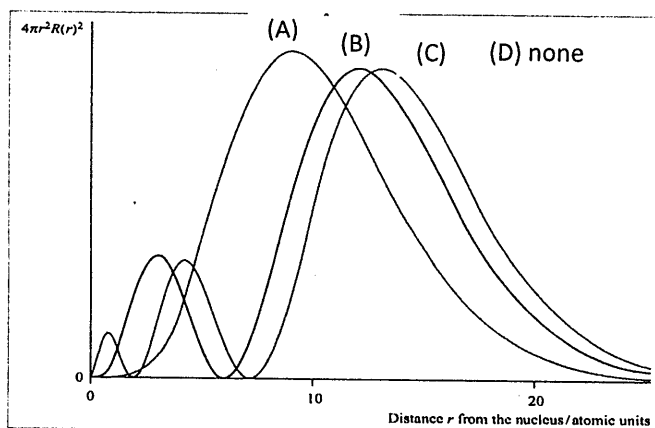
※請在答案卡內作答

選擇題(只有一個答案對，答錯不倒扣，每一題兩分，總分 100 分)

1. Which one of the following functions is the 3p radial wave function of an H atom?



2. Which one of the following functions is the 3d radial distribution function of an H atom?



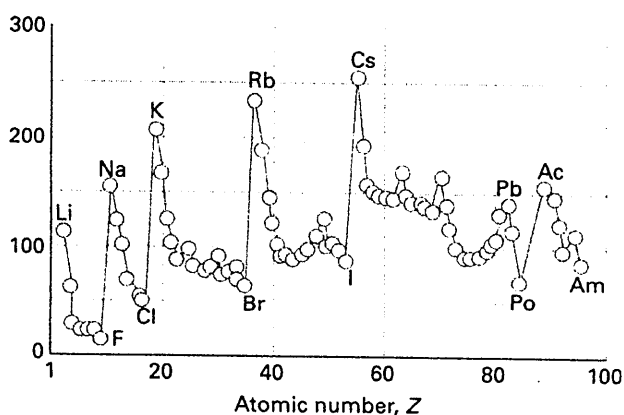
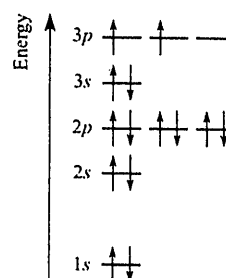
3. The ground state electron configuration of an element is shown.

What is this element?

(A) Sb (B) Sc (C) Se (D) Si (E) Sn

4. The image below describes the periodic trend of

(A) the first ionization energies (B) atomic radii (C) electron affinities
(D) Pauling electronegativities (E) none of the above



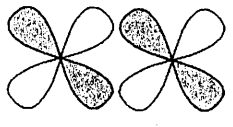
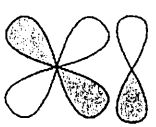
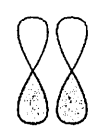
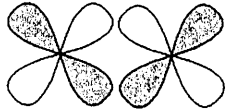

5. What is the shape of XeF_4 ?

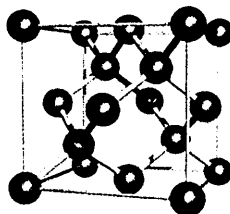
(A) trigonal pyramidal (B) tetrahedral (C) square planar
(D) trigonal bipyramidal (E) octahedral

注意：背面有試題

類組：化學類 科目：無機化學(1003)

※請在答案卡內作答

6. Which one of the following functions is the wave function of a sp hybridized orbital of an atom?
- (A) $(1/2)^{1/2}(\psi(s) + \psi(p))$
 (B) $(1/3)^{1/2} \psi(s) - (1/6)^{1/2} \psi(px) + (1/2)^{1/2} \psi(py)$
 (C) $(1/3)^{1/2} \psi(s) - (1/6)^{1/2} \psi(px) - (1/2)^{1/2} \psi(py)$
 (D) $(1/2)(\psi(s) + \psi(px) + \psi(py) + \psi(pz))$
 (E) $(1/2)(\psi(s) + \psi(px) - \psi(py) - \psi(pz))$
7. Which one of the following linear combination of atomic orbitals does not form a bonding interaction?
- (A)  (B)  (C) 
- (D)  (E) 
8. Consider eclipsed form ferrocene. Which one of the following is not a symmetry element of the molecule.
- (A) E (B) C (C) σ (D) i (E) S
9. Identify the point group of allene (C_3H_4).
- (A) C_{2h} (B) C_{2v} (C) D_2 (D) D_{2h} (E) D_{2d}
10. How many molecular orbitals will BH_3 have? Consider the orbitals containing the valence electrons only.
- (A) 4 (B) 5 (C) 6 (D) 7 (E) 8
11. Which one of the following does not have a bent structure?
- (A) BeH_2 (B) BH_2 (C) CH_2 (D) NH_2 (E) OH_2
12. A crystal has the following cell parameters:
 $a \neq b \neq c$ $\alpha = \beta = \gamma = 90^\circ$
 It belongs to the crystal system:
- (A) triclinic (B) orthorhombic (C) hexagonal (D) cubic (E) tetragonal
13. What is the coordination number of an atom in a hexagonal close-packed structure?
- (A) 3 (B) 4 (C) 6 (D) 8 (E) 12
14. The unit cell of diamond is shown. How many C atoms can be found in the cell?
- (A) 8 (B) 12 (C) 16 (D) 18 (E) 20
15. All the following compounds have rock-salt structure. Which one of them has the smallest lattice enthalpy?
- (A) LiF (B) $NaCl$ (C) KI (D) MgO (E) SrO
16. Which one of the following has the most negative pK_a value?
- (A) $B(OH)_3$ (B) H_2CO_3 (C) H_3PO_4 (D) H_2SO_4 (E) $HClO_4$
17. Which one of the following has the highest molar solubility?
- (A) NaF (B) $NaCl$ (C) $AgCl$ (D) NaI (E) AgI
18. Which one of the following is classified as a soft acid?
- (A) Ca^{2+} (B) Cl^- (C) Co^{3+} (D) Cr^{3+} (E) Cu^+

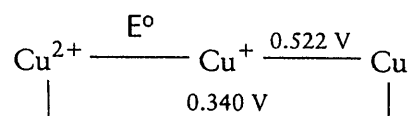


注意：背面有試題

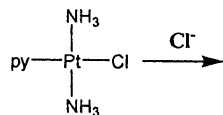
類組：化學類 科目：無機化學(1003)

※請在答案卡內作答

19. Which one of the following has the smallest dipole moment?
 (A) acetonitrile (B) benzene (C) dichloromethane (D) ethanol (E) tetrahydrofuran
20. Which one of the following cannot be a stable compound?
 (A) B₂H₆ (B) C₂H₆ (C) C₃H₆ (D) P₂H₆ (E) Si₂H₆
21. Which one of the following has the most positive standard Gibbs energy of formation?
 (A) CH₄ (B) C₂H₆ (C) SiH₄ (D) GeH₄ (E) SnH₄
22. Which one of the following ions shows the strongest reducing capability by its metallic form?
 (A) Ag⁺ (B) Al³⁺ (C) Fe²⁺ (D) K⁺ (E) Zn²⁺
23. What is the diagram called?



- (A) Frost diagram (B) Latimer diagram (C) Ellingham diagram (D) Energy level diagram
 (E) ORTEP diagram
24. From the last question, what is the value of E°?
 (A) -0.182 V (B) 0.182 V (C) -0.158 V (D) 0.158 V (E) none of the above
25. SF₆ has A_{1g}, E_g, and T_{1u} stretching vibrational modes. The A_{1g} mode is
 (A) IR active, Raman active (B) IR inactive, Raman active (C) IR active, Raman inactive
 (D) IR inactive, Raman inactive (E) none of the above
26. What would be the product from the following reaction?



- (A) $\begin{array}{c} \text{NH}_3 \\ | \\ \text{py}-\text{Pt}-\text{Cl} \\ | \\ \text{Cl} \end{array}$ (B) $\begin{array}{c} \text{NH}_3 \\ | \\ \text{Cl}-\text{Pt}-\text{Cl} \\ | \\ \text{NH}_3 \end{array}$ (C) $\begin{array}{c} \text{Cl} \\ | \\ \text{py}-\text{Pt}-\text{Cl} \\ | \\ \text{NH}_3 \end{array}$ (D) $\begin{array}{c} \text{Cl} \\ | \\ \text{H}_3\text{N}-\text{Pt}-\text{Cl} \\ | \\ \text{NH}_3 \end{array}$ (E) $\begin{array}{c} \text{NH}_3 \\ | \\ \text{Cl}-\text{Pt}-\text{Cl} \\ | \\ \text{py} \end{array}$

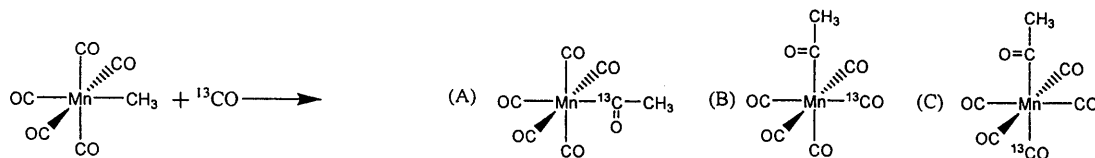
27. What is the term symbol for the ground state of Ce³⁺?
 (A) ²S (B) ²D (C) ²G (D) ²P (E) ²F
28. Which of the following complexes would undergo Jahn-Teller distortion?
 (A) [Cr(en)₃]³⁺ (B) [Mn(H₂O)₆]²⁺ (C) [Ni(H₂O)₆]²⁺ (D) [Cu(H₂O)₆]²⁺ (E) [Zn(H₂O)₆]²⁺
29. Determine which of the following metal complexes is diamagnetic.
 (A) [Cr(en)₃]³⁺ (B) [Ni(NH₃)₆]²⁺ (C) [CoCl₄]²⁻ (D) [Fe(CN)₆]⁴⁻ (E) [Cu(H₂O)₆]²⁺
30. Which one of the following solid is not considered to be a semiconductor?
 (A) AlAs (B) GaN (C) InN (D) Si (E) ZnS
31. Which one of the following complexes displays the lowest CO stretch frequency?
 (A) [Fe(CO)₄]²⁻ (B) [Ni(CO)₄] (C) Cr(CO)₆ (D) [Pt(CO)₄]²⁺ (E) Mo(CO)₆
32. How many unpaired electrons are found in the metal complex [Co(H₂O)₆]²⁺?
 (A) 0 (B) 1 (C) 2 (D) 3 (E) 4
33. Which one of the following metal complexes has highest Δ_{oct}?
 (A) [MnF₆]²⁻ (B) [Fe(ox)₃]³⁻ (C) [Cr(NH₃)₆]³⁺ (D) [Ni(H₂O)₆]²⁺ (E) [Fe(CN)₆]³⁻
34. Which one of the following complexes has magnetic moment (μ_{eff}) very close to 3.9 μ_B?
 (A) [V(NH₃)₆]Cl₂ (B) [Cr(NH₃)₆]Cl₂ (C) [Zn(H₂O)₆]²⁺ (D) [Cu(H₂O)₆]²⁺ (E) [Ni(H₂O)₆]²⁺

注意：背面有試題

類組：化學類 科目：無機化學(1003)

※請在答案卡內作答

35. What is the structure of the metal complex $[\text{Cu}(\text{py})_4]\text{Cl}$?
 (A) square planar (B) trigonal bipyramid (C) tetrahedron (D) square pyramid (E) octahedral
36. What is most abundant transition metal ion in a human body?
 (A) Fe (B) Co (C) Ni (D) Cu (E) Zn
37. Which one of the following complexes displays lowest water exchange rate?
 (A) $[\text{Cr}(\text{H}_2\text{O})_6]^{3+}$ (B) $[\text{Mn}(\text{H}_2\text{O})_6]^{2+}$ (C) $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$ (D) $[\text{Cu}(\text{H}_2\text{O})_6]^{2+}$ (E) $[\text{Zn}(\text{H}_2\text{O})_6]^{2+}$
38. Which metal complex could not be chiral?
 (A) $[\text{Rh}(\text{PPh}_3)_3\text{Cl}]$ (B) $[\text{Cr}(\text{acac})_3]$ (C) $[\text{Co}(\text{en})_2\text{Cl}_2]^+$ (D) $[\text{Co}(\text{ox})_3]^{3-}$ (E) $[\text{Ru}(\text{en})_3]^{2+}$
39. Which compound does not obey 18-electron rule?
 (A) $\text{Cr}(\text{CO})_6$ (B) $[(\eta^5\text{-C}_5\text{H}_5)_2\text{Co}]^+$ (C) $[\text{Ir}(\text{CO})(\text{PPh}_3)_2\text{Cl}]$ (D) $\text{ClMn}(\text{CO})_5$ (E) $\text{Co}_2(\text{CO})_8$
40. What is the catalyst using for the following reaction?
 $\text{CH}_3\text{OH} + \text{CO} \rightarrow \text{CH}_3\text{COOH}$
 (A) $\text{Co}_2(\text{CO})_8$ (B) $[\text{Rh}(\text{CO})_2\text{I}_2]^-$ (C) $[\text{Ru}(\text{bpy})(\text{CO})\text{Cl}]^+$ (D) $[\text{Rh}(\text{PPh}_3)_3\text{Cl}]$ (E) $[\text{PdCl}_4]^{2-}$
41. How many isomers could the metal complex $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]\text{Cl}$ have?
 (A) 1 (B) 2 (C) 3 (D) 4 (E) 5
42. Which one of the following fragment is isolobal with a neutral CH_2 fragment?
 (A) $\text{Mn}(\text{CO})_5$ (B) $\text{Fe}(\text{CO})_4$ (C) $\text{Co}(\text{CO})_3$ (D) $\text{Ni}(\text{CO})_2$ (E) CpNi
43. What structure type does the carborane $\text{C}_4\text{B}_2\text{H}_6$ belong to?
 (A) *closo* (B) *nido* (C) *arachno* (D) *hypho* (E) *klado*
44. Which one of the following ligands can be used as a π acceptor?
 (A) en (B) NH_3 (C) CO (D) Cl^- (E) H_2O
45. Which one of the following ligands is classified as a soft ligand?
 (A) OH^- (B) NH_3 (C) CO_3^{2-} (D) I^- (E) RO^-
46. What is the Os_4 core structure in $\text{Os}_4(\text{CO})_{16}$?
 (A) square (B) planar raft (C) tetrahedron (D) square pyramid (E) butterfly
47. Which one of the following reactions would undergo inner-sphere electron transfer?
 (A) $[\text{Co}(\text{NH}_3)_5\text{Cl}]^{2+} + [\text{Cr}(\text{OH}_2)_6]^{2+}$
 (B) $[\text{Os}(\text{bpy})_3]^{2+} + [\text{Mo}(\text{CN})_8]^{3-}$
 (C) $[\text{Fe}(\text{CN})_6]^{4-} + [\text{Fe}(\text{phen})_3]^{3+}$
 (D) $[\text{Ru}(\text{NH}_3)_6]^{2+} + [\text{Co}(\text{phen})_3]^{3+}$
 (E) $[\text{Fe}(\text{phen})_3]^{2+} + [\text{Fe}(\text{phen})_3]^{3+}$
48. What would be the product from the following reaction?



49. What is the metal-metal bond order in the complex of $[\text{Os}_2\text{Cl}_8]^{2-}$?
 (A) 1 (B) 2 (C) 3 (D) 4 (E) 5
50. Cisplatin *cis*- $[\text{PtCl}_2(\text{NH}_3)_2]$ acts as an anti-tumor drug. What is its main interaction *in vivo*?
 (A) binding with protein (B) binding with lipid (C) binding with DNA (D) binding with sugar
 (E) blocking ion absorption

注意：背面有試題