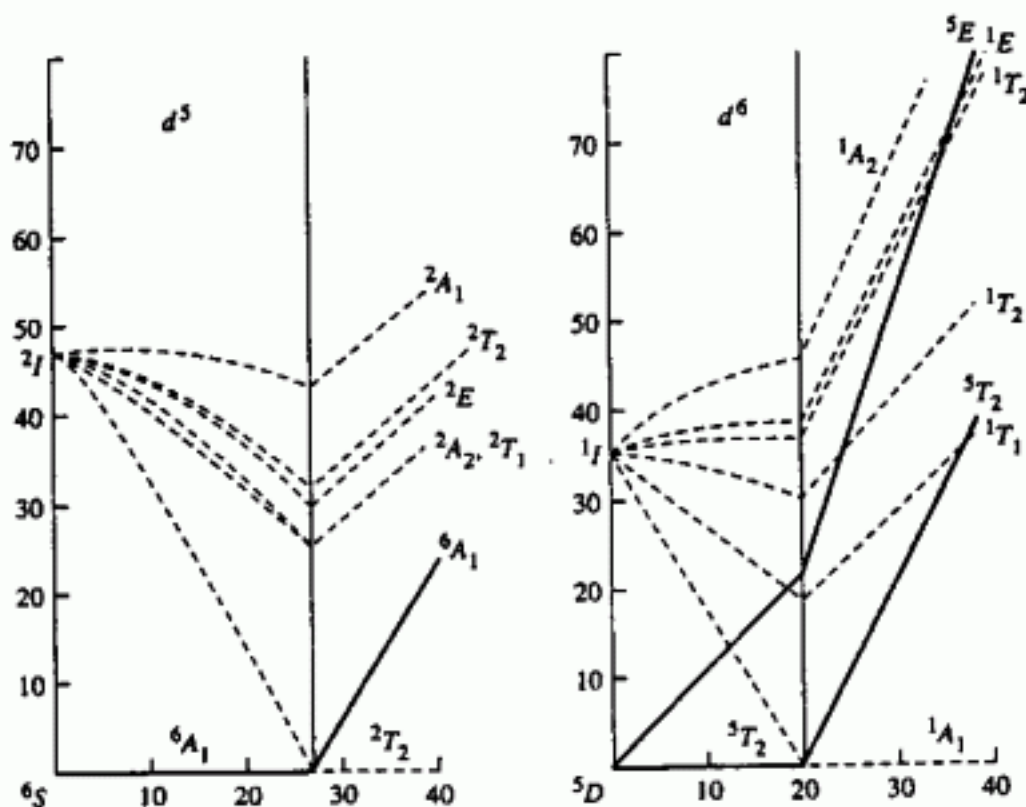


九十一學年度 化學 系(所) 化學、應用化學 組碩士班研究生招生考試
科目_無機化學及有機化學_科號_0602, 0702_共_3_頁第_1_頁 *請在試卷【答案卷】內作答

- Write down the chemical formula of the following inorganic compounds (a) chromic acid (b) sodium thiosulfate (c) potassium hexacyanoferrate(II) (d) trivinylborane (e) methylphosphane. (5%)
- What hapticities are possible for the interaction of each of the following ligands with a single *d*-block metal atom such as cobalt? (a) ethylene (b) cyclopentadienyl (c) toluene (d) cyclooctatetraene (e) ethylene diamine. (5%)
- The absorption spectrum of $[\text{Co}(\text{NH}_3)_6]^{3+}$ has a very weak band in the red and two moderate intensity bands in the visible to near UV. How should these transitions be assigned? Moreover, explain why $[\text{FeF}_6]^{3-}$ is colorless whereas $[\text{CoF}_6]^{3-}$ is colorless but exhibits only a single band in the visible region, you may consult with the simplified Tanabe-Sugano Diagrams attached below: (5%)

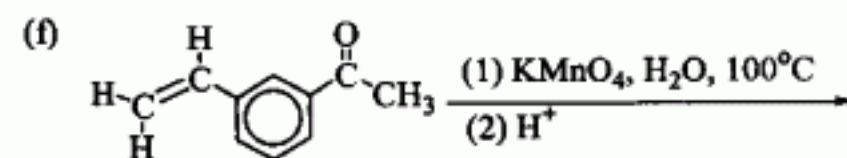
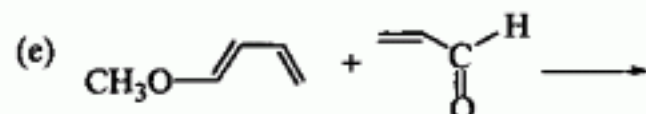
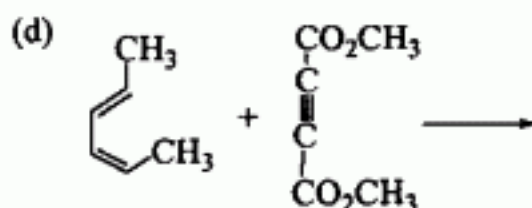
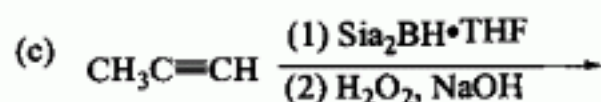
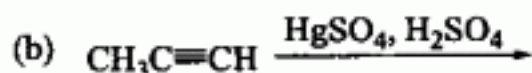
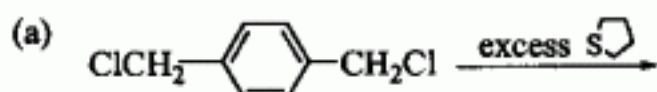


- Nano-materials have gradually become a very important research area in Inorganic chemistry. What is the definition of nano-materials? Describe the characteristics of two nano materials, including their physical shapes, potential applications and the possible methods of preparation. (5%)
- $\text{Na}[(\eta^5\text{-C}_5\text{H}_5)\text{Fe}(\text{CO})_2]$ reacts with $\text{ClCH}_2\text{CH}_2\text{SCH}_3$ to give A, a monomeric and diamagnetic substance of stoichiometry $\text{C}_{10}\text{H}_{12}\text{FeO}_2\text{S}$ having two strong IR bands at 1980 and 1940 cm^{-1} . Heating of A gives B, a monomeric, diamagnetic substance having strong IR bands at 1920 and 1630 cm^{-1} . Identify A and B and explain your reasoning concisely. (5%)

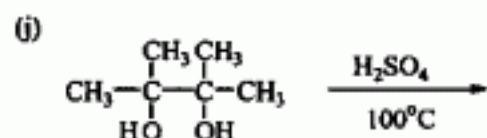
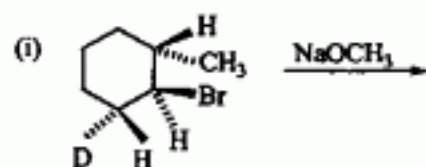
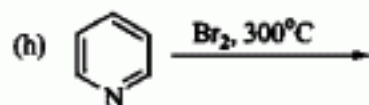
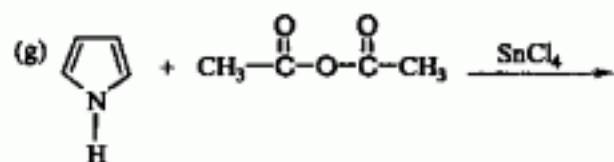
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6. Explain the following terms and give some illustrative examples. (6%)
- Hydrate isomerism
 - Ionization isomerism
 - Linkage isomerism
7. Write down all isomers of octahedral Ma_3bcd complex and indicate the number of stereoisomers. (M: metal ion; a, b, c, and d are monodentate ligands) (6%)
8. The diatomic cations Br_2^+ and I_2^+ are known. (7%)
- Sketch the molecular orbital energy level diagram of the valence electrons for these ions.
 - What is the bond order of these cations.
 - Br_2^+ is red and I_2^+ blue. What electronic transition is most likely for absorption in these ions? Which ion has the more closely spaced HOMO and LUMO?
9. a) List the following acids in order of acid strength when reacting with NH_3 . (6%)
 $\text{B}(\text{CH}_3)_3$, $\text{B}(\text{C}_6\text{H}_2(\text{CH}_3)_3)_3$, $\text{C}_6\text{H}_2(\text{CH}_3)_3$: 2,4,6-trimethylphenyl, $\text{B}(\text{C}_2\text{H}_5)_3$, BF_3 .
- b) List the following bases in order of base strength when reacting with BF_3 .
 Pyridine, 2-methylpyridine, 3-*t*-butylpyridine, 2,6-dimethylpyridine.

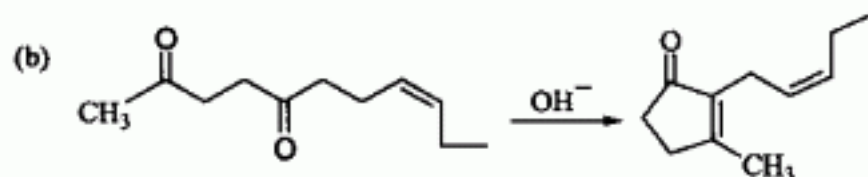
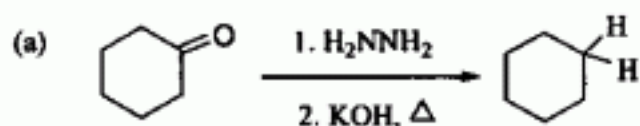
10. Write down the major products and specify the stereochemistry where appropriate (30%)



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11. Propose a mechanism for the following reactions. (10%)



12. Use molecular orbital model to explain why the [2+2] cycloaddition of two ethylene is thermally forbidden, but photochemically allowed. (6%)

13. Classify each compound as aromatic, antiaromatic, or nonaromatic. (4%)

