14 Aug. 2017

MINISTRY OF SCIENCE, RESEARCH AND TECHNOLOGY
NATIONAL ORGANIZATION
FOR
EDUCATIONAL TESTING

22th National and the 10th International Chemistry Olympiad
Summer 2017
Iran

Inorganic Chemistry I and II

Time: 90 minutes

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Question No.	Points for each question	Signature	total score (out of 100)
1	/20		
2	/20		
3	/20		
4	/20		
5	/20		

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10th International Olympiad Summer 2017

Do NOT write here

First name:

Last name:

Exam title:

Exam data:

14 Aug. 2017

1-

a- The ReO_3 structure is cubic with Re at each corner of the unit cell and one O atom on each unit cell edge midway between the Re atoms.
Sketch this unit cell and determine (a) the coordination number of the cation and anion and (b) the identity of the structure type that would be generated if a cation was inserted in the center of the ReO_3 structure.

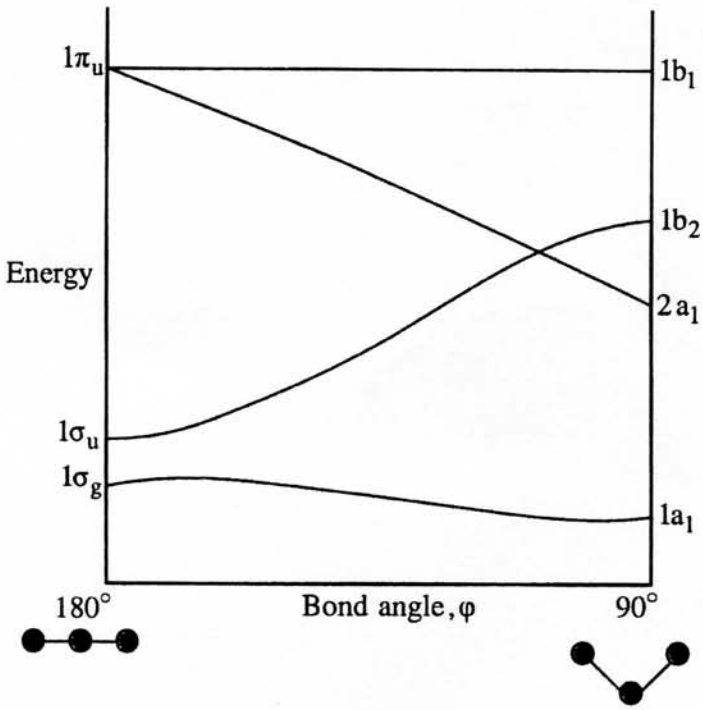
b- Imagine the construction of an MX_2 structure from the simple cubic CsCl structure by removal of half the Cs^+ ions to leave tetrahedral coordination around each Cl^-. What is this MX_2 structure?

2- **The walsh diagram for XH_2 molecules is given below (only the bonding and nonbonding orbitals are shown).**

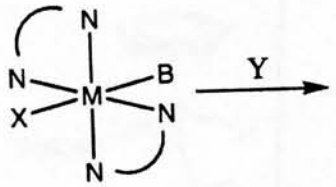
a- **For gas phase BeH_2 molecule which shape is more stable, angular or linear? Explain.**

b- **Answer the above question for neutral NH_2 molecular fragment.**

Should the first excited state of NH_2 be more bent or more linear than the ground state? Explain. Note: The molecular orbital energies for ground and excited states are assumed to be the same.

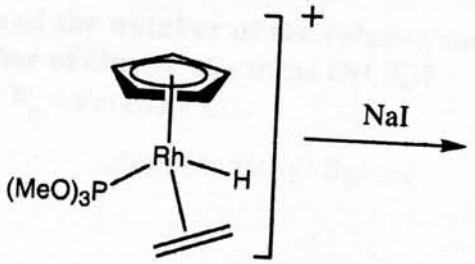


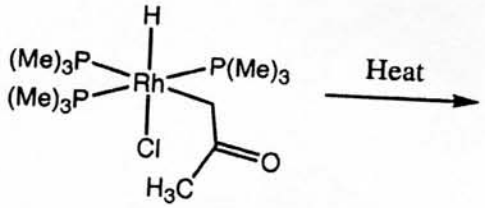
3- **Specify the different isomers that formed in the substituation reaction for the following O_h complex (Hint: assume a trigonal bipyramidal geometry for reaction intermediate)**



X= Leaving group
Y= Entering group

4- Provide the product (s) for the reactions below.





5- Heating $[Fp]_2$ to 180°C leads to a tetranucleur complex that has lost 2CO per $[Fp]_2$ complex and shows a strong band at 1620 cm^{-1} in the IR spectrum. What is its structure and the number of the valence electrons of each of the four Fe atom and the number of cluster electrons (NCE)?

$F_p = Fe(cp)(CO)_2$

cp = cyclopentadienyl ligand