Indian Institute of Technology, Delhi, Department of Chemistry

Major examination, 2016 May

CML 738 Applications of p block elements and their compounds

Time 2 hrs. maximum marks 45

1. Given that aluminium is quite oxophilic, predict the products of the following reactions which are zwitterionic in nature. [4]

$PMes_3 + 2\ Al(C_6F_5)_3$ —(CO_2)→

$PMes_3 + 2\ Al(C_6F_5)_3$ —(N_2O)→

2. Write the formulae of compounds A to E and balance the equations. Indicate which all among equations (1) to (5) are redox reactions [3]

$Mg_2Si + HCl$ —(non aqueous medium)→ A + (Ionic compound) (1)

$A + O_2 \rightarrow B + C$ (liquid) (2)

$A + H_2O \rightarrow B + D$ (gas) (3)

$A + Cl_2 \rightarrow E + HCl$ (4)

$E + H_2O \rightarrow B + HCl$ (5)

3. $HB(Mes)_2$ and BPh_3 are Lewis acids of moderate strength as indicated by gas phase hydride affinities of -74.4 and -74.7 kcal/mol and does not form FLP's with normal hindered phosphines. Draw structures of two compounds which can be used to form FLP's with these Lewis acids and are capable of activating dihydrogen. [2]

4. Starting from BF_3 show reactions with schemes for the preparation of para $C_2B_{10}H_{12}$? Compared to boranes what are the advantages of carboranes? [4]

5. Which is the world's strongest solo acid discovered so far (till 2015)? Write one unique reaction which supports its superior acid strength [2]

6. Vinyl and cyclopropyl boronic acids are highly unstable. Suggest and draw the structures of possible alternative boron based compounds which are stable and soluble in *non polar* solvents for Suzuki coupling involving vinyl and cyclopropyl groups. [2]

7. Although Gadolinium-157 and Cadmium-113 have better nuclear cross section for thermal neutrons, they are less favoured compared to boron-10 for BNCT. Indicate four reasons for the same. [2]

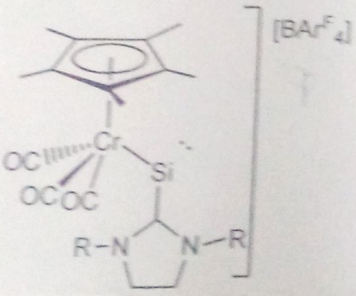
8. What were the elements additional to aluminium present in the original duralumin alloy prepared by Dr Alfred Wilma? Which among these are present in the 2XXX and 7xxx types of alloys used in aircraft manufacture nowadays. Which additional element(s) make(s) aluminium salt water corrosion free? [4]

9. Write four salient properties of germanium which reflect in its applications? Which properties are contributing to the use of germanium in fibre optic cables [3]

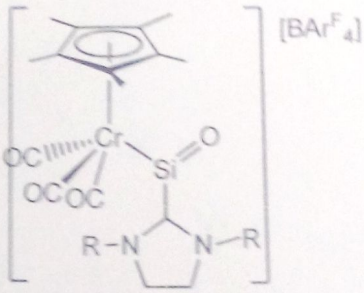
10. Draw the structure of a stable tricordinate germanone and comment on its bond order. [2]

11. How is the first example of a Si≡Si bonded compound prepared? Write a reaction in which the triple bond of this compound is directly converted to a single bond. [2]

12. Using IR and NMR spectroscopy how will you distinguish between compounds A and B. Please give specific values of chemical shifts and IR bands. Which reagent brings about conversion of A to B effectively? [3]



A



B

13. What is the catalyst used in KAAP process? How does it compare in activity and advantages with the conventional catalysts? [3]

14. How is N_2O_5 prepared? Draw equation for a reaction showing its synthetic utility. [2]

15. Starting from elemental sulphur (S_8) show steps with reagents for the synthesis of (a) S_6 and (b) phenyl sulfonic acid ($C_6H_5SO_3H$) in good yields [4]

16. Pictorially show the relative variations in the structures observed for acetylene analogues of Si, Ge, Sn and Pb indicating approximately, observed bond angles, possible location of electron involved in the triple bond and observed multiplicity of the bond. [3]