

Admission Exam of the Post Graduation Program in Chemistry
Federal University of São Carlos
Academic Master Degree and Doctoral Degree, 01/2015

Question 01

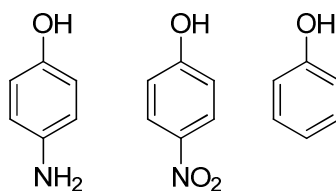
Calculate the work of one mole of an ideal gas that expands in vacuo. Justify your answer.

Question 02

Knowing the standard enthalpy change of melting water ($\Delta H_f^\circ = + 6.01 \text{ kJ/mol}$), calculate the enthalpy change of a sample of 100 g of water that freezes at 0°C .

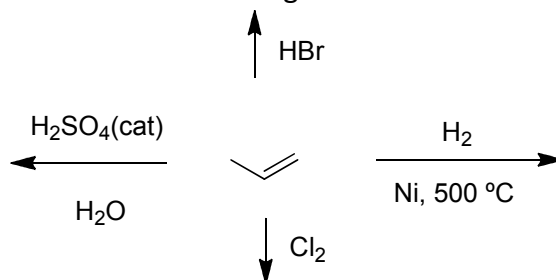
Question 03

Rank the following compounds in order of increasing acidity justifying your answer.



Question 04

Give the major product in each of the following reactions.

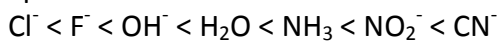


Question 05

For the following ions $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$, $[\text{Ti}(\text{NH}_3)_6]^{3+}$ and $[\text{Ti}(\text{CN})_6]^{3-}$:

- Which are their geometries?
- Rank the ions in term of the relative value of Δ .
- Rank the ions in term of the energy of visible light absorbed.
- To which kind of transition the absorption is due?

Spectrochemical series



Weak field

Strong field

Question 06

Use Molecular Orbitals (MO) diagrams to place: C_2^- , C_2 , C_2^+ in order of:

- increasing bond energy
- increasing bond length

Question 07

When 100.0 mL of a weak acid was titrated with $9.310 \times 10^{-2} \text{ mol L}^{-1}$ NaOH, 27.63 mL was required to reach the equivalence point. The pH at the equivalence point was 10.99. What was the pH when only 19.47 mL of NaOH had been added? $K_w = 1.0 \times 10^{-14}$

Question 08

A $1.0 \times 10^{-2} \text{ mol L}^{-1}$ NH_3 solution was prepared and it was determined that the NH_3 had undergone 4.2% ionization. Calculate the K_b for NH_3 .