

**Admission Exam of the Post Graduation Program in Chemistry – Federal University of  
São Carlos**

**Academic Master Degree and Doctoral Degree, 02/2012**

**Question 01**

The dissociation reaction of ethane in methyl radicals, at high temperatures, obeys a first order rate law. If 250 mg of ethane is added to a flask of 500 mL at 700 °C, calculate the initial reaction rate considering the specific rate constant  $k = 5.5 \times 10^{-4} \text{ s}^{-1}$ . What is the half-life of this reaction?



**Question 02**

A human being has a nominal power of 100 W (1 W = J s<sup>-1</sup>). What is the entropy change in the surroundings at 25 °C considering an exposition time of 2 hrs? The entropy generated will be higher or lower if this person was in a refrigerated room at temperature near to 0 °C?

**Question 03**

A buffer solution contains 0.11 mol of acetic acid and 0.15 mol of sodium acetate in 1.00 L. What is the pH of the buffer after the addition of 0.02 mol of HCl?  $K_a = 1.80 \times 10^{-5}$ ,  $pK_w = 14.0$

**Question 04**

How does titration of a strong acid with a strong base differ from titration of a weak acid with a strong base concerning the following aspects:

All the initial concentrations values are 0.100 mol L<sup>-1</sup>.

- (a) quantity of base required to reach the equivalence point.
- (b) pH at the beginning of the titration
- (c) pH at the equivalence point

**Question 05**

Using the VSEPR model determine the molecular shapes and predict the bond angles (relative to the ideal angles) of (a) SbF<sub>5</sub> and (b) BrF<sub>5</sub>.

**Question 06**

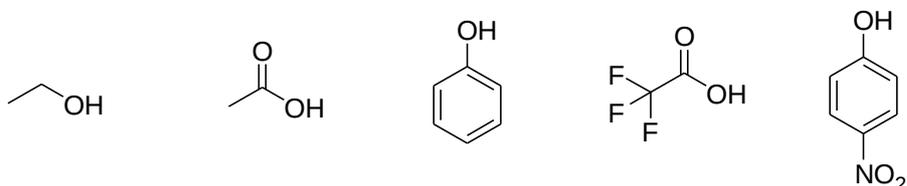
After remove one electron from N<sub>2</sub>, an ion with a weaker and longer bond is obtained compared to the parent molecule. On the other hand, the ion formed from O<sub>2</sub> has a stronger and shorter bond.

	N <sub>2</sub>	N <sub>2</sub> <sup>+</sup>	O <sub>2</sub>	O <sub>2</sub> <sup>+</sup>
Bond energy (kJ/mol)	945	841	498	623
Bond length (pm)	110	112	121	112

Explain these facts using diagrams that show the sequence and occupancy of Molecular Orbitals.

**Question 07**

Rank the following compounds in order of increasing acidity (starting from the lower acidity) and justify the established order.



**Question 08**

Give the product of the reaction shown below and justify any regioselectivity and stereoselectivity. Write the mechanism.

