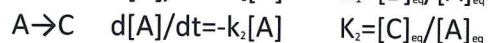


**Concorso pubblico anno accademico 2019/2020 per l'accesso al
Corso di dottorato in Scienze Chimiche e dei Materiali**

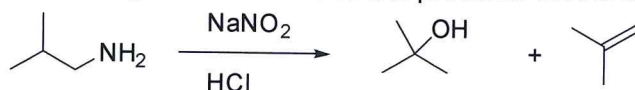
(bandito con decreto rettorale n.43379 del 24 aprile 2019 e successive modifiche e integrazioni)

- Discuss the energy level diagram of the molecular orbitals in a homonuclear diatomic molecule.
- Describe the aspects of thermodynamic control and kinetic control of chemical reactions by referring to the case of two competing reactions that provide two different products B, C:

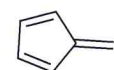


and in which the relative kinetic constants and equilibrium constants are such that $k_1 > k_2$ e $K_1 < K_2$.

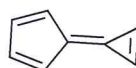
- Describe the Arrhenius equation for the dependence of kinetic constants on temperature and discuss the relative molecular interpretation.
- Explain why the following reaction leads to the products that are shown



- What is the direction of the dipole moment in fulvene and calicene? Which compound has the stronger dipole moment? Explain

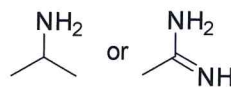
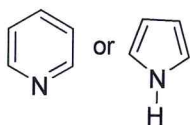


fulvene



calicene

- In each of the following pairs, which compound is a stronger base? Why?



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7. The role of catalyst in chemical reactions, with particular reference to activity, selectivity and productivity in industrial processes.
8. Composite materials: morphology and usual preparation methods, the properties induced or improved with respect to the pure matrix and main fields of application.
9. What differentiates a macromolecule from a low molecular weight compound?
10. Sodium hydride when dissolved in water produces:
 1. Acidic solution
 2. Basic solution
 3. Neutral solution
 4. Cannot be predicted
11. Give reason for the following in one or two sentences: "solid carbon dioxide is known as dry ice"
12. The experimental magnetic moments (Bohr magnetons) of a number of complex ions are listed.
Comment on (a) the d electron configuration and (b) the validity of the 'spin only' formula.

	<i>Magnetic Moment</i>
$\text{Ti}(\text{H}_2\text{O})_6^{3+}$	1.8
$\text{Mn}(\text{CN})_6^{4-}$	2.2
$\text{Mn}(\text{H}_2\text{O})_6^{2+}$	5.9

13. How are the detection limit and the instrumental detection limit defined according to IUPAC? Explain the differences between these two concepts.
14. Describe the working principle and the main characteristics of either a gas or a liquid chromatographic detector.
15. When performing a spectrophotometric determination of a molecule, explain how the measurement wavelength is selected and why.