UNIVERSITÀ DI PISA

Concorso pubblico anno accademico 2019/2020 per l'accesso al Corso di dottorato in SCIENZE CHIMICHE E DEI MATERIALI procedura concorsuale per tema di ricerca in: "Preparazione di materiali polimerici meccanocromici"

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

1. Describe the differences between the glass transition temperature and the melting temperature.

2. The carbon group elements are of particular interest in organic chemistry and chemistry of life. Select two elements of the group and describe their main features, differences and similarities.

3. Describe the difference between the Lewis and the Bronsted acid/base character.

4. The Jablonski diagram: illustrate the electronic states of a molecule and the transitions between them.

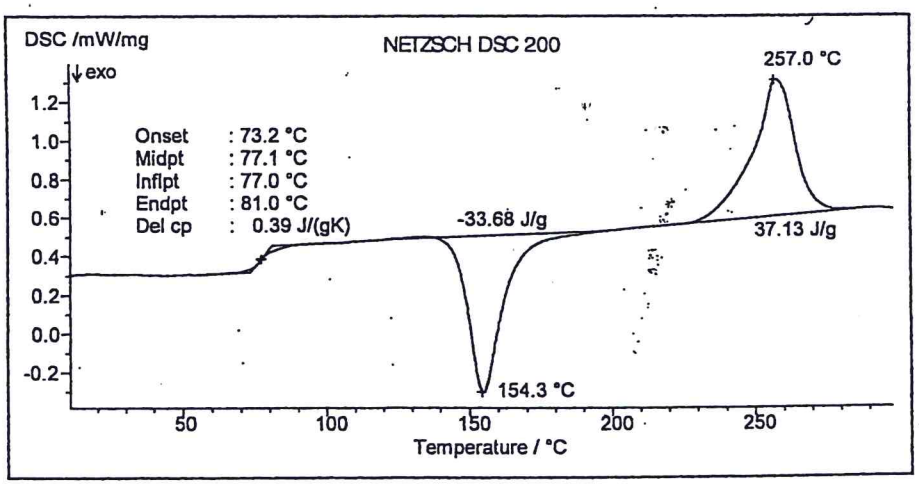
5. Describe the role of a catalyst in a chemical reaction and make an example of reaction in which a catalyst (homogeneous or heterogeneous) is used.

6. Discuss the concept of "atom economy" briefly, with the help of appropriate examples.

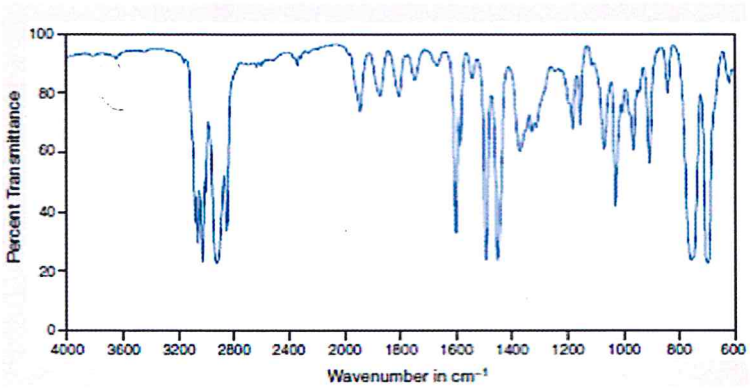
7. Discuss the differences between primary and secondary interactions also in terms of the different energies involved.

8. What is a regioselective reaction? Explain concisely but clearly.

9. Describe the following thermogram of a thermoplastic polymer. The curve has been registered with a typical heating program from 10 to 300°C at 20°C/min under nitrogen flow.



10. Assign the following IR spectrum to the right molecule: polystyrene or poly(methyl methacrylate)?. Motivate your answer.

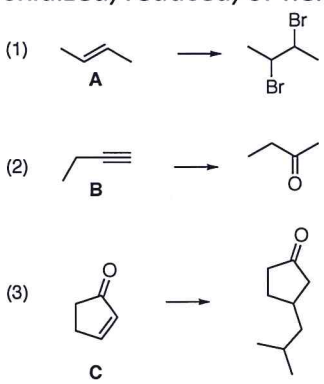


11. Semiconductors and Metals: general features and differences.

12. Carbon disulphide (CS_2) shows 3 fundamental vibration frequencies: symmetric stretching at 658 cm^{-1}, bending at 397 cm^{-1}, and asymmetric stretching at 1533 cm^{-1}. Which of these is IR active and which is Raman active and why? CS_2 is a linear molecule, therefore 4 vibrational modes are expected. Why only 3 fundamental vibrational frequencies are observed?

13. Describe the key characteristics and difference of the two main types of polymerization: chain-reaction (or addition) and step-reaction (or condensation) polymerization (monomers, kinetics, obtained polymers).

14. Say whether at the end of the following transformations the compounds A, B, and C, are oxidized, reduced, or neither. Motivate the answer.



15. Using appropriate neutral molecules and ions as examples, discuss the concept of aromaticity.