

### Part 1

1. What are the reasons for the commercial and scientific success of zeolites? Please justify based on origin and formation, chemical composition, synthesis methods, functionality, durability, harmfulness/toxicity?
2. List the basic physicochemical methods used the identification and quality assessment of zeolites: structure, porosity, acidity, crystal size and morphology.
3. Which features of the MOF materials seem to give them advantages over zeolites, and which are less favorable – consider synthesis (ease, cost, efficiency), chemical composition, catalytic functionality, durability, harmfulness/toxicity?
4. What is the basic difference between 2D and 3D zeolites, what modifications are specific to 2D zeolites only?

### Part 2

1. Discuss the basic methods of chemical syntheses under anaerobic/anhidrous conditions based on any example of an air sensitive compound.
2. Discuss the principles of the laboratory work with the use of an inert atmosphere glovebox.
3. Describe the principle of operation of the Schlenk line and the methods of preparing the glassware for anaerobic/anhidrous conditions.

### Part 3

1. Describe - taking into account specific aspects - the possible advantages of syntheses using milling/grinding or microwave irradiation compared to syntheses using the traditional heating the reactants in a suitable solvent.
2. Which of the 12 basic Principles of Green Chemistry can be addressed (and how) when conducting syntheses using non-standard methods of supplying energy to the reaction system? Describe two methods of such non-standard energy supply.
3. Using the information provided during the panel classes, describe two reactions which are more favorable to conduct under organocatalytic conditions and under influence of light of an appropriate wavelength than under traditional conditions. For each of these two selected responses, list these benefits.

### Part 4

1. Discuss the most important problems related to scaling-up from the laboratory to the technical stage.
2. Based on the ammonia synthesis, discuss technological solutions used in industrial installations leading to optimal thermodynamic and kinetic conditions for the process performance.
3. What are the functions of catalysts used in motor vehicles? Explain in what form the car catalysts are used and why.

### Part 5

1. Define and write what do the division constants  $K$  and  $P$  measure? What is the thermodynamic reason for the degree of transfer of a substance from phase a to phase b in a two-phase system?
2. List and characterize the main intermolecular interactions?
3. Describe the difference between chemical sensors and biosensors taking into account the structure of a receptor part and characteristic analytical parameters.
4. List and describe the types of sorbents used in the extraction with solid phase extraction process.

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5. Discuss the most known ionization methods (so-called ion sources) used in the LC-MS system.
6. Discuss the advantages of the method of concentration and isolation of analytes - QuEChERS.
7. List and briefly characterize at least 10 evaluation criteria of the analytical methods that you consider important for expressing its overall potential. Classify them into 3 groups: red (analytical efficiency), green (compliance with the principles of green chemistry) and blue (economic and practical efficiency).
8. Explain what the term "accuracy" of the analytical method means and what is its measure. What are the ways to estimate of "accuracy"?