NMR

1. What is the fundamental requirement of an atomic nucleus to give a nmr spectrum?
2. Describe bravely the physical phenomenon of NMR.
3. Why, in an external magnetic field, do spin-up and spin-down states have different energies?
4. What is net magnetization and how does it apply to NMR?
5. Why does the RF-field have to be applied at the Larmor frequency for resonance to occur?
6. Explain the correlation between relaxation time constants T1 and T2 and molecular dimensions.
7. How Magnetic resonance imaging (MRI) maps the different regions in a soft tissue?
8. What region of the electromagnetic spectrum is used in nuclear magnetic resonance?
9. What is meant by a chemical shift?
10. What is TMS, and why it is used as chemical shift reference?
11. Why is the number of absorbing carbons not proportional to the area under a 13C NMR signal?
12. Why is the number of absorbing protons proportional to the area under a 1H NMR signal?
13. What is shielding and deshielding in NMR? Can you give me an example?
14. What influence a chemical shift?
15. How many NMR signals does ethane show?
16. For a 2D experiment (Two-dimensional correlation spectroscopy) in NMR how is the second dimension obtained?
17. What is the Magnetic resonance fingerprinting?

LC-MS and Validation

1. Definition of Screening Methods and Confirmatory Methods
2. Coupling GC-MS: main ionization methods.
3. What does exactly measures Mass Spectrometry?
4. Differences between HPLC and UHPLC.
5. Coupling LC-MS with atmospheric pressure ionization.
6. Comparison between LC-UV and LC-MS
7. Applicability of GC-MS and LC-MS
8. Ionization techniques: soft and hard approaches.
9. Magnetic sector: principles and functioning
10. Quadrupole mass analyser: brief description.
11. Time of flight (TOF), principles and coupling
12. Resolution and accuracy: definitions
13. Orbitrap MS analyser: advantages of HRMS
14. Tandem MS (MS/MS): advantages and operational modes.
15. list and define at least 3 parameters needed for the validation
16. Define CCalfa according to 2002/657/CE decision
17. Define CCBeta according to 2002/657/CE decision
18. Define what is Maximum Residue Limit in Eu regulation
19. List at least three different categories of contaminants in food according to EU

FTIR

1. why molecules absorb in the IR region of the spectrum?
2. define the fingerprinting region of IR Spectra
3. in which region of IR we observe absorption of chemical groups?
4. define overtones in IR
5. What is the role of a Michelson interferometer in a FTIR Instrument?
6. Why a Fourier Trasform needs to be applied in FTIR?
7. advantage of a FTIR versus classical IR instrument
8. describe the attenuated total reflection sampling mode
9. report main advantages of FTIR analysis of food vs. classical methods
10. report main disadvantages of FTIR analysis of food vs. classical methods
11. which is the signal used in FT-NIR instruments?
12. describe the type of calibration used in FTIR analysis of food
13. report 3 application of FT-NIR in food analysis
14. why FTIR is useful for food process control?
15. Why FTIR cannot be used to detect food contaminants?

ENZYMES ELECTRODES AND NANOMATERIALS

1. Classification of biosensors on the basis of transducer and biological element
2. Which phenomena affect the current measured at an amperometric transducer?
3. Define a voltammetric transducer
4. How a Clark oxygen electrode works?
5. How a platinum based hydrogen peroxide electrode works?
6. Define a chemical mediator in enzyme electrodes
7. Describe what is a screen printed electrode
8. Briefly report how the current signal is generated at an amperometric enzyme electrode
9. Briefly explain how a BOD biosensor works
10. Define first, second and third generation of enzyme electrodes
11. What is the use of ferrocene and its derivatives in enzyme electrodes?
12. how it is possible to detect amperometrically hydrogen peroxide with no Pt electrode?
13. advantages and disadvantages of working in flow injection analysis for an enzyme electrode
14. list three possible applications of enzyme electrodes in food analysis
15. what is the advantage of using nanomaterials in sensor and biosensors?
16. differences among graphene and carbon nanotubes
17. define an inhibition based biosensor
18. report an application of enzyme inhibition biosensing in food analysis
19. advantages and disadvantages of the use of paper in electrochemical sensing

METAL NANOPARTICLES BASED ASSAY

1. what is the localised surface plasmon resonance?
2. Report how to mesasure antioxidant activity using metal nanoparticles
3. List 2 application of metal nanoparticles based assay for food
4. List possible assay formats using metal nanoparticles
5. Report a possible application of metal nanoparticles assay coupled with smartphone detection

AFFINITY BIOSENSING

1. scheme of a competitive immunoassay
2. scheme of a non competitive immunoasssay
3. what is the non-specific background signal in heterogeneous immunoassay?
4. shape and key parameters of a calibration curve of an immunoassay
5. scheme of an ELISA
6. why HRP and AP are the most used enzymes in ELISA?
7. Polyclonal vs. monoclonal antibodies differences in production and analytical use
8. list three possible detection techniques in immunoassays
9. list three possible applications of immunoassays and immunosensors in food analysis
10. scheme of a lateral flow immunoassay
11. scheme of a surface plasmon based (SPR) biosensor
12. scheme of a piezoelectric biosensor
13. advantages and disadvantages of SPR based biosensor vs ELISA
14. advantages and disadvantages of piezoelectric based biosensor vs ELISA
15. scheme of a DNA hybridisation biosensor
16. report one example of label free DNA biosensor in food analysis
17. why gold surfaces are used in affinity biosensing?
18. definition of a biomimetic based biosensor
19. definition a molecularly imprinted polymer
20. definition of an aptamer
21. properties of gold nanoparticles
22. definition of an electronic nose
23. report 2 types of sensors used in electronic noses