

# Instrumental Analytical Chemistry

## INSTANCHEM

### Part I

### Self-assessment



Chemistry Degree

3<sup>rd</sup> Year

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Sample INSTANCHEM test questions:

- 1. In UV-VIS spectroscopy, interaction of radiant energy with matter involves**
  - A. Nuclear configuration change
  - B. Binding electron excitation
  - C. Either molecular rotation or vibration
- 2. Isosbestic point of a system HA/A<sup>-</sup> is one in which:**
  - A.  $\text{pH} = 2 \text{ pKa}$
  - B.  $\epsilon_{\text{HA}} = \epsilon_{\text{A}^-}$
  - C.  $\text{pH} = \text{pKa}$
  - D.  $[\text{HA}] = [\text{A}^-]$
- 3. If the molar absorptivity of HA is far superior to that of A<sup>-</sup>**
  - A. The calibration will be linear if done at  $\text{pH} = \text{pKa}$
  - B. The calibration will be linear if it is done in a strong acid medium
  - C. The buffering of solutions will ensure the linearity of the calibration
  - D. It is not possible to obtain a linear calibration
- 4. Beer's law is complied with:**
  - A. When the monochromator's bandpass is exactly 3 nm wide
  - B. When the wavelengths used match the maximum of the absorption peak
  - C. When the monochromator's bandpass is at least 10 times wider than the half-height absorption width of the analyte
- 5. In UV-VIS spectrometry, the cuvette must always be placed between the monochromator and the detector**
  - A. True
  - B. False
- 6. Shot noise is due to**
  - A. Thermal movement of electrons in the resistors
  - B. Changes in temperature in the conducting circuitry
  - C. Movement of the electrons through a junction
- 7. The refractive index of the material used to manufacture a prism is to remain constant with wavelength**
  - A. True
  - B. False
- 8. Indicate which of the following properties does not correspond to an ideal detector**
  - A. High sensitivity
  - B. High signal / noise (S / N) ratio
  - C. Long response time
  - D. Absence of dark current
- 9. The simultaneous recording of a spectrum at all the wavelengths is possible with ...**
  - A. Time-resolved double beam spectrophotometer
  - B. Space-resolved double beam spectrophotometer
  - C. Photo Diode Array, PDA, detector
- 10. The S/N ratio**
  - A. Decreases when averaging spectra
  - B. Increases with the square root of the the number of averaged spectra
  - C. It is independent of the number of measuments done
- 11. An interference filter**
  - A. Provides a broader bandpass width than that provided by a colored filter
  - B. Presents a lower Transmittance than a colored filter
  - C. Is based on the phenomenon of scattering of radiation
  - D. Shows bandwidths that are typically thinner than those of colored filters



- 12. The dispersion caused by a quartz prism**
- A. It is linear along the focal plane of the exit slit
  - B. It is larger in the red zone of the spectrum than in the blue zone
  - C. It is especially high in the UV
- 13. An echelette grating provides a uniform linear dispersion across the UV-VIS**
- A. True
  - B. False
- 14. Just considering the uncertainty in the measurement of the Transmittance**
- A. To report the concentration, C, with a minimum error requires the measurements to be made in a range between 0.2 and 0.8 of absorbance units.
  - B. The absolute value of T is irrelevant to the precise quantification of the analyte
  - C. It is preferred to perform a calibration at such an interval of C that guarantees the minimum T
  - D. It is demanded that absorbance must acquire a positive integer value  $> 1$
- 15. The multiplicity of non-conjugated chromophores**
- A. Exerts a marked influence on the wavelength
  - B. Produces a hypsochromic effect
  - C. Significantly increases the value of the molar absorptivity
- 16. Absorption by transition metal solutions**
- A. Depends on the nature of the ligands present
  - B. Gives sharp and well-defined signals
  - C. Is independent of the nature of the solvent
  - D. It always happens in the VIS regardless of the electronic structure in the layer d
- 17. In fluorescence and phosphorescence measurements, the detector is normally placed**
- A. In line with the source
  - B. Perpendicularly to the source
  - C. Forming an angle of 135 degrees with the source
- 18. Fluorescence emissions**
- A. Are obtained at wavelengths shorter than those corresponding to the respective absorption process
  - B. They may involve excited states with different multiplicity to that of the ground state
  - C. Occur between high vibrational levels of the first excited electronic state and the zero vibrational level of the electronic ground state
  - D. Occur between the 0 vibrational level of the first excited electronic state and one of the vibrational levels associated with the ground electronic state
- 19. The lifetime of a triplet excited state is much lower than that of a singlet excited state**
- A. True
  - B. False
- 20. Stokes' shift**
- A. Indicates a shift to higher energies of the fluorescent process with respect to the absorbing process
  - B. Refers to a shift in the wavelength of the fluorescence to higher values with respect to the absorption wavelength
  - C. It is not related to a radiational pathway energy dissipation process
- 21. The predissociation and dissociation phenomena are more favorable when energies absorbed from the incident beam give rise to transitions of the type:**
- A.  $n-\pi^*$
  - B.  $\sigma-\sigma^*$
  - C.  $\pi-\pi^*$
- 22. Quinine's fluorescence will be enhanced**
- A. At high temperature
  - B. In the presence of 1-bromopropane
  - C. In a micellar medium