Instrumental Analytical Chemistry

INSTANCHEM

Part I

Self-assessment

Chemistry Degree

3rd 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¯ is one in which:
   A. pH = 2 pKa
   B. $\varepsilon_{\text{HA}} = \varepsilon_{\text{A}¯}$
   C. pH = pKa
   D. $[\text{HA}] = [\text{A}¯]$  

3. If the molar absorptivity of HA is far superior to that of A¯
   A. The calibration will be linear if done at pH = 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 cm 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 number of averaged spectra
    C. It is independent of the number of measurements 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 minimun 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 happen 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-π*
B. σ-σ*
C. π-π*

22. Quinine's fluorescence will be enhanced
A. At high temperature
B. In the presence of 1-bromopropane
C. In a micellar medium