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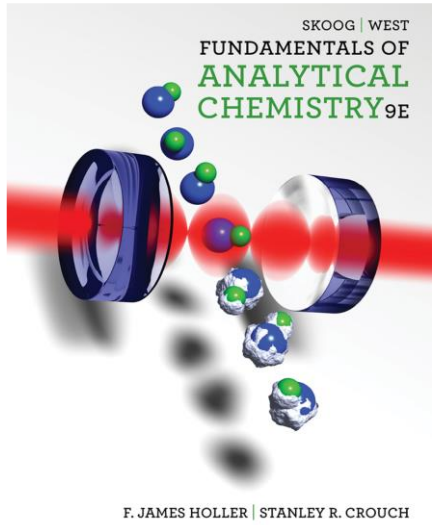
1.



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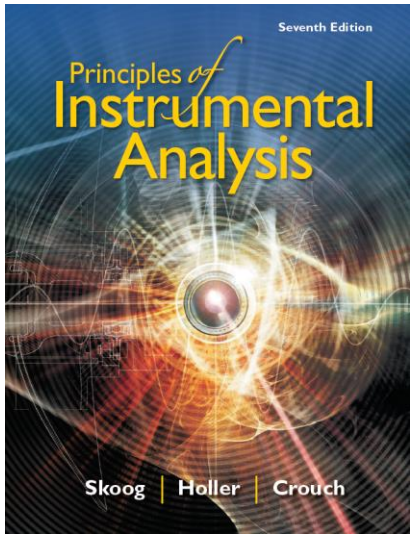


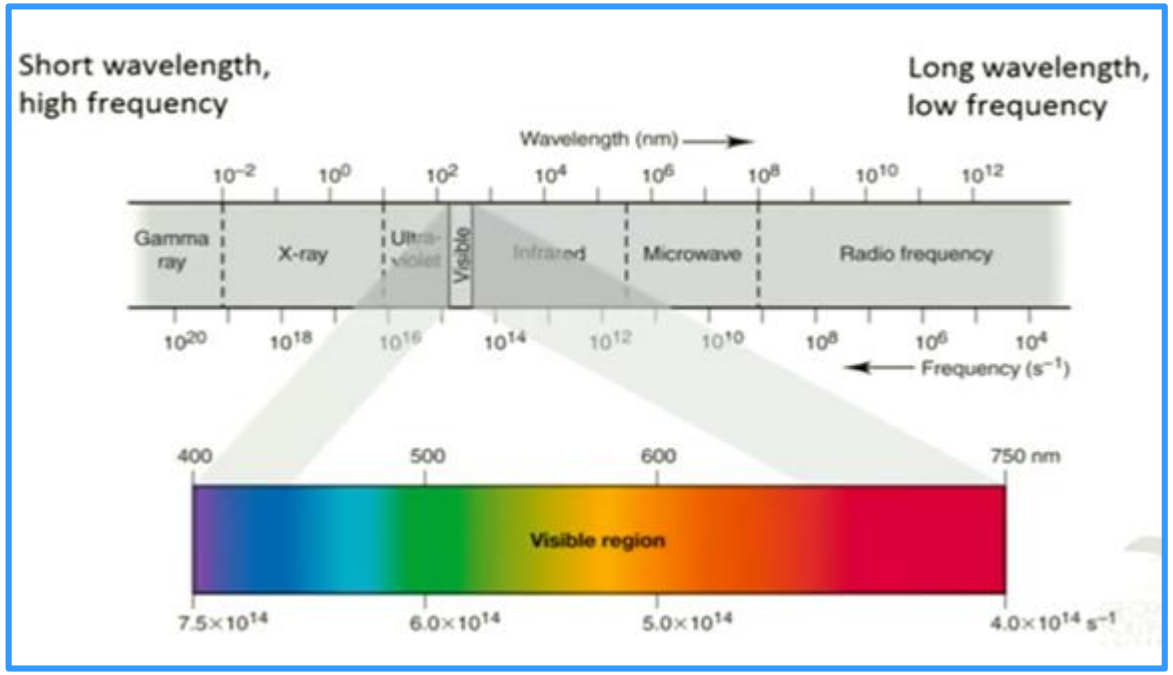
3. ATAKOL's lecture notes

1. Skoog, D.A., West, D.M., Holler, J.F., Crouch, S.R. 2013. Fundamentals of Analytical Chemistry (9E). Cengage Learning, Belmont, USA.
2. Skoog, D.A., Holler, J.F., Crouch, S.R. 2016. Principles of Instrumental Analysis (7E). Cengage Learning, Boston, USA.
3. Prof. Dr. Orhan ATAKOL's lecture notes.

The Electromagnetic Spectrum and effects on the matter

The Electromagnetic Spectrum and effects on the matter

The Electromagnetic Spectrum is the diagram that shows that the region where the radiation stimulates the substance and the change in the substance as a result of excitation.



- We can classify spectroscopic methods according to the region of the electromagnetic spectrum used or produced in the measurement.

- The γ-ray, X-ray, ultraviolet (UV), visible, infrared (IR), microwave, and radio-frequency (RF) regions have been used.

Interaction of Radiation and Matter

- The most interesting and useful interactions in spectroscopy are those in which transitions occur between different energy levels of chemical species.
- Other interactions, such as reflection, refraction, elastic scattering, interference, and diffraction, are often related to the bulk properties of materials rather than to the unique energy levels of specific molecules or atoms.
- Although these bulk interactions are also of interest in spectroscopy, we will limit our discussion here to those interactions in which energy level transitions ocur.
- The specific types of interactions observed depend strongly on the energy of the radiation used and the mode of detection.

- Types of atomic and molecular transitions that result from interactions of the radiation with a sample.
- The low-energy radiation used in nuclear magnetic resonance (NMR) and electron spin resonance (ESR) spectroscopy causes subtle changes, such as changes in spin.
- The high-energy radiation used in γ-ray spectroscopy can cause much more dramatic changes, such as nuclear configuration changes.
- Spectrochemical methods that use not only visible but also ultraviolet and infrared radiation are often called optical methods in spite of the fact that the human eye is not sensitive to UV or IR radiation.
- This terminology arises from the many common features of instruments for the three spectral regions and the similarities in the way we view the interactions of the three types of radiation with matter.

Spectroscopic Measurements

- Spectroscopists use the interactions of radiation with matter to obtain information about a sample.
- Several of the chemical elements were discovered by spectroscopy.
- The sample is usually stimulated in some way by applying energy in the form of heat, electrical energy, light, particles, or a chemical reaction.
- Prior to applying the stimulus, the analyte is predominately in its lowest-energy or ground state.
- The stimulus then causes some of the analyte species to undergo a transition to a higher-energy or excited state.
- We acquire information about the analyte by measuring the electromagnetic radiation emitted as it returns to the ground state or by measuring the amount of electromagnetic radiation absorbed as a result of excitation.

- When the sample is stimulated by applying an external electromagnetic radiation source, several processes are possible.
- For example, the radiation can be scattered or reflected.
- What is important to us is that some of the incident radiation can be absorbed and promote some of the analyte species to an excited state.
- In absorption spectroscopy, we measure the amount of light absorbed as a function of wavelength.
- Absorption measurements can give both qualitative and quantitative information about the sample.
- In photoluminescence spectroscopy, the emission of photons is measured following absorption.
- The most important forms of photoluminescence for analytical purposes are fluorescence and phosphorescence spectroscopy.