QA Spectroscope

16525

Instructions for the Quantitative Analysis Spectroscope

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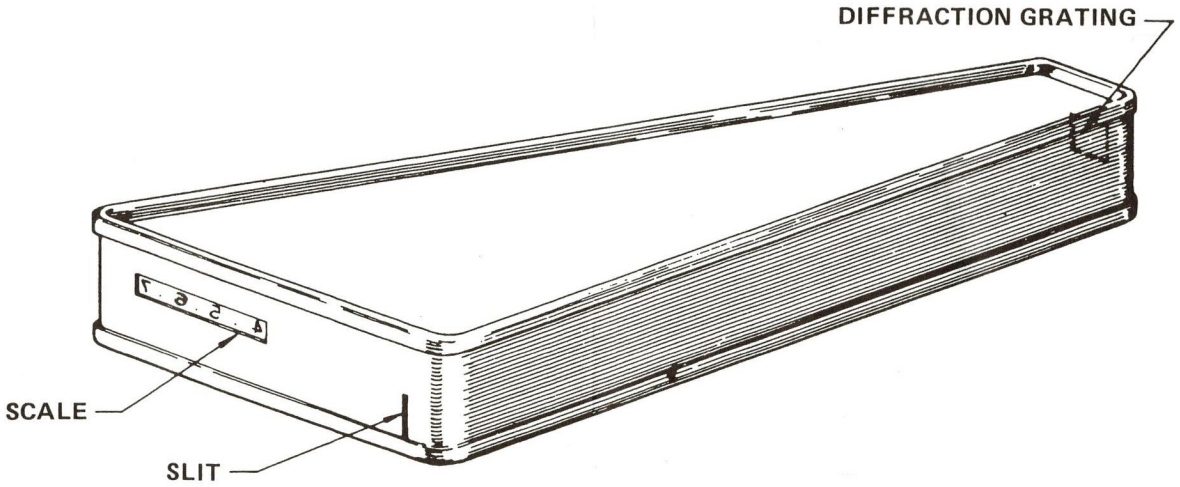

Operation

Look through the diffraction grating at the narrow end of the spectroscope pointing the slit towards the light source to be analyzed. The spectrum will appear on the right side of the slit below the scale where the wavelengths of the absorption or emission lines can be read. The visibility of the spectrum can be improved by holding the hand around the narrow end of the spectroscope using the thumb and the index finger to keep stray light from around the eye.

Calibration

The numbers on the scale represent 1000 Å units. Looking through the spectroscope at a fluorescent lamp, all colors of the spectrum will be visible with two brighter lines - one violet line at 4360 Å and one green line at 5460 Å. If the lines are not exactly in place, the difference must be added or subtracted respectively in all determinations.

The Study of the "Fingerprints" of Light

When white light is properly analyzed, it appears as a continuous band of colors ranging from violet at one end to red at the other end. Such a band is called a spectrum. A spectrum will be formed when white light passes from one medium into another, and the light is separated into its component wavelengths. The separation of light can be achieved by using a prism or a diffraction grating.

Fundamentally, there are three basic types of spectra:
(1) Continuous spectrum - formed when all wavelengths are present.
(2) Emission (bright line) spectrum - appearing when a gas is radiating a limited number of wavelengths and thus producing a limited number of bright lines.
(3) Absorption (dark line) spectrum - resulting from the absorption of certain wavelengths by a gas, liquid, or other filtering substances located between the radiating source and the observer.

Emission and absorption spectra can be used as "fingerprints" in the identification or absorbing substances because their lines are specific for each element.

As a widely used technique at the frontiers of research, spectroscopy makes use not only of the visible light but of the infrared and ultraviolet radiation as well. Once the student has understood and actually done spectroscope work in the visible spectrum, he will have no difficulty in understanding and using this technique in the full range of electromagnetic radiation in his future research.

Suggestions for use in the Laboratory

Every student in class can experience the excitement of identification of substances by the quality of light as it is absorbed or emitted.

Each element in its gaseous form will emit light of definite wavelengths if subjected to high temperatures or to an electric arc. Strontium, sodium, lithium, and copper salts produce easily recognizable emission spectra if vaporized in a Bunsen burner flame. Helium, oxygen, hydrogen, mercury, neon, etc. are more easily recognized from the electric arc of vacuum tubes.

Elements and compounds may be identified by the light they absorb. Spectroscopic investigation of filters and filter combinations can well serve as a model for this technique. Observation of the absorption spectrum of a chlorophyll or hemoglobin solution with the QA Spectroscope is an exciting first-hand experience for any student.

It is recommended that students be confronted with the task of identification of substances by their emission or absorption spectra. The teacher may either set up stations or have students work in groups. The details of the setups of a laboratory investigation will vary with the type of course, whether it be Physics, Chemistry, Biology, Earth Science, or Astronomy.

The following chart lists the wavelengths emitted by some elements:

Element	Wavelengths in Å
Sodium	5890
Strontium	6060
Lithium	6708
Copper	4300-6300
Hydrogen (vacuum tube)	6530, 4830, 4310
Mercury (vacuum tube)	4360, 5460, 5770
Helium (vacuum tube)	4470, 4680, 4920, 5010
	5870, 6670

Caution: The sodium line (5890Å) may appear as a contaminant in all spectra.

The following solutions are suggested for producing absorption spectra (each solution absorbs in the spectral range indicated):

Aqueous Copper Sulfate - wavelengths greater than 6450Å

Aqueous Potassium Permanganate - wavelengths between 4550 and 5750 Å