

Chemistry 1210
Quantitative Determination of a Two-Component System

Date: _____

Name: _____

OBJECT: The objective of this experiment is to quantitatively determine the composition of a two-component system using spectrophotometric methods.

PROCEDURE: As in the Chemistry 1210 lab manual, page _____ plus additional procedure as noted below.

OBSERVATIONS:
Describe Nickel, Cobalt, and Mixture solutions here.

Two-Component System

PROCEDURE:

1. With a partner, determine the Absorbance vs. Wavelength of Ni and Cobalt from 360-600 nm. Since the Spec 20 must be re-set each time, have the nickel and the cobalt samples ready to be measured for each wavelength. **Use cuvettes that match within 2% Transmittance.**
- a) Choose the desired wavelength (360 nm). If there is a filter lever, make sure it is set to the correct range.
- b) Set the instrument.
- c) Measure the absorbance of the cobalt known and the nickel knowns at that wavelength.
- d) Change the wavelength (380 nm). Adjust the filter lever if needed.
- e) Re-set the instrument .
- f) Again measure the absorbance of nickel and cobalt at the new wavelength.
- g) Repeat the procedure every 20 nm until a wavelength of 600 has been measured.
- h) Find the wavelength of maximum absorbance (λ_{max}) more accurately by finding regions of high absorbance and re-scanning them in steps of 5 nm.

Note: If you cannot read Absorbance to 3 decimal places, record transmittance and then convert to absorbance use the following formula:

$$A=2-\log(\%T)$$

3. **Now work on your own**, and use only one instrument for the rest of the readings:

Measuring the knowns:

- a) Make sure the instrument is re-set at the nickel λ_{\max} .
- b) At the nickel λ_{\max} , **determine the absorbance (see data section) of the known nickel and known cobalt twice each, the second of each with a fresh sample.**
- c) Re-set the machine at the cobalt λ_{\max} .
- d) At the cobalt λ_{\max} , measure the **known** nickel and the **known** cobalt **as above**.

Measuring the unknowns:

- e) Empty the cuvettes containing known nickel and cobalt solutions and refill them (with correct rinsing) with your **unknown** cobalt. Also fill another cuvette with the unknown mixture.
- f) Since the instrument is still at the cobalt λ_{\max} , rezero, and measure the **unknown** cobalt and **unknown** mixture at the cobalt λ_{\max} . (Be sure to put your data in the correct table). **Take two readings of each as previously described.**
- g) At the nickel λ_{\max} , re-set the instrument.
- h) Now measure the **unknown** mixture at that wavelength. Again, take two readings of each.
- i) **All cuvettes must be rinsed out thoroughly with distilled water and turned upside down in the test tube rack to indicate they are clean.**

DATA:

Determination of λ_{max}

Use the extra space at the end to determine the two wavelengths more accurately by finding regions of highest absorbance for each metal and re-scanning them in 5 nm increments.

Wavelength	Absorbance of known Co solution	Absorbance of known Ni solution
360		
380		
400		
420		
440		
460		
480		
500		
520		
540		
560		
580		
600		

Attach a graph of absorbance vs. wavelength for both Co and Ni. Label each λ_{max} clearly.

DATA:

Concentration of known nickel solution	
Concentration of known cobalt solution	

Ni λ_{\max}	
Co λ_{\max}	

When less than 2 decimal places are obtained for absorbance, record %T, then calculate absorbance. Note: Calculate average absorbance after converting %T to absorbance.

% T or Absorbance of known nickel at the nickel λ_{\max}			Average absorbance: _____
%T or Absorbance of known nickel at the cobalt λ_{\max}			Average absorbance: _____

% T or Absorbance of known cobalt at the nickel λ_{\max}			Average absorbance _____
% T or Absorbance of known cobalt at the cobalt λ_{\max}			Average absorbance: _____

Unknown# (Cobalt): _____

% T or Absorbance of unknown cobalt # _____ at the Cobalt λ_{\max}			Average absorbance: _____
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Unknown# (mixture): _____

% T or Absorbance of unknown mixture at Nickel λ_{\max}			Average absorbance: _____
%T or Absorbance of unknown mixture at Cobalt λ_{\max}			Average absorbance: _____

4. In the space below, calculate the concentration of the cobalt and of the nickel in your mixture.

RESULTS:

Unknown	Concentration	
Co# _____		
Mixture# _____	Ni	Co

DISCUSSION:

Give one source of error (beyond your reasonable control) in this experiment, and state how it would affect your results.