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 known 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 (λmax) 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:

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

2. **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 previousely 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) **<u>All cuvettes must be rinsed out thoroughly with distilled water and turned upside down in the test tube rack to indicate they are clean.</u>**

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 (nm)	**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 3 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:____

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:____

CALCULATIONS:

1. In the space below, calculate the extinction coefficients for **nickel** at the nickel λ_{max} and for **nickel** at the cobalt λ_{max}.

2. In the space below, calculate the extinction coefficients for **cobalt** at the cobalt λ_{max} and for **cobalt** at the nickel λ_{max}.

3. In the space below, calculate the concentration of your unknown cobalt solution:

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.