

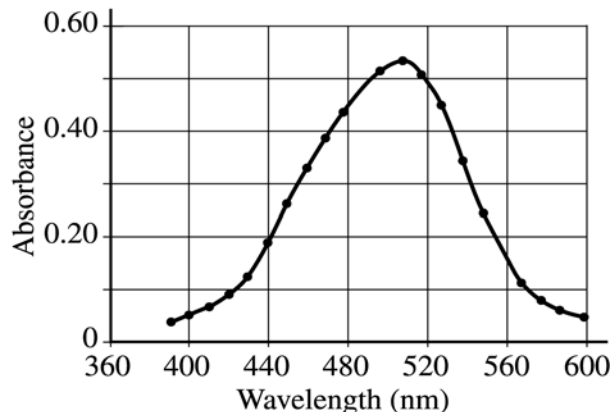
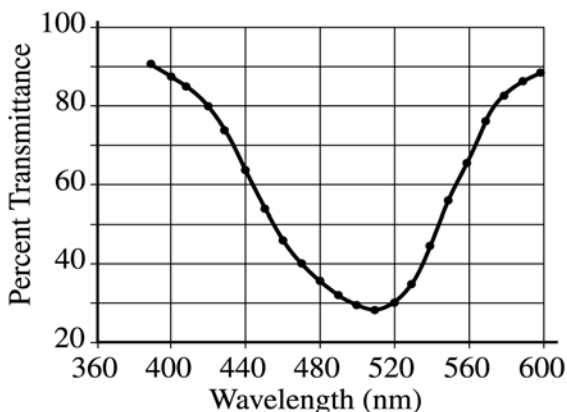
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based on absorption of light (spectrometric/colorimetric method). The student is provided with a 0.10 *M* solution of CoCl₂ with which to prepare standard solutions with concentrations of 0.020 *M*, 0.040 *M*, 0.060 *M* and 0.080 *M*.

- (a) Describe the procedure for diluting the 0.10 *M* solution to a concentration of 0.020 *M* using distilled water, a 100 mL volumetric flask, and a pipet or buret. Include specific amounts where appropriate.

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| $M_1V_1 = M_2V_2 : \quad V_1 = \frac{M_2V_2}{M_1}$ $V_1 = \frac{(0.020\ M)(100\ \text{mL})}{0.10\ M} = 20.\ \text{mL}$ <p>Pipet 20 mL of 0.10 <i>M</i> CoCl₂ into the 100 mL volumetric flask, then add enough water to reach the 100 mL mark on the neck of the volumetric flask. Stopper the flask and mix.</p> | <p>1 point for 20 mL of 0.10 <i>M</i> CoCl₂ (unit required)</p> <p>1 point for adding enough water to reach final volume of 100 mL</p> |
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The student takes the 0.10 *M* solution and determines the percent transmittance and the absorbance at various wavelengths. The two graphs below represent the data.

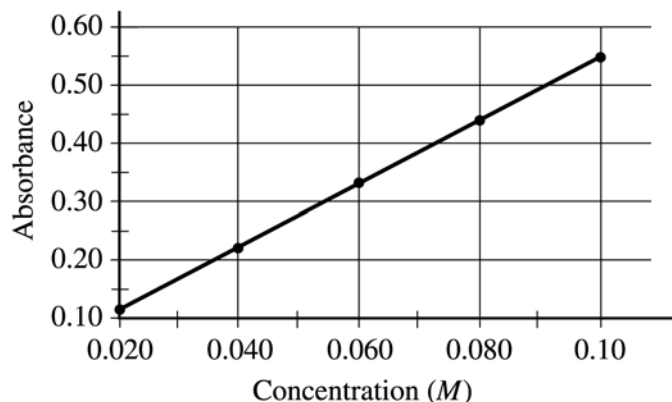


- (b) Identify the optimum wavelength for the analysis.

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| 510 nm (acceptable range 490-520 nm) | 1 point for wavelength ~510 nm (unit not required) |
|--------------------------------------|--|

The student measures the absorbance of the 0.020 *M*, 0.040 *M*, 0.060 *M*, 0.080 *M*, and 0.10 *M* solutions. The data are plotted below.

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(c) The absorbance of the unknown solution is 0.275. What is the concentration of the solution?

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| 0.050 M (acceptable range 0.045 to 0.055 M) | 1 point for concentration ~ 0.050 M (unit not required) |
|---|--|

(d) Beer's Law is an expression that includes three factors that determine the amount of light that passes through a solution. Identify two of these factors.

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| $A = a b c$ a = molar absorptivity (<u>not</u> absorbance) b = path length of cuvette/test tube c = concentration | 1 point for each factor |
|---|-------------------------|

Note: Symbols alone not sufficient; for a , accept molar absorbance, absorptivity, & absorbance coefficient

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Question 5 (cont'd.)

- (e) The student handles the sample container (e.g., test tube or cuvette) that holds the unknown solution and leaves fingerprints in the path of the light beam. How will this affect the calculated concentration of the unknown? Explain your answer.

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| The presence of the fingerprints will scatter or absorb light. Since less light reaches the detector, the solution will have a higher apparent absorbance, and therefore a higher reported concentration. | 1 point for increase in reported concentration of CoCl_2 1 point for “apparent” increase in absorbance or decrease in light |
|---|---|

- (f) Why is this method of determining the concentration of CoCl_2 solution appropriate, whereas using the same method for measuring the concentration of NaCl solution would not be appropriate?

| | |
|--|---|
| A CoCl_2 solution absorbs visible light. A NaCl solution is colorless (or does not absorb visible light). OR CoCl_2 solution has an appreciable molar absorptivity in the visible region and NaCl does not. | 1 point for indicating that NaCl does not absorb visible light or is colorless |
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