

Concentration, separation and absorbance

AP Chemistry · Lab

Name: _____ Date: _____ Class: _____

Many drinks and medicines are coloured by dyes whose amount can be measured by light absorption. In this lab you make standards by dilution, measure their absorbance with a colorimeter and test whether absorbance is proportional to concentration. You then use the calibration line to find the dye concentration in an unknown sample.

Level: AP Chemistry · **Curriculum:** AP Chem Unit 3

Aim

To verify the Beer-Lambert law for a blue food dye and to find the concentration of the dye in a sample of drink.

Equipment

- stock dye solution of concentration 1.00×10^{-5} mol/L
- five 25.00 mL volumetric flasks
- 10 mL graduated pipette with filler
- colorimeter with red filter (about 630 nm) and matched cuvettes
- distilled water, drink sample, tissue

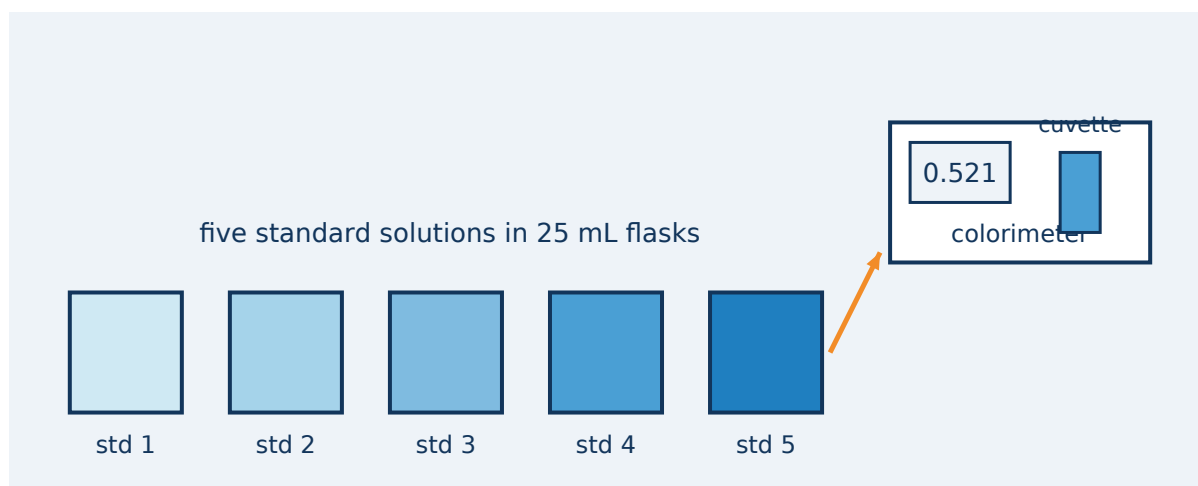
Safety

Safety

Wear goggles and a lab coat. Food dyes stain skin and clothes. Never pipette by mouth. Clean spills on the floor at once, because they are slippery.

Method

1. Pipette 2.50, 5.00, 10.0, 15.0 and 20.0 mL of stock dye into five 25.00 mL flasks and fill each to the mark with distilled water.
2. Fill a cuvette with distilled water and zero the colorimeter (blank).
3. Rinse a cuvette with a little of standard 1, fill it, wipe the sides and measure the absorbance.
4. Repeat for standards 2 to 5, working from the least to the most concentrated.
5. Measure the absorbance of the drink sample, diluted if it is outside the range.

*Standards and colorimeter.*

Results

Sample data (1.00 cm cuvette, 630 nm). The drink sample gave $A = 0.405$.

Standard	Stock volume (mL)	c (10^{-6} mol/L)	Absorbance
1	2.50	1.00	0.131
2	5.00	2.00	0.258
3	10.0	4.00	0.521
4	15.0	6.00	0.783
5	20.0	8.00	1.036

Analysis questions

Question 1 Check the concentrations

Show that the concentration of standard 3 is 4.00×10^{-6} mol/L.

Question 2 Why a blank

Explain why the colorimeter is zeroed with distilled water.

Question 3 Plot the graph

Plot A against c and describe the shape. State whether Beer's law is obeyed.

Question 4 Gradient

Calculate the gradient using standards 1 and 5 and state the molar absorptivity.

Question 5 Concentration of the drink

Use the line $A = 1.30 \times 10^5 c$ to find c for the drink sample, $A = 0.405$.

Question 6 Mass concentration

The dye has a molar mass of 792.9 g/mol. Calculate the mass of dye per litre of drink in mg.

Question 7 Choice of wavelength

Why was a red filter chosen for a blue dye?

Question 8 Improvements

State one source of uncertainty and one way to reduce it.