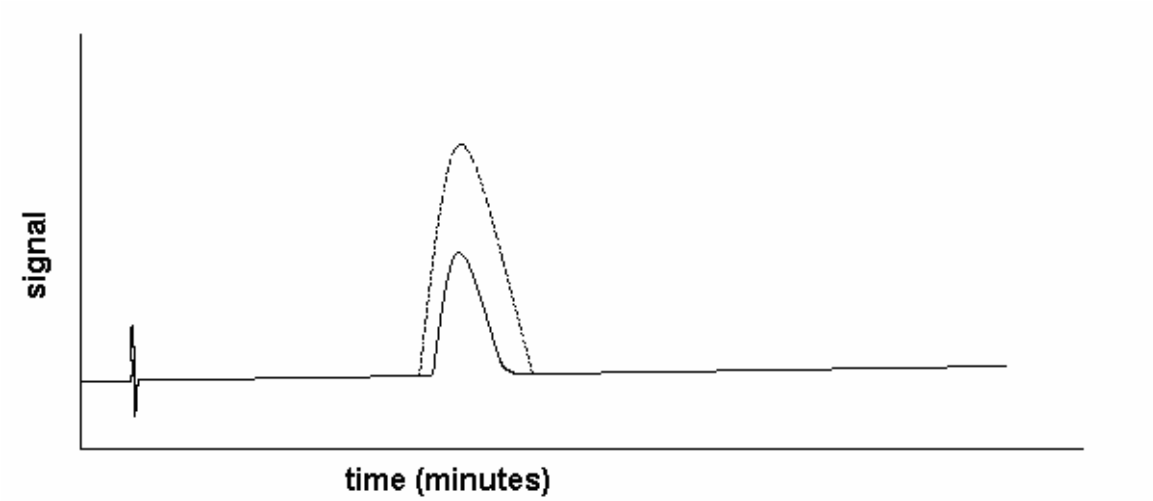
Chromatography Additional Problems

1. A separation on an affinity column produced the chromatogram shown below. Overtop of the chromatogram, sketch show what it would look like if a second sample with more (higher concentration) of analyte was run.



Note that the peak is in the same position, but larger.

2. Chromatography was performed on the following solutions, where the total volume of each solution is 100.0 mL:

solution	volume 100 ppm X (mL)	volume 50 ppm Y (mL)	volume 50 ppm Z (mL)
1	5	20	10
2	10	15	20
3	15	10	5
4	20	5	15

This resulted in 4 chromatograms with the following resuts:

peak A		**peak B**		**peak C**	
time (min)	Area (x 10^4)	time (min)	Area (x 10^5)	time (min)	Area (x 10^4)
6.44	0.68	8.00	4.10	9.72	7.99
6.54	1.98	7.96	8.30	9.68	7.63
6.34	2.18	8.03	2.53	9.66	7.27
6.49	3.02	8.12	6.29	9.58	6.93

a. Which peak corresponds to which analyte?

Peak A is the peak for X, since its area is consistently increasing.
Peak C is the peak for Y, since its area is consistently decreasing.
Peak B is the peak for Z, since its area increases in the first two trials then decreases and increases again, as the pattern for the concentrations.

b. **Make a calibration curve for each analyte**
See link to spreadsheet. The resulting equations are

$A_a = (1444 \pm 286)[X] + (1600 \pm 3914)$

$A_c = (1416 \pm 14)[Y] + (65700 \pm 95)$

$A_b = (43000 \pm 24556)[Z] + (39000 \pm 1793)$

c. A unknown solution was analyzed with the same method. Based on the results below, what is the composition of the sample?

retention time (min)	peak area
6.59	33419
8.05	554193
9.68	76416

$33419 = 1444[X] + 1600$
$31819 = 1444[X]$
$22.0 = [X]$

$$\frac{e_x}{22.0} = \sqrt{\left(\frac{286}{1444}\right)^2 + \left(\frac{3914}{31819}\right)^2} = 0.233$$

$e_x = (22.0)(0.233) = 5.1$

$[X] = 22.0 \pm 5.1$ ppm

$76416 = 1416[Y] + 65700$
$10716 = 1416[Y]$
$7.57 = [Y]$

$$\frac{e_y}{7.57} = \sqrt{\left(\frac{14}{1416}\right)^2 + \left(\frac{95}{10716}\right)^2} = 0.0133$$

$e_y = (7.57)(0.0133) = 0.10$

$[Y] = 7.57 \pm 0.10$ ppm

554193 = 43000[Z] + 39000
515193 = 43000[Z]
12.0 = [Z]

$$\frac{e_z}{12.0} = \sqrt{\left(\frac{1793}{39000}\right)^2 + \left(\frac{24556}{515193}\right)^2} = 0.0662$$

$e_z = (12.0)(0.0662) = 0.8$

$[Z] = 12.0 \pm 0.8$ ppm