Calibration Problems

Problem 1.

Calculate standard concentrations

$[Standard] = 16.93*V_{std}/50.00$

Graph [standard] versus absorbance

$A = (0.3185\pm0.0207)c + (0.0263\pm0.0392)$

Solve for concentration with absorbance of unknown solution

$0.511 = 0.3185c + 0.0263$
$1.52 = c$
(note: only 3 sf in absorbance, units are same as concentration units in graph)

Account for dilution

$(1.52 ppm)(50.00\ mL) = C_A(10.00\ mL)$
$7.60\ ppm = c_A$

Account for original solution

$7.60\ \ ppm\ Co = 7.60\ mg/L * 0.200\ L = 1.52\ mg\ Co =$
$1.52\ X10^{-3}\ g\ Co/0.2960\ g *100 = 0.512\%$

Measure error
$e_x/x = [(e_m/m)^2 + (e_b/\{y-b\})^2]^{1/2}$

$e_x/0.512 = [(0.0207/0.3185)^2 + (0.0392/0.4847)^2]^{1/2} = 0.104$

$e_x = 0.104*0.512 = 0.0534$

<u>Final answer = 0.512±0.053%</u>

Problem 2

Calculate the standard concentrations

$[standard] = 9.58 * V_{std}/100$

Graph [std] versus absorbance

$A = (1.1461 \pm 0.1178)\ c + (0.4076 \pm 0.0334)$

Set A = 0 (since this is standard addition) and solve for c

$0 = 1.1461c + 0.4076$
0.356 ppm = c
only 3 sf based on absorbance and standard concentration
units are same as concentration units in graph

"undilute" This is concentration in the curve

*[solution B] = 0.356*100/5.00 = 7.11 ppm*

*[original solution] = 7.11*50/10 = 35.6 ppm*

in solid

*35.6 mg/L * 0.1000 L = 3.56 mg/10.02 mg * 100 = 35.5%*

error

$e_x/x = [(e_m/m)^2 + (e_b/\{y-b\})^2]^{1/2}$

note y = zero

$e_x/35.5 = [(0.1178/1.1461)^2 = (0.0334/0.4076)^2]^{1/2} = 0.13145$

$e_x = 35.5 * 0.13145 = 4.666$

Final answer = 35.5±4.7%

Problem 3

Graph Calibration curve as log[nitrate] versus potential

$E = (-0.08136 \pm 0.00908)\log[\text{nitrate}] + (0.02599 \pm 0.03229)$

note: point 4 is questionable, I left in it because I was tired. You can remove it and get slightly different numbers and better error.

Solve for nitrate ion concentration

$0.402 = -0.08136(\log[\text{nitrate}]) + 0.02599$
$-4.62 = \log[\text{nitrate}]$
$2.4 \times 10^{-5}\ M = [\text{nitrate}]$

note: 2 sf since decimals in log become sf in concentration,
units are same as concentration units in graph

Determine amount in solid

$2.4 \times 10^{-5}\ mol/L * 0.1000\ L = 2.5 \times 10^{-6}\ mol * (62.01\ g/1\ mol) = 1.6 \times 10^{-4}\ g *1000 = 0.16 mg$

Concentration in solid

$0.16 mg/0.440\ mg * 100 = 35\%$

Error

$e_x/x = [(e_m/m)^2 + (e_b/\{y-b\})^2]^{1/2}$

$e_x/35 = [(.00908/0.08136)^2 + (0.03229/0.376)^2] = 0.14082$

$e_x = 0.14082*35 = 4.9$

<u>Final Answer = 35±5%</u>

Problem 4

Small variations in retention time and peak area are normal. If anything, you should expect larger variations from real data.

Peak 2 increases by an order of magnitude. Therefore, that is the phenol peak.

Since peak area is proportional to concentration. Retention time is just a way of identifying the peak.

$$\frac{657199 = kC_x}{1901456 = k(5C_x+5(6.85)/10)}$$

$$0.345629 = 10C_x/(5C_x + 34.25)$$

$$1.728C_x + 11.84 = 10C_x$$

$$11.84 = 8.27C_x$$

$$1.43\% = C_x$$

Note: you cannot do error with this method
units are the same as the standard concentration

Original solution was not diluted, so final answer = 1.43%

Problem 5

a. Absorptivity time pathlength is the slope of the calibration curve.

$a = 1.36\ ppm^{-1}\cdot cm^{-1}$ (since pathlength only had 3 sf)

b. *%T = 57.5 so T = 0.575 so A = 0.240*

0.240 = 1.363c + 0.084
0.156 = 1.363c
0.114 = c

undilutions

0.114 mg/L.25L = 0.0285 mg/416 mg *100 = 0.00685%*

or

$0.0285\ mg/4.16 \times 10^{-4}\ kg = 68.5\ ppm$

error

$e_x/x = [(e_m/m)^2 + (e_b/\{y-b\})^2]^{1/2}$
$e_x /68.5 = [(0.067/1.363)^2 + (0.076/0.156)^2]^{0.5} = 0.490$
$e_x = 68.5 * 0.490 = 33.6$

<u>Final answer = 68.5±33.5 ppm</u>

c. The *ultraviolet*. It is worth remembering that about 400 to 800 nm is the visible region. Shorter wavelengths are higher energy, the uv, which goes to about 100 nm before you have to start calling them x-rays. Infrared are the longer wavelengths.