Complete the following. Provide answers in the spaces below and attach all work and any computer printouts to this sheet. You may work with a partner on this assignment and turn in a single copy of your results; however, you must ultimately be able to do these calculations yourself.

You have conducted an electrochemistry experiment to determine the quantity of lead in a drinking water sample by driving the reduction of Pb^{2+} to Pb^0 at an electrode surface and measuring the flow of electrons (current) that occurs in the process. Over the concentration range that you use, the response of the measurement should be directly proportional to concentration. Using the data for experiments A and B below, evaluate the following items.

1. The slope and intercept for the linear relationship describing how current depends on concentration, with the appropriate units and 95% confidence intervals for each.
2. The sensitivity of the measurement (with appropriate units)
3. The concentration and 95% confidence limit for the unknown in each experiment
4. The limit of detection for the measurement (with appropriate units).
5. The limit of quantitation for the measurement (with appropriate units).

Calibration Data

Pb^{2+} concentration (ppm)	Current (µA)
10.0	14.6
20.0	33.1
50.0	70.1
75.0	121
100.0	153

Unknown Results

For Experiment A, you measure three replicate unknowns and find their responses to be 41.8 µA, 39.4 µA, and 43.5 µA.
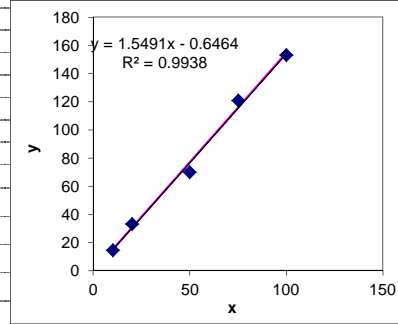
For Experiment B, you measure only one unknown and find its response to be 82.4 µA.

Answers:

1. Slope and intercept at the 95% confidence level: (5)

   m = 1.5 +/- 0.2₂ µA/ppm
   b = -0.6 +/- 13 ppm

2. Sensitivity of the measurement: (2)

   1.5 +/- 0.2₂ µA/ppm

3A. Concentration and 95% confidence limit for the unknown in Experiment A: (4)

   27 +/- 3 ppm (based on 3 x_{calc})
   27 +/ 12 ppm (based on y_{avg})

4A. LOD for Experiment A: (5)

   s_{LOD} = 12 µA = b + 3s_b
   LOD = 8 ppm

5A. LOQ for Experiment A: (2)

   s_{LOD} = 42 µA = b + 10s_b
   LOQ = 30 ppm (27)

3B. Concentration and 95% confidence limit for the unknown in Experiment B: (4)

   50 +/- 10 ppm (54 +/- 14 ppm)

4B. LOD for Experiment B: (2 for 4B and 5B combined)

   Same as 4A

5B. LOQ for Experiment B:

   Same as 5A

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
1		x	y	xy	x^2	n	y_{calc}	d	d^2	$(y-y_{bar})^2$	$y_{Unknown}$										
2		10	14.6	146	100	5	14.845	-0.2450178	0.06	4065.3	82.4										
3		20	33.1	662	400		30.3365	2.7635231	7.6371	2048.5											
4		50	70.1	3505	2500		76.8109	-6.7108541	45.036	68.228											
5		75	121	9075	5625		115.54	5.4604982	29.817	1818.2											
6		100	153	15300	10000		154.268	-1.2681495	1.6082	5571.1											
7				0	0		0	0	0												
8				0	0		0	0	0												
9				0	0		0	0	0												
10				0	0		0	0	0												
11				0	0		0	0	0												
12	Sums	255	391.8	28688	18625		391.8	7.105E-15	84.158	13571							LOD/LOQ Calculation for #4/#5				
13																	S_{LOD}	12.3	= b + 3s_b		
14		D =	28100				D = (E12*F2)-(B12*B12)										LOD	8.35	=(s-b)/m		
15		m=	1.54915				m = ((D12*F2)-(C12*B12))/C14										S_{LOQ}	42.5	= b + 10s_b		
16		b=	-0.64644				b =((E12*C12)-(D12*B12))/C14										LOQ	27.8	=(s-b)/m		
17		S_y=	5.29647				S_y = SQRT(I12/(F2-2))														
18		S_m=	0.07065	% S_m=	4.5606		S_m = SQRT((C17^2*F2)/C14)														
19		S_b=	4.31203	% S_b=	-667.04		S_b = SQRT((C17^2*E12)/C14)														
20		S_x=	3.74718	% S_x=	6.99		S_x=(C17/ABS(C15))*SQRT((1/1)+(C21^2*F2/C14)+(E12/C14)-((2*C21*B12)/C14))										Calculation for #3B				
21		x_{unk}=	53.6079				x_{unk}=(J2-C16)/C15										m	1.5491			
22		x-int.=	0.41729				x-int.=-C16/C15										b	-0.6464			
23		$S_{x-int.}$=	2.76761	%$S_{x-int.}$=	663.24		$S_{x-int.}$=(C17/C15)*SQRT((1/F2)+AVERAGE(C2:C11)^2/(C15^2*DEVSQ(B2:B11)))														
24		R^2 =	0.9938				R^2 = 1-(I12/J12)										y1	41.8	x1	27.4	
25							t = TINV(0.05,F2-2)										y2	39.4	x2	25.9	
26																	y3	43.5	x3	28.5	
27		value	unc. (s)	% rel unc.			95% Confidence Intervals			t=	3.1824										
28	m	1.5491	0.071	4.5606			m=	1.5491	+/-	0.2248							Average	41.6	uA	27.2	ppm
29	b	-0.6464	4.312	-667.04			b=	-0.6464	+/-	13.723							Stdev	2.1		1.3	ppm
30	x	53.6079	3.74718	6.99			x_{unk}=	53.608	+/-	11.925							t	4.303		4.3	
31							x-int.=	0.4173	+/-	8.8078							conf inv.	5.1		3.3	ppm

y = 1.5491x - 0.6464
R² = 0.9938