

The Education University of Hong Kong

2021-2022 Quality Education Fund Thematic Network – Tertiary Institutes

STEM Project Team

SCHOOL: CHRISTIAN AND MISSIONARY ALLIANCE SUN
KEI SECONDARY SCHOOL (S4)

TOPIC: WORKSHOP 2 – DATA CONVERSION AND
ANALYSIS

REQUIREMENT LIST:



- - COMPUTER WITH ARDUINO IDE AND EXCEL



DATA COLLECTED IN EXCEL



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A1

11:26:59.897 -> A,B,C,D,E,F,G,H,R,I,S,J,T,U,V,W,K,L

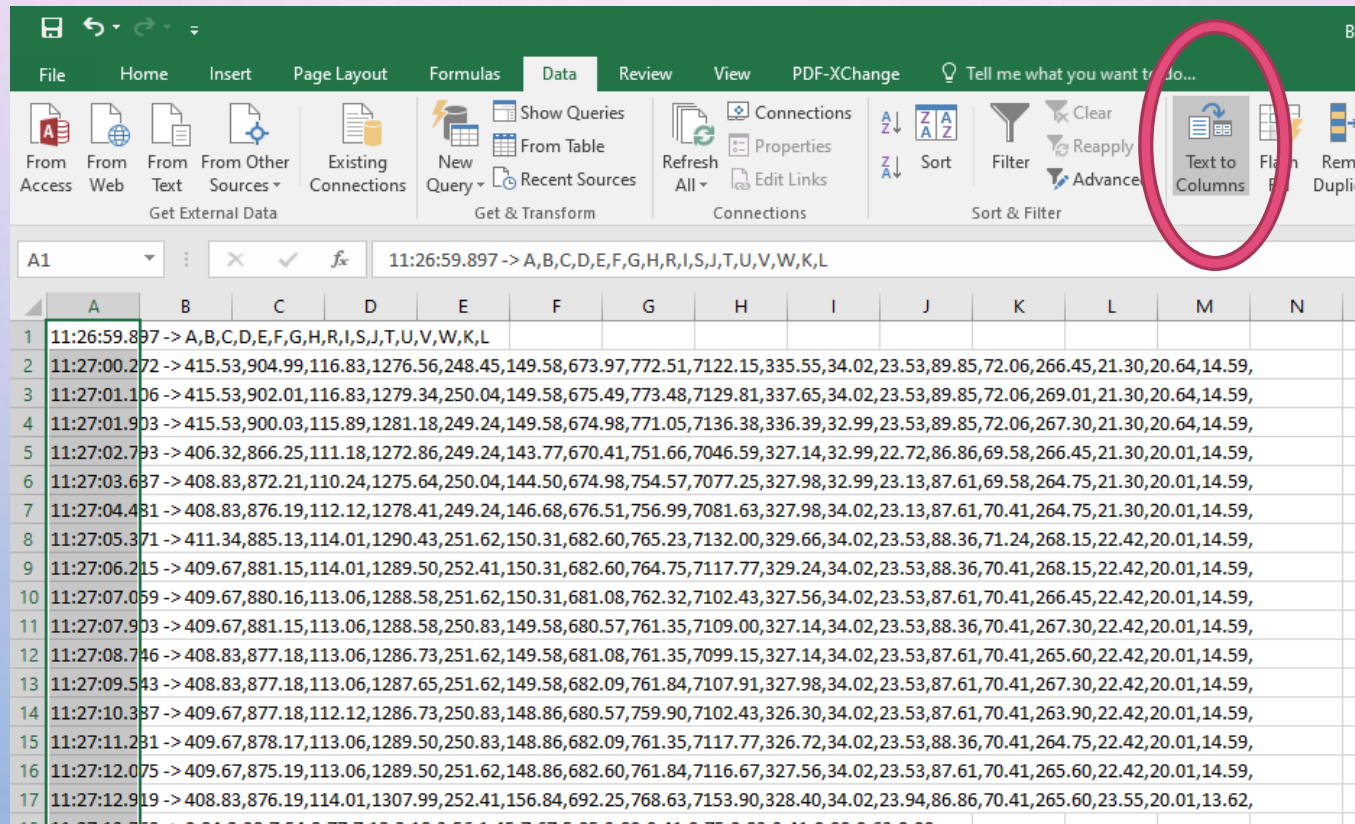
	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	11:26:59.897 ->	A,B,C,D,E,F,G,H,R,I,S,J,T,U,V,W,K,L												
2	11:27:00.272 ->	415.53,904.99,116.83,1276.56,248.45,149.58,673.97,772.51,7122.15,335.55,34.02,23.53,89.85,72.06,266.45,21.30,20.64,14.59,												
3	11:27:01.106 ->	415.53,902.01,116.83,1279.34,250.04,149.58,675.49,773.48,7129.81,337.65,34.02,23.53,89.85,72.06,269.01,21.30,20.64,14.59,												
4	11:27:01.903 ->	415.53,900.03,115.89,1281.18,249.24,149.58,674.98,771.05,7136.38,336.39,32.99,23.53,89.85,72.06,267.30,21.30,20.64,14.59,												
5	11:27:02.793 ->	406.32,866.25,111.18,1272.86,249.24,143.77,670.41,751.66,7046.59,327.14,32.99,22.72,86.86,69.58,266.45,21.30,20.01,14.59,												
6	11:27:03.687 ->	408.83,872.21,110.24,1275.64,250.04,144.50,674.98,754.57,7077.25,327.98,32.99,23.13,87.61,69.58,264.75,21.30,20.01,14.59,												
7	11:27:04.481 ->	408.83,876.19,112.12,1278.41,249.24,146.68,676.51,756.99,7081.63,327.98,34.02,23.13,87.61,70.41,264.75,21.30,20.01,14.59,												
8	11:27:05.371 ->	411.34,885.13,114.01,1290.43,251.62,150.31,682.60,765.23,7132.00,329.66,34.02,23.53,88.36,71.24,268.15,22.42,20.01,14.59,												
9	11:27:06.215 ->	409.67,881.15,114.01,1289.50,252.41,150.31,682.60,764.75,7117.77,329.24,34.02,23.53,88.36,70.41,268.15,22.42,20.01,14.59,												
10	11:27:07.059 ->	409.67,880.16,113.06,1288.58,251.62,150.31,681.08,762.32,7102.43,327.56,34.02,23.53,87.61,70.41,266.45,22.42,20.01,14.59,												
11	11:27:07.903 ->	409.67,881.15,113.06,1288.58,250.83,149.58,680.57,761.35,7109.00,327.14,34.02,23.53,88.36,70.41,267.30,22.42,20.01,14.59,												
12	11:27:08.746 ->	408.83,877.18,113.06,1286.73,251.62,149.58,681.08,761.35,7099.15,327.14,34.02,23.53,87.61,70.41,265.60,22.42,20.01,14.59,												
13	11:27:09.543 ->	408.83,877.18,113.06,1287.65,251.62,149.58,682.09,761.84,7107.91,327.98,34.02,23.53,87.61,70.41,267.30,22.42,20.01,14.59,												
14	11:27:10.387 ->	409.67,877.18,112.12,1286.73,250.83,148.86,680.57,759.90,7102.43,326.30,34.02,23.53,87.61,70.41,263.90,22.42,20.01,14.59,												
15	11:27:11.281 ->	409.67,878.17,113.06,1289.50,250.83,148.86,682.09,761.35,7117.77,326.72,34.02,23.53,88.36,70.41,264.75,22.42,20.01,14.59,												
16	11:27:12.075 ->	409.67,875.19,113.06,1289.50,251.62,148.86,682.60,761.84,7116.67,327.56,34.02,23.53,87.61,70.41,265.60,22.42,20.01,14.59,												
17	11:27:12.919 ->	408.83,876.19,114.01,1307.99,252.41,156.84,692.25,768.63,7153.90,328.40,34.02,23.94,86.86,70.41,265.60,23.55,20.01,13.62,												
18	11:27:13.753 ->	408.83,876.19,114.01,1307.99,252.41,156.84,692.25,768.63,7153.90,328.40,34.02,23.94,86.86,70.41,265.60,23.55,20.01,13.62,												

OPEN NEW SHEET FOR 'TIME AND ACTION'



	A	B	C	D	
1	Time(From)	Time(To)	Event	Remark	
2	15:44	15:51	Warm up		
3	15:52	15:55	H2O	15:54:30	
4	15:55	15:57:36	Sample 7	15:58:30	
5	16:02:20	16:05	Sample 5	16:03:30	
6	16:08:36	16:12:40	Sample 3	16:10:30	
7	16:15:20	16:18:20	Sample 6	16:16:30	
8	16:20:41	16:23:41	Sample 4	16:22:30	
9	16:25:40	16:28:40	Sample 2	16:27:30	
10	16:29:00	16:32:00	ACR	16:31:30	
11	16:33:17	16:36:00	H2O (2)	16:34:30	
12					
13					

SEPARATE 18 CHANNELS DATA INTO DIFFERENT COLUMNS



	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	11:26:59.897 -> A,B,C,D,E,F,G,H,I,S,J,T,U,V,W,K,L													
2	11:27:00.272 -> 415.53,904.99,116.83,1276.56,248.45,149.58,673.97,772.51,7122.15,335.55,34.02,23.53,89.85,72.06,266.45,21.30,20.64,14.59,													
3	11:27:01.106 -> 415.53,902.01,116.83,1279.34,250.04,149.58,675.49,773.48,7129.81,337.65,34.02,23.53,89.85,72.06,269.01,21.30,20.64,14.59,													
4	11:27:01.903 -> 415.53,900.03,115.89,1281.18,249.24,149.58,674.98,771.05,7136.38,336.39,32.99,23.53,89.85,72.06,267.30,21.30,20.64,14.59,													
5	11:27:02.793 -> 406.32,866.25,111.18,1272.86,249.24,143.77,670.41,751.66,7046.59,327.14,32.99,22.72,86.86,69.58,266.45,21.30,20.01,14.59,													
6	11:27:03.637 -> 408.83,872.21,110.24,1275.64,250.04,144.50,674.98,754.57,7077.25,327.98,32.99,23.13,87.61,69.58,264.75,21.30,20.01,14.59,													
7	11:27:04.431 -> 408.83,876.19,112.12,1278.41,249.24,146.68,676.51,756.99,7081.63,327.98,34.02,23.13,87.61,70.41,264.75,21.30,20.01,14.59,													
8	11:27:05.371 -> 411.34,885.13,114.01,1290.43,251.62,150.31,682.60,765.23,7132.00,329.66,34.02,23.53,88.36,71.24,268.15,22.42,20.01,14.59,													
9	11:27:06.215 -> 409.67,881.15,114.01,1289.50,252.41,150.31,682.60,764.75,7117.77,329.24,34.02,23.53,88.36,70.41,268.15,22.42,20.01,14.59,													
10	11:27:07.059 -> 409.67,880.16,113.06,1288.58,251.62,150.31,681.08,762.32,7102.43,327.56,34.02,23.53,87.61,70.41,266.45,22.42,20.01,14.59,													
11	11:27:07.903 -> 409.67,881.15,113.06,1288.58,250.83,149.58,680.57,761.35,7109.00,327.14,34.02,23.53,88.36,70.41,267.30,22.42,20.01,14.59,													
12	11:27:08.746 -> 408.83,877.18,113.06,1286.73,251.62,149.58,681.08,761.35,7099.15,327.14,34.02,23.53,87.61,70.41,265.60,22.42,20.01,14.59,													
13	11:27:09.543 -> 408.83,877.18,113.06,1287.65,251.62,149.58,682.09,761.84,7107.91,327.98,34.02,23.53,87.61,70.41,267.30,22.42,20.01,14.59,													
14	11:27:10.387 -> 409.67,877.18,112.12,1286.73,250.83,148.86,680.57,759.90,7102.43,326.30,34.02,23.53,87.61,70.41,263.90,22.42,20.01,14.59,													
15	11:27:11.231 -> 409.67,878.17,113.06,1289.50,250.83,148.86,682.09,761.35,7117.77,326.72,34.02,23.53,88.36,70.41,264.75,22.42,20.01,14.59,													
16	11:27:12.075 -> 409.67,875.19,113.06,1289.50,251.62,148.86,682.60,761.84,7116.67,327.56,34.02,23.53,87.61,70.41,265.60,22.42,20.01,14.59,													
17	11:27:12.919 -> 408.83,876.19,114.01,1307.99,252.41,156.84,692.25,768.63,7153.90,328.40,34.02,23.94,86.86,70.41,265.60,23.55,20.01,13.62,													
18	11:27:13.753 -> 0.84,2.08,7.54,2.77,7.12,2.18,2.56,1.45,7.67,5.05,2.00,0.41,0.75,0.83,2.41,0.00,0.52,0.00,													

EXCEL FORMATTING

Convert Text to Columns Wizard - Step 1 of 3

The Text Wizard has determined that your data is Fixed Width.

If this is correct, choose Next, or choose the data type that best describes your data.

Original data type

Choose the file type that best describes your data:

☒ Delimited - Characters such as commas or tabs separate each field.
☐ Fixed width - Fields are aligned in columns with spaces between each field.

Preview of selected data:

1	11:26:59.897	->	A,B,C,D,E,F,G,H,I,S,J,T,U,V,W,K,L
2	11:27:00.272	->	415.53,904.99,116.83,1276.56,248.45,149.58,673.97
3	11:27:01.106	->	415.53,902.01,116.83,1279.34,250.04,149.58,675.49
4	11:27:01.903	->	415.53,900.03,115.89,1281.18,249.24,149.58,674.98
5	11:27:02.793	->	406.32,866.25,111.18,1272.86,249.24,143.77,670.41

Cancel < Back **Next >** Finish

Convert Text to Columns Wizard - Step 2 of 3

This screen lets you set the delimiters your data contains. You can see how your text is affected in the preview below.

Delimiters

☐ Tab
☐ Semicolon
☒ Comma
☐ Space
☒ Other: >|

☐ Treat consecutive delimiters as one
 Text qualifier: "

Data preview

	A	B	C	D	E	F	G
11:26:59.897 -							
11:27:00.272 -	415.53	904.99	116.83	1276.56	248.45	149.58	673.97
11:27:01.106 -	415.53	902.01	116.83	1279.34	250.04	149.58	675.49
11:27:01.903 -	415.53	900.03	115.89	1281.18	249.24	149.58	674.98
11:27:02.793 -	406.32	866.25	111.18	1272.86	249.24	143.77	670.41

Cancel < Back **Next >** Finish

SEPARATED 18 CHANNELS' DATA

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Data Validation

Consolidate

Relationships

Manage Data Model

What-If Analysis

Forecast Sheet

Group

Ungroup

Subtotal

Show Detail

Hide Detail

U4

COPY SHEET AND SAVE AS 'RAW DATA'

0880.95	18551.82	451.01	527.61	1237.04
SparkFun Action&Time	Raw Data	+		

WHAT IS OVF

FileHomeInsertPage LayoutFormulasDataReviewViewPDF-XChangeTell me what you want to do...

From AccessFrom WebFrom TextFrom Other SourcesExisting ConnectionsNew QueryRecent SourcesShow QueriesFrom TableGet & Transform

RefreshAllConnectionsPropertiesEdit LinksSortFilterClearResponsiblyAdvanced

Text to ColumnsFlash FillRemove DuplicatesData ValidationConsolidate RelationshipsManage Data ModelWhat-If AnalysisForecast SheetGroupUngroup Subtotal

U4

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	
1	27:27.4	AS7265x Spectral Triad Example																												
2	27:27.6	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC
3	27:28.0	21875.68	31896.35	45551.5	30313.03	31559.93	36382.59	20235.32	18584.32	31142.96	14287.63	40724.66	14772.42	23823.86	25150.32	24041.95	26645.93	8801.28	6641.22											
4	27:28.8	21846.36	31859.39	45537.37	30237.24	31538.57	36300.53	20204.84	18564.44	31089.3	14265.34	40755.59	14764.71	23764.71	25123.81	24034.28	26624.63	8796.9	6631.49											
5	27:29.6	21835.47	31843.69	45516.64	30301.02	31522.75	36422.53	20226.17	18569.29	31083.83	14224.13	40717.45	14742.4	23710.05	25111.39	24013	26645.93	8784.39	6621.76											
6	27:30.5	9271.53	12498.07	30920.03	16510.26	29662.51	22938.35	12349.32	9762.31	16740.99	10657.39	37586.44	9236.87	12451.42	15684.26	22836.53	22550.09	7356.5	3953.01											
7	27:31.3	162.53	183.78	312.81	265.3	310.96	242.53	218.9	209.01	315.37	131.61	415.47	168.37	222.39	280.8	627.4	811.77	195.14	85.62											
8	27:32.1	108.07	119.21	211.05	174.71	209.68	158.3	143.22	139.18	206.96	89.14	279.39	110.35	151.25	190.51	439.26	552.76	140.73	62.27											
9	27:33.0	71.21	76.49	121.54	113.7	118.69	101.66	91.93	91.65	135.79	51.72	160.83	72.22	103.33	128.39	259.64	368.88	88.19	45.73											
10	27:33.8	46.91	48.68	81.03	71.18	74.38	62.45	56.88	57.71	84.32	34.48	104.13	45.44	67.39	82.83	166.85	227.61	60.04	33.08											
11	27:34.6	39.37	40.73	70.66	58.24	63.3	50.83	46.22	47.52	70.08	30.17	89.69	37.33	56.91	68.75	143.02	186.12	51.91	28.21											
12	27:35.4	29.32	29.8	48.99	41.6	39.56	34.85	32	33.46	50.37	21.02	58.76	26.37	41.93	49.7	90.24	123.33	35.02	22.38											
13	27:36.3	24.3	24.84	41.46	34.2	31.65	28.32	25.9	27.64	41.61	17.66	47.42	21.91	35.94	40.59	69.81	95.3	28.77	18.49											
14	27:37.2	25.13	25.83	41.46	35.13	31.65	28.32	26.41	28.13	42.71	18.08	47.42	22.31	35.94	41.42	69.81	96.43	28.77	19.46											
15	27:38.0	195.2	223.52	54.65	310.59	46.68	283.19	250.39	242.95	374.5	23.13	68.04	194.74	264.32	328.02	108.11	889.13	40.03	95.35											
16	27:38.8	21509.58	31479.11	44841.08	30149.42	31279.04	36121.18	20103.26	18398.59	30948.14	13869.67	40506.1	14929.02	23255.54	24688.11	24102.39	27156.09	8693.08	6557.55											
17	27:39.6	21487.8	31440.37	44852.39	30134.63	31275.87	36061.64	20078.89	18386.95	30932.71	13949.56	40432.91	14914.01	23220.35	24631.79	24138.14	27098.91	8725.6	6548.79											
18	27:40.5	21475.23	31416.33	44827.89	30124.46	31260.05	36021.7	20057.05	18378.22	30937.09	13925.59	40429.81	14900.62	23211.36	24621.02	24136.44	27066.39	8717.47	6541.98											
19	27:41.3	21313.54	29696.94	44743.09	25717.04	31105.75	33719.16	17466.81	16855.51	43525.68	15174.01	40435.58	17309.34	31780.37	30089.6	24496.53	29755.09	8786.27	7242.49											
20	27:42.2	17464.86	23875.57	31066.15	17574.22	15374.84	11776.33	6677.72	11374.25	36699.2	19328.39	50553.76	ovf	26818.97	27569.84	28900.22	32549.18	12138.66	7445.83											
21	27:43.0	15170.55	25709.4	32794.14	19540.37	16290.33	13384.7	5745.75	10102.74	37645.31	18110.25	ovf	ovf	28066.44	29481.61	27317.68	36611.38	10581.3	5619.64											
22	27:43.8	19369.09	25925.96	33934.2	19775.16	16793.56	13550.98	5744.73	10105.65	38036.24	19865.77	ovf	ovf	28655.02	30251.95	29909.84	37823.43	13006.78	5632.29											
23	27:44.6	17911.39	24366.31	34583.37	18023.47	17431.31	12420.4	5546.66	9904.4	38650.56	17226.81	ovf	ovf	28655.02	30251.95	29909.84	37823.43	13006.78	5632.29											
24	27:45.4	16481.33	22672.55	30397.19	16323.54	14828.88	10723.44	5537.51	9885.85	38710.79	17162.9	ovf	ovf	28655.02	30251.95	29909.84	37823.43	13006.78	5632.29											
25	27:46.3	16089.25	22230.49	28515.62	15826.23	13845.35	10266.71	5512.63	9875.79	39218.89	17020.77	ovf	ovf	28655.02	30251.95	29909.84	37823.43	13006.78	5632.29											
26	27:47.1	16165.49	22291.08	28547.66	15938.08	13858.8	10366.91	5522.79	9806.09	38969.22	17048.53	ovf	ovf	2972.98	31534.19	31472.8	38847.1	8985.16	5235.77											
27	27:48.0	16085.06	22188.76	28419.52	15825.3	13824.78	10242.02	5528.88	9875.3	39306.49	17059.04	ovf	ovf	30288.81	32560.48	32500.3	40817.1	8969.53	5225.61											
28	27:48.8	21279.2	31109.57	44392.6	29880.43	30899.24	35645.57	19813.26	18190.07	30747.65	13743.94	40065.89	14714.81	22908.11	24347.67	23977.25	26602.2	8639.29	6433.99											
29	27:49.6	21283.39	31143.34	44444.42	29932.19	30951.46	35645.57	19825.45	18222.56	30738.89	13698.53	39961.76	14713.59	22905.86	24338.66	23917.66	26596.6	8618.65	6433.99											
30	27:50.5	21302.65	31135.4	44481.16	29927.57	30991.02	35723.26	19855.41	18220.13	30735.61	13710.3	40058.67	14739.15	22916.34	24399.03	23930.43	26686.29	8626.16	6433.99											
31	27:51.3	6778.35	7855.87	13320.79	10355.77	18499.5	22713.25	12751.57	17924.81	49725.8	20309.38	51471.31	ovf	31012.13	31769.43	33846.17	35737.95	10306.73	6133.35											
32	27:52.1	6637.6	7708.85	11720.94	10510.15	17675.81	22072.08	13838.96	19178.86	49864.87	20981.73	51729.05	ovf	30133.06	29690.35	29349.7	31725.08	12052.98	7344.65											
33	27:52.9	6653.52	7723.75	11757.09	10520.31	17701.92	22074.99	14559.15	20096.85	49703.9	20677.3	ovf	ovf	30011.76	29562.79	29537.83	31628.66	10752.67	8423.63											
34	27:53.8	6674.46	7726.73	11679.49	10580.4	17647.33	21990.75	13411.83	18931.54	49757.56	20733.23	51703.27	ovf	29932.39	29415.34	29182.85	31376.38	10438.07	6951.59											

Ovf = Over flowing
> 65536(2^16)

Ovf = Over flowing
> 65536(2^16)

MARKING OF TIME AND ACTION

	A	B	C	D	
1	Time(From)	Time(To)	Event	Remark	
2	15:44	15:51	Warm up		
3	15:52	15:55	H2O	15:54:30	
4	15:55	15:57:36	Sample 7	15:58:30	
5	16:02:20	16:05	Sample 5	16:03:30	
6	16:08:36	16:12:40	Sample 3	16:10:30	
7	16:15:20	16:18:20	Sample 6	16:16:30	
8	16:20:41	16:23:41	Sample 4	16:22:30	
9	16:25:40	16:28:40	Sample 2	16:27:30	
10	16:29:00	16:32:00	ACR	16:31:30	
11	16:33:17	16:36:00	H2O (2)	16:34:30	
12					
13					

1. Time*

DATA SELECTION

3. take away
unstable
readings (if
necessary)

2. Double
check
readings

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
1	27:27.4	A57265x Spectral Triad Example																			
2	27:27.6	A	B	C	D	E	F	G	H	R	I	S	J	T	U	V	W	K	L		
3	27:28.0	21875.68	31896.35	45551.5	30313.03	31559.93	36382.59	20235.32	18584.32	31142.96	14287.63	40724.66	14772.42	23823.86	25150.32	24041.95	26645.93	8801.28	6641.22		
4	27:28.8	21846.36	31859.59	45537.37	30237.24	31538.57	36300.53	20204.84	18564.44	31089.3	14265.34	40755.59	14764.71	23764.71	25123.81	24034.28	26624.63	8796.9	6631.49	sunlight	
5	27:29.6	21835.47	31843.69	45516.64	30301.02	31522.75	36422.53	20226.17	18569.29	31083.83	14224.13	40717.45	14742.4	23710.05	25111.39	24013	26645.93	8784.39	6621.76	sunlight AVG	
6	27:30.3	21771.33	31808.01	45490.01	30210.26	31482.51	36382.51	20218.35	18548.32	30962.11	14240.99	40652.58	14758.44	23688.87	25051.43	23984.26	26638.53	8758.5	6591.01		
7	27:31.3	21733.3	31768.78	45458.81	30165.3	31450.96	36353.3	20218.9	18509.01	30937.37	14218.61	40625.47	14748.87	23659.99	25028.8	23958.4	26611.77	8735.14	6561.4		
8	27:32.1	21698.07																			
9	27:33.0	71.21	6.49	121.54	113.7	118.69	101.66	91.93	91.65	135.79	51.72	160.83	72.22	103.33	128.39	259.64	368.88	88.19	45.73		
10	27:33.8	46.91	48.68	81.03	71.18	74.38	62.45	56.88	57.71	84.32	34.48	104.13	45.44	67.39	82.83	166.85	227.61	60.04	33.08		
11	27:34.6	39.37	40.73	70.66	58.24	63.3	50.83	46.22	47.52	70.08	30.27	89.69	37.33	56.91	68.75	143.02	186.12	51.91	28.21		
12	27:35.4	29.32	29.8	48.99	41.6	39.56	34.85	32	33.46	50.37	21.02	58.76	26.37	41.93	49.7	90.24	123.33	35.02	22.38		
13	27:36.3	24.3	24.84	41.46	34.2	31.65	28.32	25.9	27.64	41.61	17.66	47.42	21.91	35.94	40.59	69.81	95.3	28.77	18.49	cover in box	
14	27:37.2	25.13	25.83	41.46	35.13	31.65	28.32	26.41	28.13	42.71	18.08	47.42	22.31	35.94	41.42	69.81	96.43	28.77	19.46	cover in box AVG	
15	27:38.0	21509.58	31479.11	44841.08	30149.42	31279.04	36121.11	20103.26	18486.59	30944.14	14189.67	40506.1	14629.02	23295.54	24668.11	24102.39	27156.09	8891.08	6557.95		
16	27:38.8	21487.8	31440.87	44832.98	30134.83	31275.87	36061.64	20078.89	18466.95	30912.71	14168.96	40483.91	14614.01	23220.35	24611.79	24088.14	27088.91	8725.6	6548.79		
17	27:40.1	21479.28	31418.53	44827.88	30124.46	31266.09	36021.7	20053.09	18458.32	30917.09	14152.95	40459.81	14600.62	23211.38	24611.02	24088.44	27068.35	8717.47	6541.98		
18	27:41.3	21413.34	31396.94	44748.09	30119.18	31255.25	35979.16	20034.31	18446.31	30855.51	14132.01	40435.58	14589.38	23199.38	24589.8	24068.53	27055.09	8706.27	6534.46		
19	27:42.2	21464.86	31375.57	44748.09	30106.15	31244.22	35974.84	20017.76	18434.84	30837.72	14117.25	40419.2	14573.79	23182.39	24573.76	24053.76	27041.87	8699.8	6527.76		
20	27:42.2	17464.86	23875.57	31066.15	17574.22	15374.84	11776.33	6677.72	11374.25	36699.2	19328.39	50553.76	ovf		26818.97	27569.84	28900.22	32549.18	12138.66	7445.83	
21	27:43.0	19170.55	25709.4	32794.14	19540.37	16290.33	13384.7	5745.75	10102.74	37645.31	18110.25	ovf		28066.44	29481.61	27317.68	36611.38	10581.3	5619.64		
22	27:43.8	19369.09	25925.96	33934.2	19775.16	16793.56	13550.98	5744.73	10105.65	38036.24	19865.77	ovf		28628.02	30251.95	29909.84	37823.43	13006.78	5632.29		
23	27:44.6	17911.39	24366.31	34583.37	18023.47	17431.31	12420.4	5546.66	9904.4	38650.56	17226.81	ovf		29319.14	30991.64	29113.04	37492.67	9172.17	5369.6		
24	27:45.4	16481.33	22672.55	30397.19	16323.54	14828.88	10723.44	5537.31	9889.85	38710.79	17162.9	ovf		29523.56	31342.02	28827.86	38709.19	9081.48	5314.14		
25	27:46.3	16089.25	22230.49	28515.62	15826.23	13845.35	10266.71	5512.63	9875.79	39218.89	17020.77	ovf		30097.87	32211.76	31833.74	40291.25	8960.14	5227.55		
26	27:47.1	16165.49	22291.08	28547.66	15938.08	13858.8	10366.91	5522.79	9866.09	38969.22	17048.53	ovf		29727.98	31534.19	31472.8	38847.1	8985.16	5255.77		
27	27:48.0	16085.06	22188.76	28419.52	15825.3	13824.78	10242.02	5528.88	9875.3	39306.49	17059.04	ovf		30288.81	32560.48	32500.3	40817.1	8969.53	5225.61	Red	
28	27:48.8	21279.2	31109.57	44392.6	29880.43	30899.24	35645.57	19813.26	18190.07	30747.65	13743.94	40065.89	14714.81	22908.11	24347.67	23977.25	26602.2	8639.29	6433.99	Red AVG	
29	27:49.6	21281.39	31143.34	44444.42	29912.19	30953.46	35645.57	19825.45	18222.56	30718.89	13698.53	40065.89	14714.81	22908.11	24347.67	23977.25	26602.2	8639.29	6433.99		
30	27:50.3	21303.65	31135.4	44481.16	29922.57	30993.02	35723.26	19855.41	18220.13	30735.61	13718.1	40058.67	14714.81	22908.11	24347.67	23977.25	26602.2	8639.29	6433.99		
31	27:51.3	6778.35	7855.87	13320.79	10355.77	18499.5	22713.25	12751.57	17924.81	49725.8	20309.38	51471.31	ovf		31012.13	31769.43	33846.17	35737.95	10306.73	6133.35	
32	27:52.1	6637.6	7708.85	11720.94	10510.15	17675.81	22072.08	13838.96	19178.86	49864.87	20981.73	51729.05	ovf		30133.06	29690.35	29349.7	31725.08	12052.98	7344.65	
33	27:52.9	6653.52	7723.75	11757.69	10520.31	17701.92	22074.99	14559.15	20096.85	49703.9	20677.3	ovf		30011.76	29562.79	29537.83	31628.66	10752.67	8423.63		
34	27:53.8	6674.46	7726.73	11679.49	10580.4	17647.33	21990.75	13411.83	18931.54	49757.56	20733.23	51703.27	ovf		29932.39	29415.34	29182.85	31376.38	10438.07	6951.59	
35	27:54.6	6576.44	7686.99	11745.44	10397.37	17697.97	22153.41	12918.16	18182.31	49574.69	20819.85	ovf		30038.72	29711.88	29405.03	32051.36	10989.09	6186.86		
36	27:55.5	6714.68	7787.33	11768.99	10548.97	17713	22268.86	12800.33	18112.48	49939.33	20374.56	ovf		30261.1	29904.88	29662.12	32172.45	10085.95	6068.16		
37	27:56.3	6704.62	7762.49	11965.91	10584.09	17961.45	22356	12808.45	18105.2	49811.21	20341.76	ovf		30262.6	29990.2	29847.7	32395.58	9995.88	6035.09		
38	27:57.1	6565.55	7663.15	11689.85	10401.07	17664.73	22160.67	12892.76	18145.94	49479.05	20509.11	ovf		30116.25	29661.36	29369.28	31932.51	10470.6	6147.45		

OPEN NEW SHEET, 'LIGHT INTENSITY'



TAKE AVG & PLOT GRAPH

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T		V	W	X	Y	Z	AA	AB	AC	AD	AE	
1	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T		Channel	Wavelength	Marks	sunlight	AVG	cover in box	Red	Orange	Yellow	Green	Blue
2	21876	31896	45552	30313	31560	36383	20235	18584	31143	14288	40725	14772	23824	25150	24042	26646	8801.3	6641.2				A	410	21852.50	39.37	17342.13	6659.48	9154.80	4438.84	18852.78		
3	21846	31860	45537	30237	31539	36301	20205	18564	31089	14265	40756	14765	23765	25124	24034	26625	8796.9	6631.5				B	435	31866.54	41.06	23657.52	7739.97	10137.57	4602.46	31877.47		
4	21835	31844	45517	30301	31523	36423	20226	18569	31084	14224	40717	14742	23710	25111	24013	26646	8784.4	6621.8	sunlight			C	460	45535.17	67.52	31032.23	11913.25	16299.24	7265.60	58094.33		
	21853	31867	45535	30284	31540	36369	20222	18573	31105	14259	40733	14760	23766	25129	24030	26639	8794.2	6631.5	sunlight	AVG		D	485	30283.76	59.01	17353.30	10484.36	23348.48	5163.05	35796.24		
																						E	510	31540.42	59.87	15280.98	17797.75	61200.65	19567.79	51266.48		
7																						F	535	36368.55	51.07	11591.44	22223.84	65536.00	33985.24	65536.00		
8	71.21	76.49	121.54	113.7	118.69	101.66	91.93	91.65	135.79	51.72	160.83	72.22	103.33	128.39	259.64	368.88	88.19	45.73				G	560	20222.11	46.56	5727.08	13258.90	65536.00	22851.74	19312.03		
9	46.91	48.68	81.03	71.18	74.38	62.45	56.88	57.71	84.32	34.48	104.13	45.44	67.39	82.83	166.85	227.61	60.04	33.08				H	585	18572.68	47.69	10124.26	18601.89	65536.00	18213.51	13062.27		
10	39.37	40.73	70.66	58.24	63.3	50.83	46.22	47.52	70.08	30.27	89.69	37.33	56.91	68.75	143.02	186.12	51.91	28.21				R	610	31105.36	70.81	38404.59	49733.95	43665.30	20952.15	14417.31		
11	29.32	29.8	48.99	41.6	39.56	34.85	32	33.46	50.37	21.02	58.76	26.37	41.93	49.7	90.24	123.33	35.02	22.38				I	645	14259.03	28.87	17852.81	25586.99	18343.76	8558.07	6313.65		
12	24.3	24.84	41.46	34.2	31.65	28.32	25.9	27.64	41.61	17.66	47.42	21.91	35.94	40.59	69.81	95.3	28.77	18.49				S	680	40732.57	84.71	63663.22	60902.18	63058.21	36217.91	22709.61		
13	25.13	25.83	41.46	35.13	31.65	28.32	26.41	28.13	42.71	18.08	47.42	22.31	35.94	41.42	69.81	96.43	28.77	19.46	cover in box			J	705	14759.84	37.60	65536.00	65536.00	58003.81	15265.22	8930.84		
	39.373	41.062	67.523	59.008	59.872	51.072	46.557	47.685	70.813	28.872	84.708	37.597	56.907	68.613	133.23	182.95	48.783	27.892	cover in box	AVG		T	730	23766.21	56.91	29058.85	30238.72	28729.98	20171.82	13794.58		
15																						U	760	25128.51	68.61	30742.94	30008.42	30525.43	24168.76	22996.60		
16																						V	810	24029.74	133.23	29984.44	29929.99	31316.16	26682.06	27594.01		
17																						W	860	26638.83	182.95	37892.66	32445.41	39147.59	39611.66	32712.10		
18																						K	900	8794.19	48.78	10111.90	10320.01	10695.03	9722.70	9488.52		
19																						L	940	6631.49	27.89	5636.30	6678.73	6494.80	5145.83	5389.16		
20	17465	23876	31066	17574	15375	11776	6677.7	11374	36699	19328	50554	65536	26819	27570	28900	32549	12139	7445.8														
21	19171	25709	32794	19540	16290	13385	5745.8	10103	37645	18110	65536	65536	28066	29482	27318	36611	10581	5619.6														
22	19369	25926	33934	19775	16794	13551	5744.7	10106	38036	19866	65536	65536	28628	30252	29910	37823	13007	5632.3														
23	17911	24366	34583	18023	17431	12420	5546.7	9904.4	38651	17227	65536	65536	29319	30992	29113	37493	9172.2	5369.6														
24	16481	22673	30397	16324	14829	10723	5537.5	9889.9	38711	17163	65536	65536	29524	31342	28828	38709	9081.5	5314.1														
25	16089	22230	28516	15826	13845	10267	5512.6	9875.8	39219	17021	65536	65536	30098	32212	31834	40291	8960.1	5227.6														
26	16165	22291	28548	15938	13859	10367	5522.8	9866.1	38969	17049	65536	65536	29728	31534	31473	38847	8985.2	5255.8														
	16085	22189	28420	15825	13825	10242	5528.9	9875.3	39306	17059	65536	65536	30289	32560	32500	40817	8969.5	5225.6	Red													
	17342	23658	31032	17353	15281	11591	5727.1	10124	38405	17853	63663	65536	29059	30743	29984	37893	10112	5636.3	Red	AVG												
29																																
30																																
31	6778.4	7855.9	13321	10356	18500	22713	12752	17925	49726	20309	51471	65536	31012	31769	33846	35738	10307	6133.4														

COPY AND PASTE CLASSIFIED DATA

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	
1	Time	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	Sample	ppm		
2	16:34:30	ovf		4871.67	4324.69	847.65	1114.88	17670.30	338.25	389.41	1107.09	475.99	1057.76	142.81	945.71	696.62	1763.86	2603.49	228.91	195.56	Sample 1	0.00	Water
3	16:27:30	ovf		5120.02	4301.13	890.17	1022.30	14440.49	293.56	391.35	1104.90	534.44	1088.69	147.68	932.98	681.71	1757.05	2629.27	236.42	206.26	Sample 2	0.04	
4	16:10:30	ovf		5001.81	27596.04	1073.20	8827.22	15731.54	258.52	371.46	1511.16	568.07	340.21	143.22	1021.33	377.71	996.85	339.73	885.63	220.86	Sample 3	0.10	
5	16:22:30	ovf		3254.40	20515.42	810.68	3373.90	9620.45	159.48	266.23	1295.43	547.89	379.39	143.22	1043.80	481.25	1428.45	457.46	547.89	205.29	Sample 4	0.20	
6	16:03:30	ovf		4519.01	25805.86	834.71	4756.22	6318.76	123.42	230.83	1383.04	555.88	324.75	136.73	941.21	342.92	1005.37	331.88	944.42	212.10	Sample 5	0.30	
7	16:16:30	ovf		3590.18	22515.70	741.35	2832.69	3997.33	91.42	181.37	1229.73	533.59	329.90	137.54	962.18	381.03	1226.70	350.94	813.08	204.32	Sample 6	0.40	
8	15:58:30		32188.55	14545.48	21581.99	1201.69	4112.93	2686.67	83.80	189.61	1107.09	534.01	284.54	114.82	660.42	164.01	242.62	245.55	1384.11	198.48	Sample 7	0.50	
9																							

- Take average before using
- Turn ovf to 65535

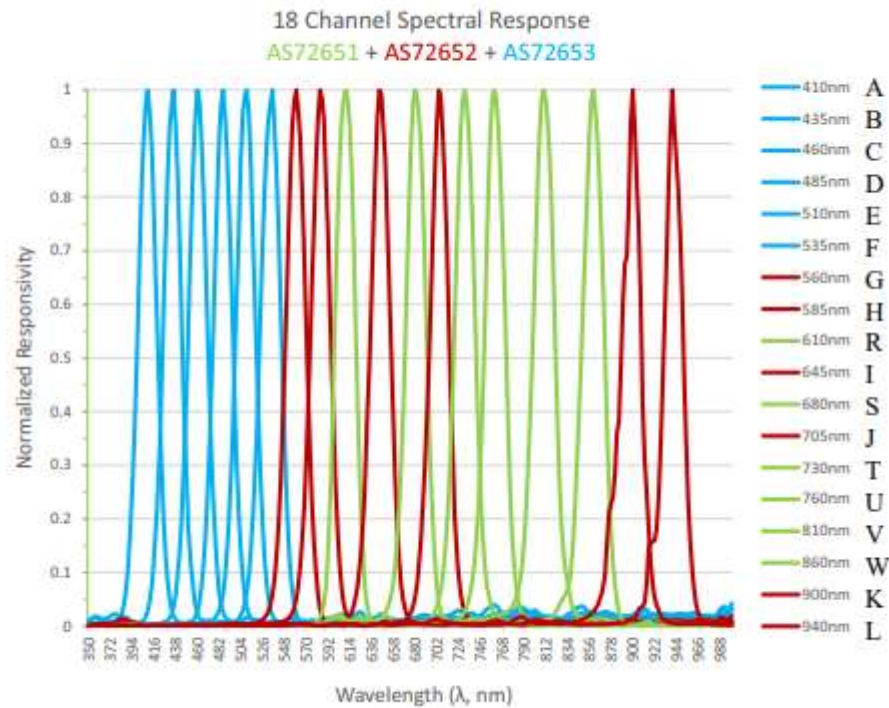
- Make down data/sample

For
checking

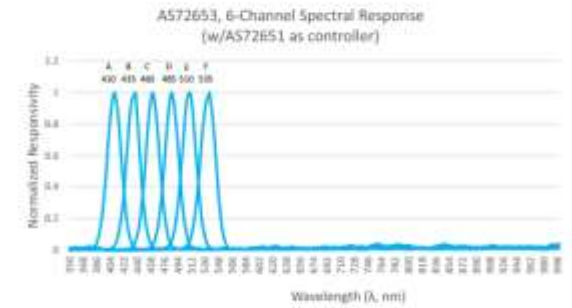
TOTAL 18 CHANNEL SPECTRAL RESPONSE

	Wavelength
A	410
B	435
C	460
D	485
E	510
F	535
G	560
H	585
I	610
J	645
K	680
L	705
M	730
N	760
O	810
P	860
Q	900
R	940

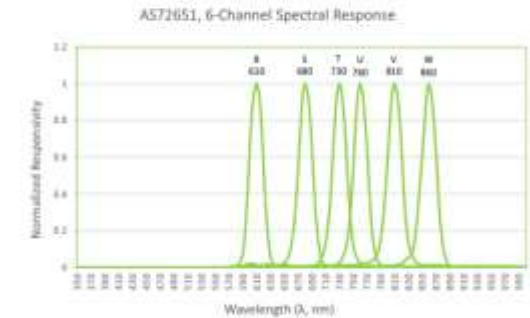
Channel Spectral Responsivity



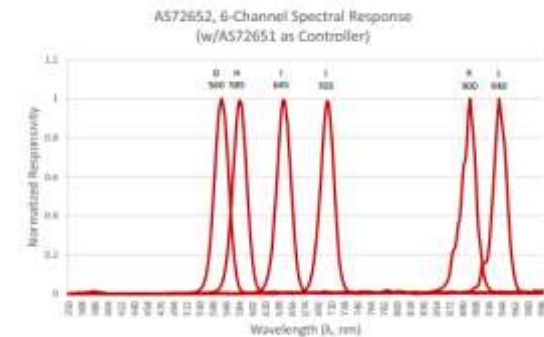
AS72653 Spectral Responsivity



AS72651 Spectral Responsivity



AS72652 Spectral Responsivity

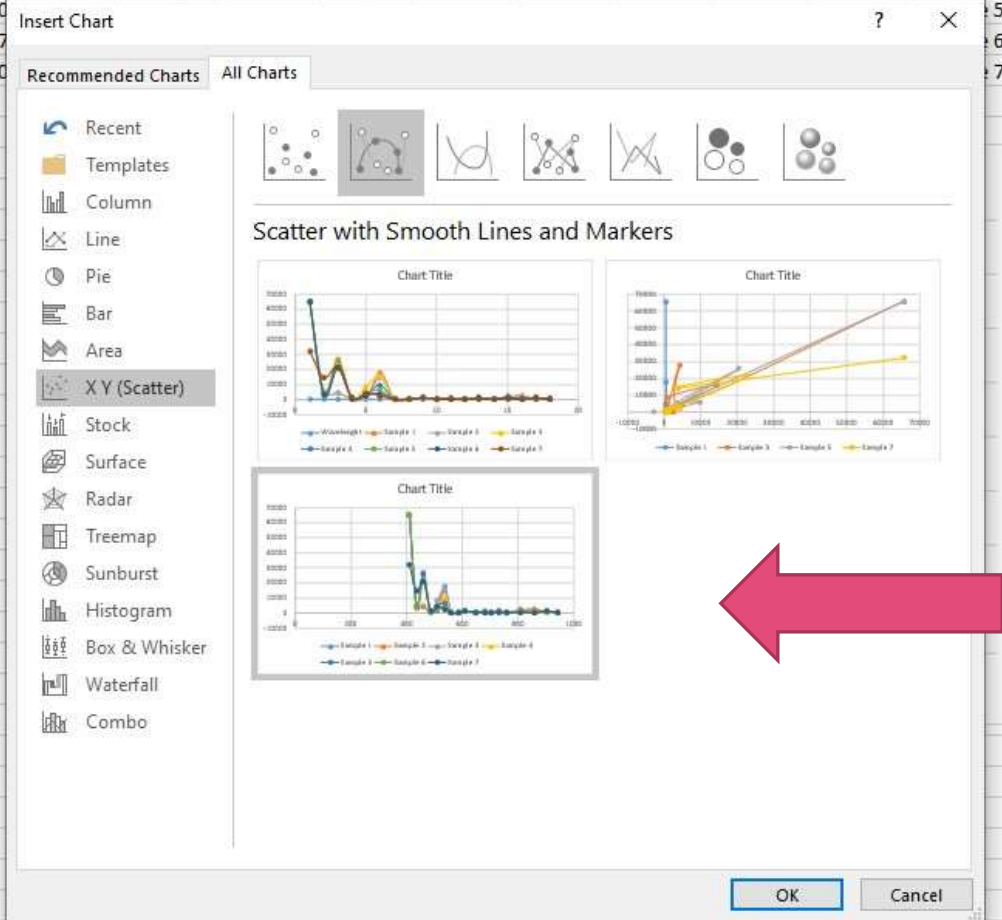


FORMAL FOR PLOT GRAPH

		Wavelength	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6	Sample 7
12	A	410	65535	65535	65535	65535	65535	65535	32188.55
13	B	435	4871.67	5120.02	5001.81	3254.40	4519.01	3590.18	14545.48
14	C	460	4324.69	4301.13	27596.04	20515.42	25805.86	22515.70	21581.99
15	D	485	847.65	890.17	1073.20	810.68	834.71	741.35	1201.69
16	E	510	1114.88	1022.30	8827.22	3373.90	4756.22	2832.69	4112.93
17	F	535	17670.30	14440.49	15731.54	9620.45	6318.76	3997.33	2686.67
18	G	560	338.25	293.56	258.52	159.48	123.42	91.42	83.80
19	H	585	389.41	391.35	371.46	266.23	230.83	181.37	189.61
20	I	610	1107.09	1104.90	1511.16	1295.43	1383.04	1229.73	1107.09
21	J	645	475.99	534.44	568.07	547.89	555.88	533.59	534.01
22	K	680	1057.76	1088.69	340.21	379.39	324.75	329.90	284.54
23	L	705	142.81	147.68	143.22	143.22	136.73	137.54	114.82
24	M	730	945.71	932.98	1021.33	1043.80	941.21	962.18	660.42
25	N	760	696.62	681.71	377.71	481.25	342.92	381.03	164.01
26	O	810	1763.86	1757.05	996.85	1428.45	1005.37	1226.70	242.62
27	P	860	2603.49	2629.27	339.73	457.46	331.88	350.94	245.55
28	Q	900	228.91	236.42	885.63	547.89	944.42	813.08	1384.11
29	R	940	195.56	206.26	220.86	205.29	212.10	204.32	198.48
30									

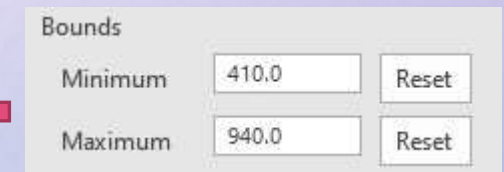
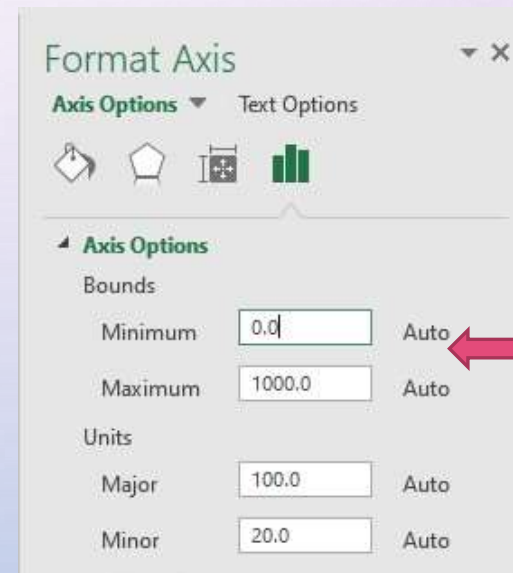
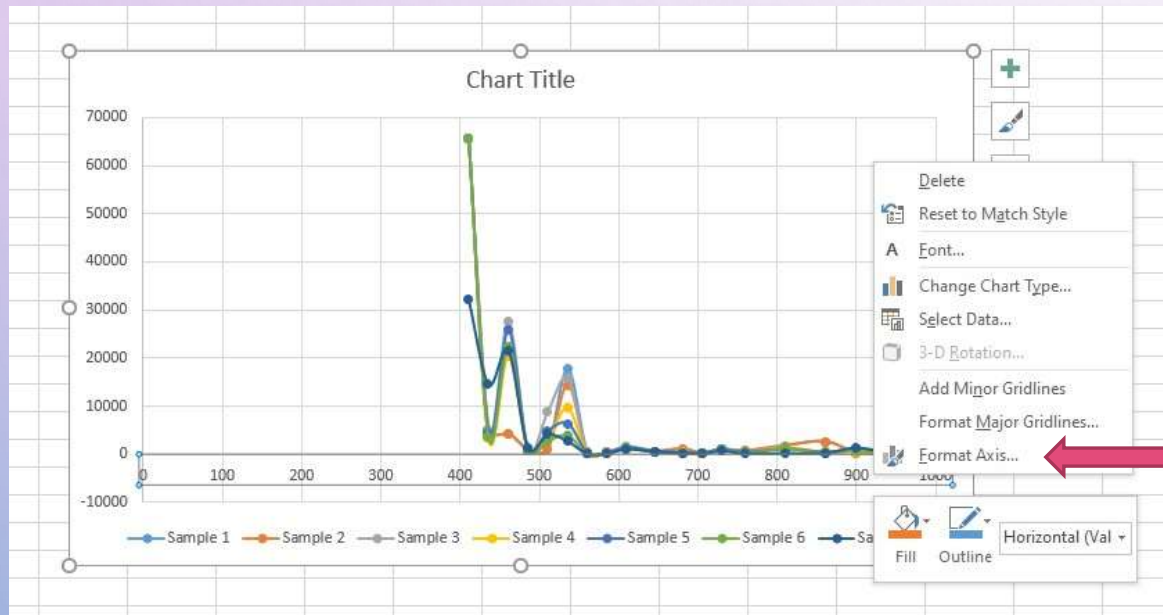
X Y (SCATTER)

5	16:22:30	ovf	3254.40	20515.42	810.68	3373.90	9620.45	159.48	266.23	1295.43	547.89	379.39	143.22	1043.80	481.25	1428.45	457.46	547.89	205.29	Sample 4
6	16:03:30	ovf	4519.01	25805.86	834.71	4756.22	6318.76	123.42	230.83	1383.0										
7	16:16:30	ovf	3590.18	22515.70	741.35	2832.69	3997.33	91.42	181.37	1229.7										
8	15:58:30		32188.55	14545.48	21581.99	1201.69	4112.93	2686.67	83.80	189.61	1107.0									
9																				
10																				
11																				
12	A		Wavelength	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6	Sample 7										
13	B		410	65535	65535	65535	65535	65535	65535	32188.55										
14	C		435	4871.67	5120.02	5001.81	3254.40	4519.01	3590.18	14545.48										
15	D		460	4324.69	4301.13	27596.04	20515.42	25805.86	22515.70	21581.99										
16	E		485	847.65	890.17	1073.20	810.68	834.71	741.35	1201.69										
17	F		510	1114.88	1022.30	8827.22	3373.90	4756.22	2832.69	4112.93										
18	G		535	17670.30	14440.49	15731.54	9620.45	6318.76	3997.33	2686.67										
19	H		560	338.25	293.56	258.52	159.48	123.42	91.42	83.80										
20	I		585	389.41	391.35	371.46	266.23	230.83	181.37	189.61										
21	J		610	1107.09	1104.90	1511.16	1295.43	1383.04	1229.73	1107.09										
22	K		645	475.99	534.44	568.07	547.89	555.88	533.59	534.01										
23	L		680	1057.76	1088.69	340.21	379.39	324.75	329.90	284.54										
24	M		705	142.81	147.68	143.22	143.22	136.73	137.54	114.82										
25	N		730	945.71	932.98	1021.33	1043.80	941.21	962.18	660.42										
26	O		760	696.62	681.71	377.71	481.25	342.92	381.03	164.01										
27	P		810	1763.86	1757.05	996.85	1428.45	1005.37	1226.70	242.62										
28	Q		860	2603.49	2629.27	339.73	457.46	331.88	350.94	245.55										
29	R		900	228.91	236.42	885.63	547.89	944.42	813.08	1384.11										
30			940	195.56	206.26	220.86	205.29	212.10	204.32	198.48										
31																				
32																				
33																				
34																				
35																				
36																				
37																				

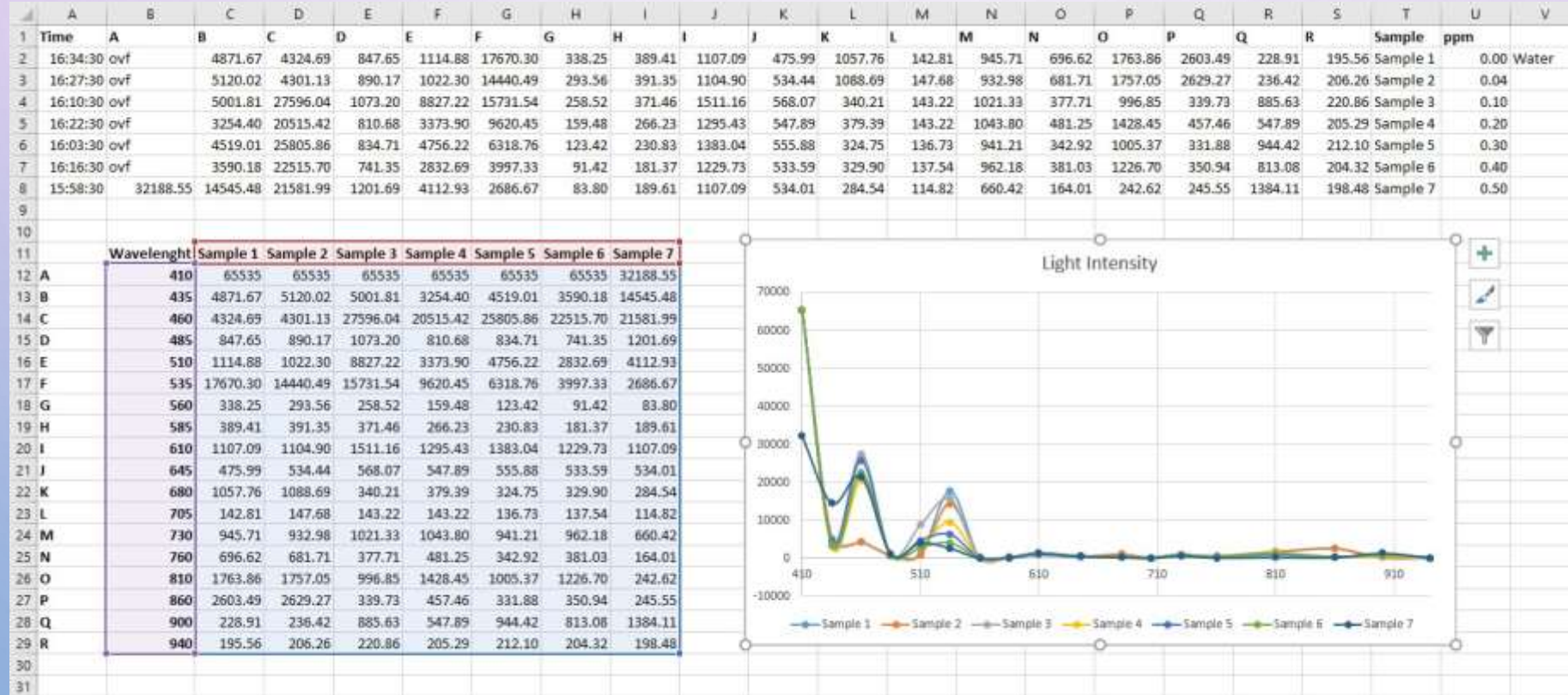


GRAPH FORMATTING

Y-AXIS > RIGHT CLICK > FORMAT AXIS



LIGHT INTENSITY



OPEN NEW SHEET, 'ABSORBANCE'

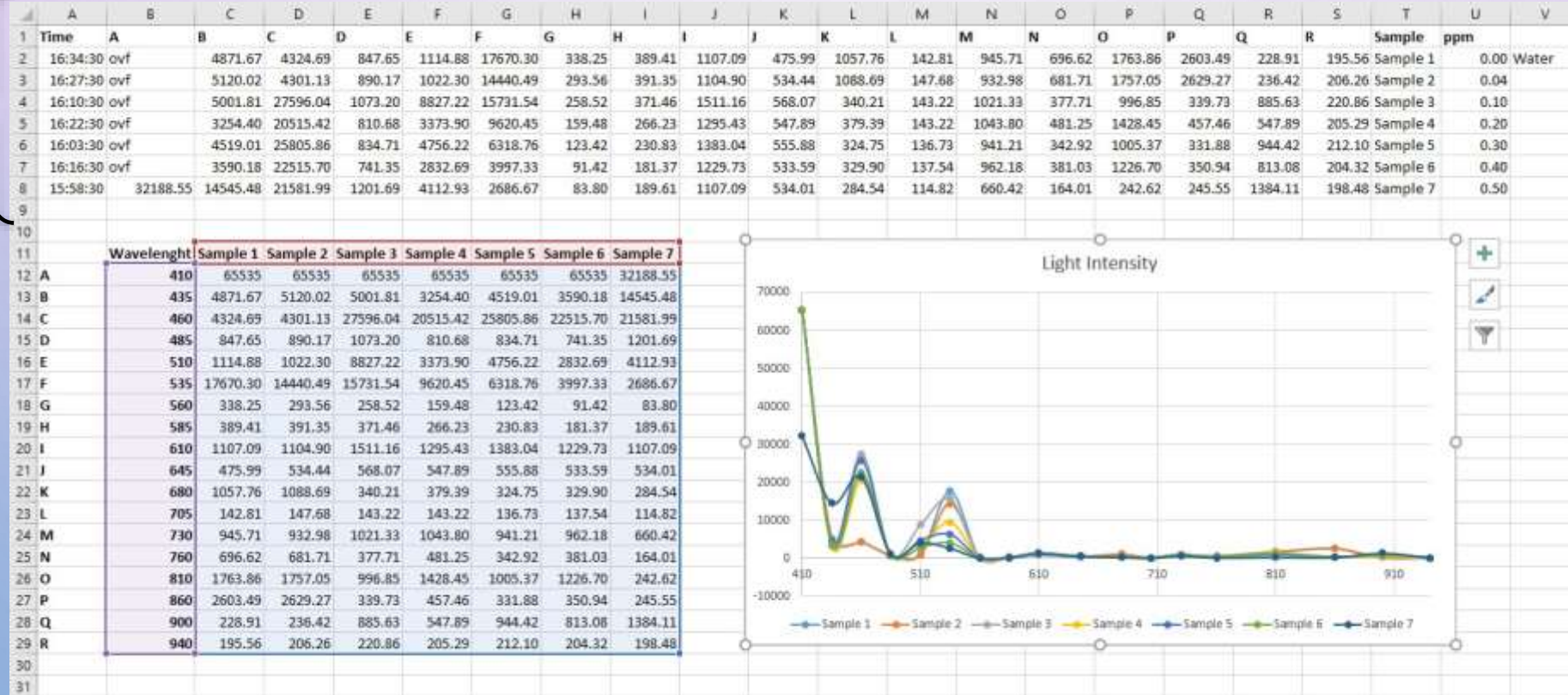
SparkFun Action&Time

Raw Data

Light Intensity

Absorbance

COPY & PASTE DATA



MORE INFO

(ABSORBANCE AND BEER'S LAW)

- [HTTPS://CHEM.LIBRETEXTS.ORG/BOOKSHELVES/ANALYTICAL CHEMISTRY/PHYSICAL METHODS IN CHEMISTRY AND NANO SCIENCE \(BARRON\)/04%3A CHEMICAL SPECIATION/4.04%3A UV-VISIBLE SPECTROSCOPY](https://chem.libretexts.org/Bookshelves/Analytical_Chemistry/Physical_Methods_in_Chemistry_And_Nano_Science_(Barron)/04%3A_Chemical_Speciation/4.04%3A_UV-Visible_Spectroscopy)

$$A = \epsilon bc$$

A = absorbance (logarithmic scale)
 B = the path length of the sample holder
 C = the concentration of solution ($\text{M}^{-1}\text{cm}^{-1}$)


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4.4: UV-Visible Spectroscopy

Last updated: Mar 22, 2021

 Readability
  Cite this page
 

Contributed by Pavan M. V. Saiz & Andrew R. Barron
 Professor (Chemistry) at Rice University
 Sourced from OpenStax CNX

Ultraviolet-visible (UV-vis) spectroscopy is used to obtain the absorbance spectra of a compound in solution or as a solid. What is actually being observed spectroscopically is the absorbance of light energy or electromagnetic radiation, which excites electrons from the ground state to the first singlet excited state of the compound or material. The UV-vis region of energy for the electromagnetic spectrum covers 1.5 - 6.2 eV which relates to a wavelength range of 800 - 200 nm. The Beer-Lambert Law, Equation 4.4.1, is the principle behind absorbance spectroscopy. For a single wavelength, A is absorbance (unitless, usually seen as arb. units or arbitrary units), ϵ is the molar absorptivity of the compound or molecule in solution ($\text{M}^{-1}\text{cm}^{-1}$), b is the path length of the cuvette or sample holder (usually 1 cm), and c is the concentration of the solution (M).

$$A = \epsilon bc \quad (4.4.1)$$

All of these instruments have a light source (usually a deuterium or tungsten lamp), a sample holder and a detector, but some have a filter for selecting one wavelength at a time. The single beam instrument (Figure 4.4.1) has a filter or a monochromator between the source and the sample to analyze one wavelength at a time. The double beam instrument (Figure 4.4.2) has a single source and a monochromator and then there is a splitter and a series of mirrors to get the beam to a reference sample and the sample to be analyzed; this allows for more accurate readings. In contrast, the simultaneous instrument (Figure 4.4.3) does not have a monochromator between the sample and the source; instead, it has a diode array detector that allows the instrument to simultaneously detect the absorbance at all wavelengths. The simultaneous instrument is usually much faster and more efficient, but all of these types of spectrometers work well.



MORE INFO

(ABSORBANCE AND BEER'S LAW)

part of the electromagnetic spectrum that we can access with equipment found in a typical chemistry laboratory. The basic principles of spectrum analysis can also be applied to other instrumentation that extend the ultraviolet, infrared, and radio frequency regions.

In a visible spectrophotometer, we shine a beam of light into a solution containing the sample, and detect how much of it comes out of the other side of the solution. By comparing the amount of light transmitted by the pure solvent to the amount transmitted when the sample is dissolved in it, we can calculate a quantity called the **absorbance**. Absorbance is directly proportional to concentration, so if you know the proportionality constant, you can use it to calculate the concentration of a substance in solution. Being able to answer the "how much?" question means that a visible spectrophotometer is a tool for doing quantitative analysis.

Knowing exactly which wavelengths of light are absorbed by a substance also gives us information that can be used to tell one substance from another or to determine whether a sample is a pure substance or a mixture. Being able to answer the "what is it?" question means that a visible spectrophotometer is also a tool for doing qualitative analysis.

Absorbance and Beer's Law

When colored solutions are irradiated with white light, the solution selectively absorbs incident light of some wavelengths. The wavelength of light where the absorbance is highest is used as the analytical wavelength. Once the analytical wavelength for a particular solution is determined, we can learn more about the solution through the relationship between absorbance (A) and three variables:

A = εbc Beer's Law

The three variables are: concentration of the solution (c), the pathlength of the light through the solution (b), and the sensitivity of the absorbing species to the energy of the analytical wavelength. When the concentration is expressed in molarity and the path length is measured in centimeters, the sensitivity factor is known as the molar absorptivity (ε) of the particular absorbing species.

Visible spectrophotometers are capable of displaying data in either of two scales:

- Percent transmittance (%T), which is a linear scale
- Absorbance (A), which is a logarithmic scale

The linear %T scale can be converted to absorbance where T is the percent transmittance expressed as a decimal (e.g., 22% = 0.22)

A = -Log₁₀ T

The most important lesson to take home from this logarithmic relationship is the realization that when the absorbance is 1.0, only 10% of the light beam's full intensity is reaching the detector (and when the absorbance is 2.0, only 1% of the light beam is reaching the detector). The accuracy and sensitivity of low cost instruments starts to suffer at absorbance values higher than 1.5.

Transmittance (or %T) itself is determined by the instrument by dividing the detector signal when measuring the sample (I) by the signal recorded for a "blank" solution (I₀)

T = $\frac{I}{I_0}$ Transmittance

When we work with cuvettes or test tubes where the path through the liquid is exactly 1 cm, the value of "b" in the equation for Beer's Law is simply 1, so it effectively drops out of the equation and simplifies it to A = εc. This means that:

- If you were to measure the absorbance of several solutions of known concentration, and plot the absorbance on the y-axis and concentration on the x-axis, the slope would be the molar absorptivity (ε) of the sample in solution.
- If you know the molar absorptivity, you can calculate the concentration (c) of a solution with ease by simply dividing the absorbance by ε (c = A/ε).

Purpose

In this experiment, you will make different kinds of measurement on various food dyes.

1. A scan of the visible spectrum recorded using a Thermo Scientific™ SPECTROMIC™ 200 Visible Light Spectrophotometer will show you which wavelengths are absorbed by each sample. You will identify a peak or peaks in the scan and record the wavelength of each peak. Officially, the wavelength of the top of the peak is

2

$$A = -\log_{10} T$$

1

$$T = \frac{I}{I_0}$$

Transmittance

T = Percent transmittance(%T) (linear scale)

The linear %T scale can be converted to absorbance where T is the percent transmittance expressed as a decimal (e.g., 22% = 0.22)

Transmittance (or %T) itself is determined by the instrument by dividing the detector signal when measuring the sample (I) by the signal recorded for a "blank" solution(I₀)

EXCEL EQUATION SET UP (1)

SUM		=LOG10(B7/B\$6)																				
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
4																						
5	Time	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R		Sample	ppm
6	16:34:30	65535	4871.67	4324.69	847.65	1114.88	17670.30	338.25	389.41	1107.09	475.99	1057.76	142.81	945.71	696.62	1763.86	2603.49	228.91	195.56	Sample 1	0.00	
7	16:27:30	65535	5120.02	4301.13	890.17	1022.30	14440.49	293.56	391.35	1104.90	534.44	1088.69	147.68	932.98	681.71	1757.05	2629.27	236.42	206.26	Sample 2	0.04	
8	16:10:30	65535	5001.81	27596.04	1073.20	8827.22	15731.54	258.52	371.46	1511.16	568.07	340.21	143.22	1021.33	377.71	996.85	339.73	885.63	220.86	Sample 3	0.10	
9	16:22:30	65535	3254.40	20515.42	810.68	3373.90	9620.45	159.48	266.23	1295.43	547.89	379.39	143.22	1043.80	481.25	1428.45	457.46	547.89	205.29	Sample 4	0.20	
10	16:03:30	65535	4519.01	25805.86	834.71	4756.22	6318.76	123.42	230.83	1383.04	555.88	324.75	136.73	941.21	342.92	1005.37	331.88	944.42	212.10	Sample 5	0.30	
11	16:16:30	65535	3590.18	22515.70	741.35	2832.69	3997.33	91.42	181.37	1229.73	533.59	329.90	137.54	962.18	381.03	1226.70	350.94	813.08	204.32	Sample 6	0.40	
12	15:58:30	32188.55	14545.48	21581.99	1201.69	4112.93	2686.67	83.80	189.61	1107.09	534.01	284.54	114.82	660.42	164.01	242.62	245.55	1384.11	198.48	Sample 7	0.50	
13																						
14																						
15		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R		Sample	ppm
16	I>0	65535	4871.67	4324.69	847.65	1114.88	17670.30	338.25	389.41	1107.09	475.99	1057.76	142.81	945.71	696.62	1763.86	2603.49	228.91	195.56	Sample 1	0.00	
17		410	435	460	485	510	535	560	585	610	645	680	705	730	760	810	860	900	940			
18	Sample 2	10(B7/B\$6)	-0.022	0.002	-0.021	0.038	0.088	0.062	-0.002	0.001	-0.050	-0.013	-0.015	0.006	0.009	0.002	-0.004	-0.014	-0.023	Sample 2	0.04	
19	Sample 3	0.000	-0.011	-0.805	-0.102	-0.899	0.050	0.117	0.020	-0.135	-0.077	0.493	-0.001	-0.033	0.266	0.248	0.884	-0.588	-0.053	Sample 3	0.10	
20	Sample 4	0.000	0.175	-0.676	0.019	-0.481	0.264	0.327	0.165	-0.068	-0.061	0.445	-0.001	-0.043	0.161	0.092	0.755	-0.379	-0.021	Sample 4	0.20	
21	Sample 5	0.000	0.033	-0.776	0.007	-0.630	0.447	0.438	0.227	-0.097	-0.067	0.513	0.019	0.002	0.308	0.244	0.895	-0.616	-0.035	Sample 5	0.30	
22	Sample 6	0.000	0.133	-0.717	0.058	-0.405	0.645	0.568	0.332	-0.046	-0.050	0.506	0.016	-0.007	0.262	0.158	0.870	-0.550	-0.019	Sample 6	0.40	
23	Sample 7	0.309	-0.475	-0.698	-0.152	-0.567	0.818	0.606	0.313	0.000	-0.050	0.570	0.095	0.156	0.628	0.862	1.025	-0.782	-0.006	Sample 7	0.50	
24																						

1

$$I_0 = \text{water}(0\%) / \text{ppm} = 0, \text{ Sample 1}$$

2

$$= -\text{LOG10}(B7/B\$6)$$

=

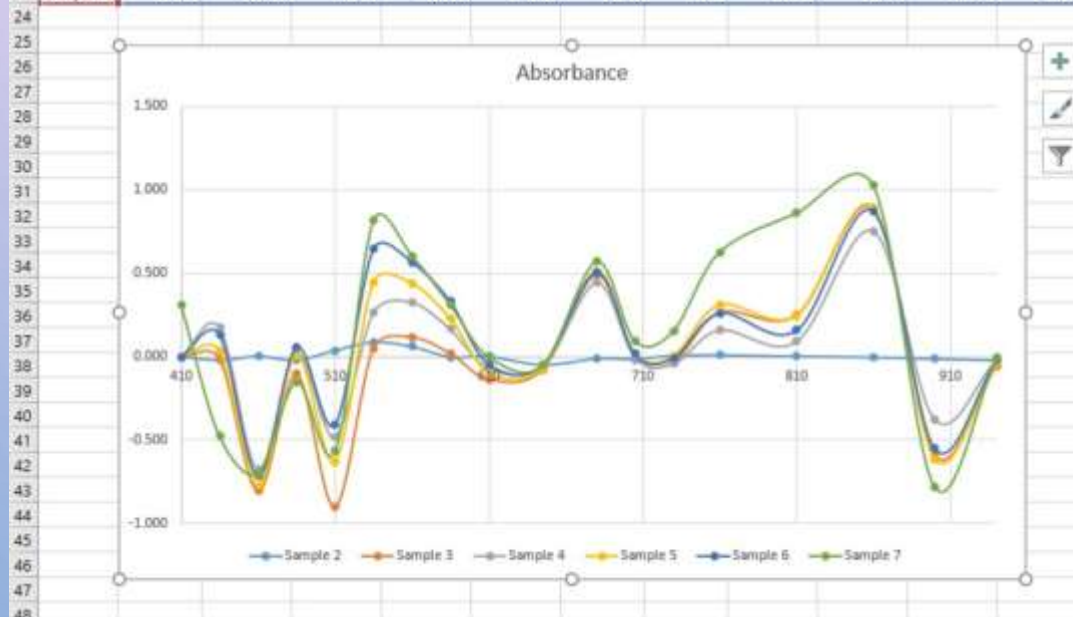
$$A = -\text{Log}_{10} T$$

+

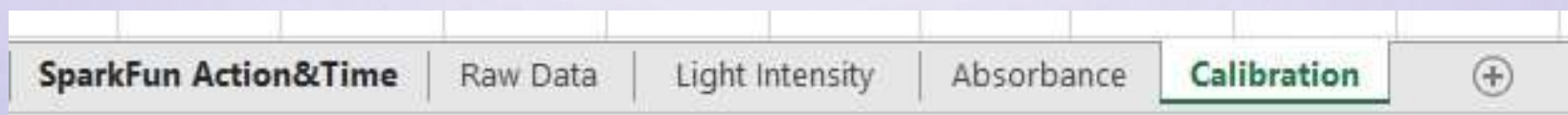
$$T = \frac{I}{I_0} \quad \text{Transmittance}$$

PLOT GRAPH

14																					
15		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	Sample	ppm
16	1>0	65535	4871.67	4324.69	847.65	1114.88	17670.30	338.25	389.41	1107.09	475.99	1057.76	142.81	945.71	696.62	1763.86	2603.49	228.91	195.56	Sample 1	0.00
17		410	435	460	485	510	535	560	585	610	645	680	705	730	760	810	860	900	940		
18	Sample 2	0.000	-0.022	0.002	-0.021	0.038	0.088	0.062	-0.002	0.001	-0.050	-0.013	-0.015	0.006	0.009	0.002	-0.004	-0.014	-0.023	Sample 2	0.04
19	Sample 3	0.000	-0.011	-0.805	-0.102	-0.899	0.050	0.117	0.020	-0.135	-0.077	0.493	-0.001	-0.033	0.266	0.248	0.884	-0.588	-0.053	Sample 3	0.10
20	Sample 4	0.000	0.175	-0.676	0.019	-0.481	0.264	0.327	0.165	-0.068	-0.061	0.445	-0.001	-0.043	0.161	0.092	0.755	-0.379	-0.021	Sample 4	0.20
21	Sample 5	0.000	0.033	-0.776	0.007	-0.630	0.447	0.438	0.227	-0.097	-0.067	0.513	0.019	0.002	0.308	0.244	0.895	-0.616	-0.035	Sample 5	0.30
22	Sample 6	0.000	0.133	-0.717	0.058	-0.405	0.645	0.568	0.332	-0.046	-0.050	0.506	0.016	-0.007	0.262	0.158	0.870	-0.550	-0.019	Sample 6	0.40
23	Sample 7	0.309	-0.475	-0.698	-0.152	-0.567	0.818	0.606	0.313	0.000	-0.050	0.570	0.095	0.156	0.628	0.862	1.025	-0.782	-0.006	Sample 7	0.50



COPY SHEET AND SAVE AS 'CALIBRATION'



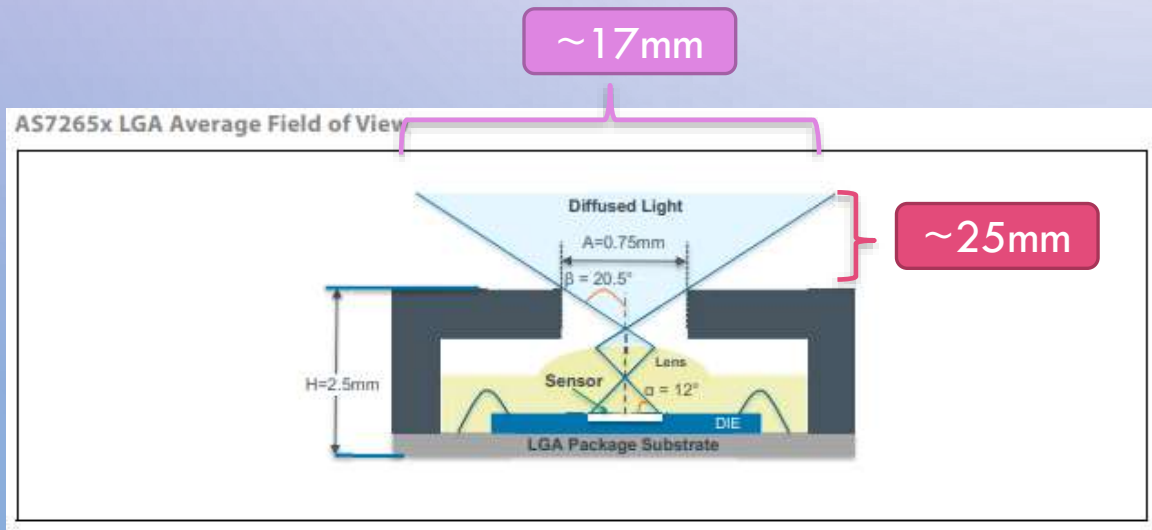
CALIBRATION FOR MEASUREMENT EQUIPMENT

$$A = \epsilon bc$$

A = absorbance (logarithmic scale)

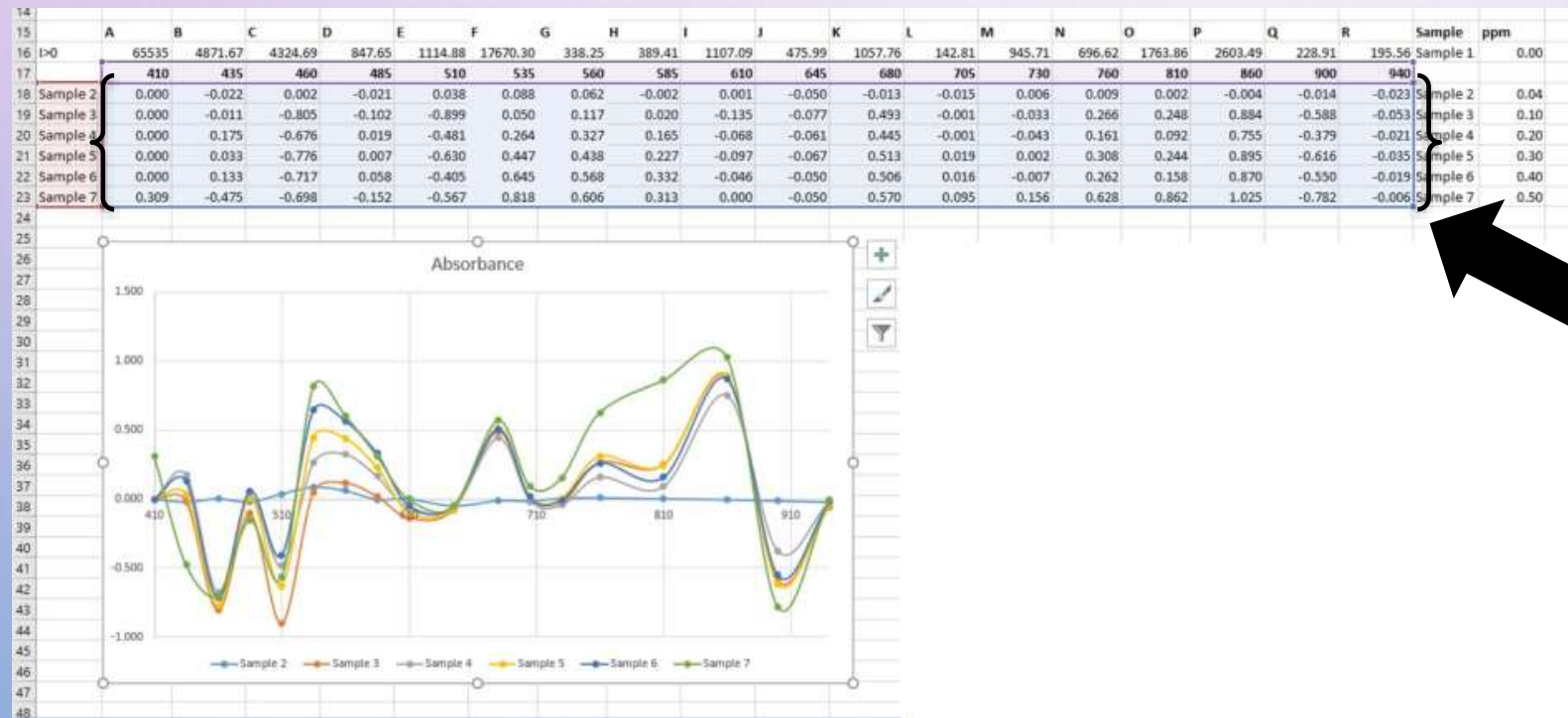
B = the path length of the sample holder

C = the concentration of solution ($\text{M}^{-1}\text{cm}^{-1}$)



Path length x2

CALIBRATION EQUATION

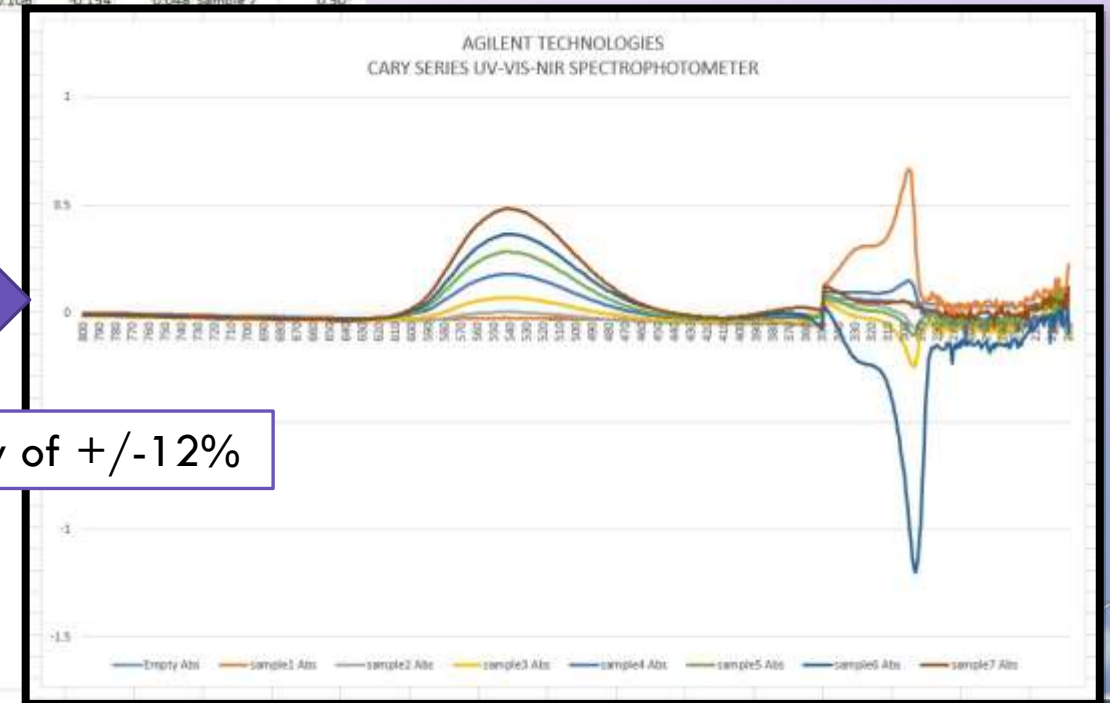
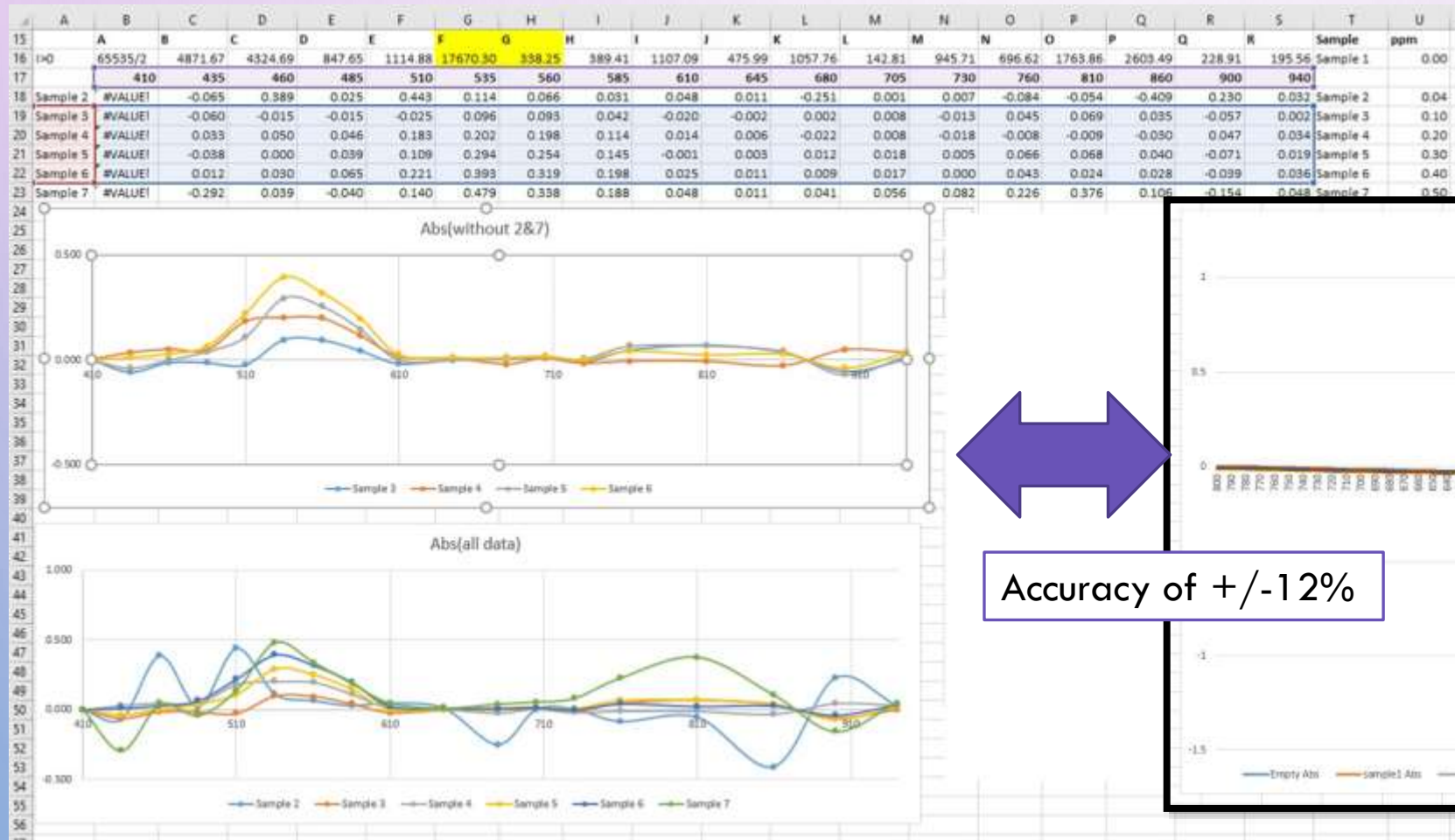


/2

Path length x2



ABSORBANCE GRAPH (WITH ACCURACY)

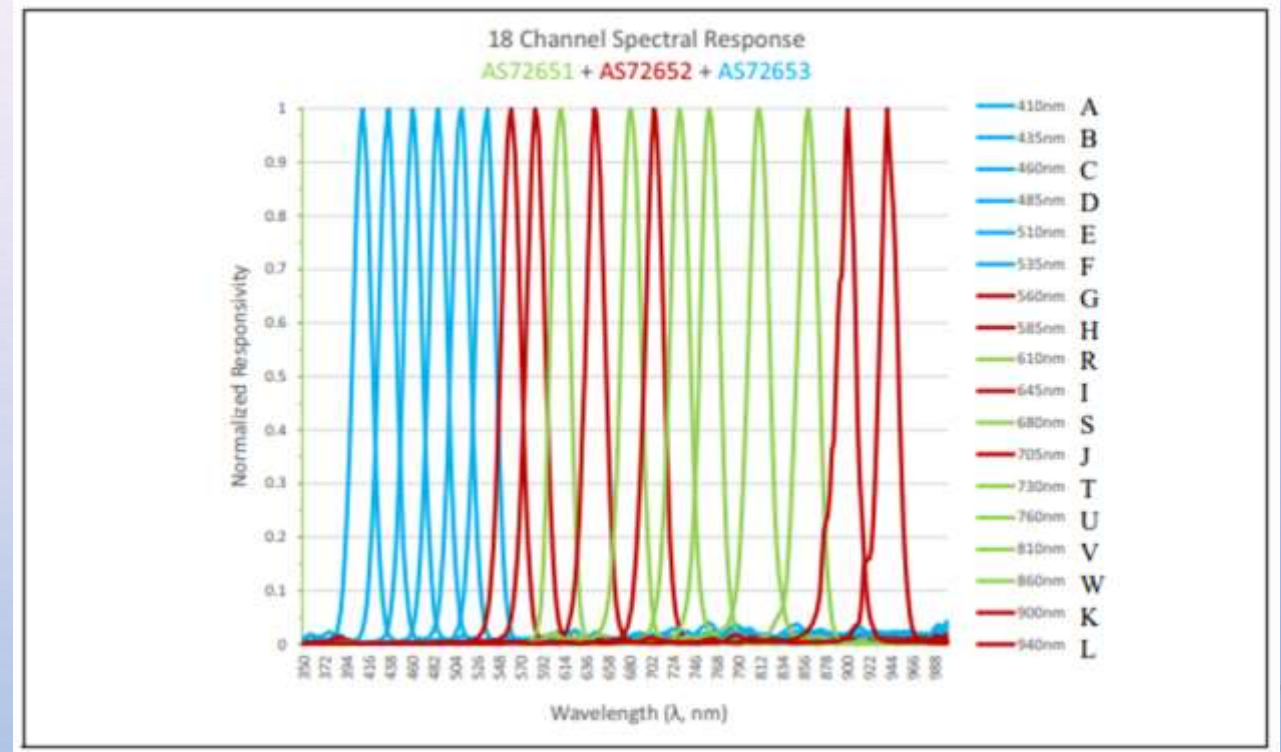


DATA ANALYSIS

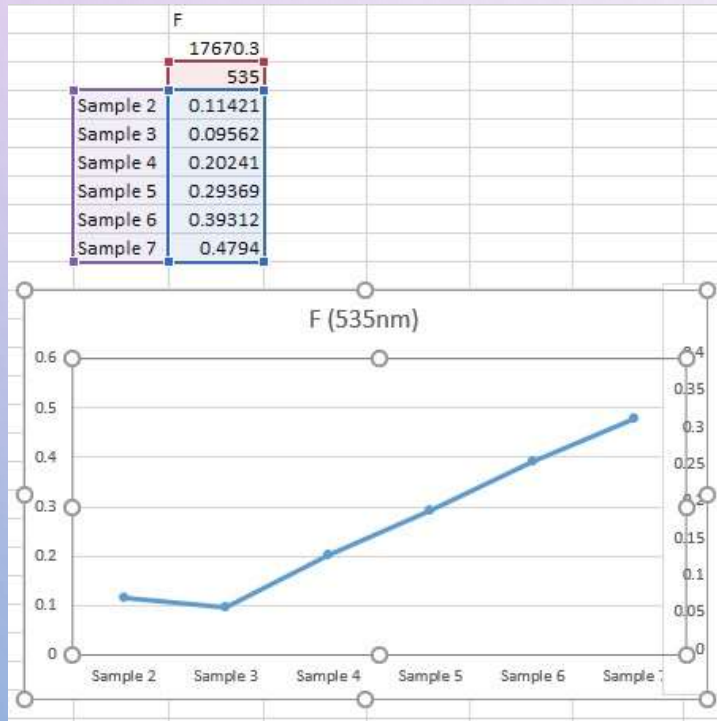


Sample	ppm
1	0.00
2	0.04
3	0.10
4	0.20
5	0.30
6	0.40
7	0.50

AS7265x 18-Channel Spectral Responsivity



COLORIMETRIC-DYE FOR NITRITE ANALYSIS (AZO DYE, 542NM)



Azo dye, 542nm
 Organic compounds,
 Function group R-N=N-R'

