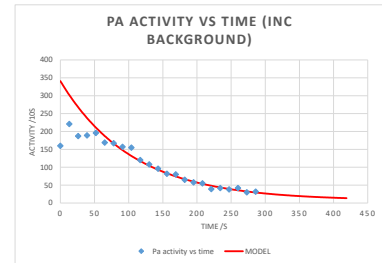
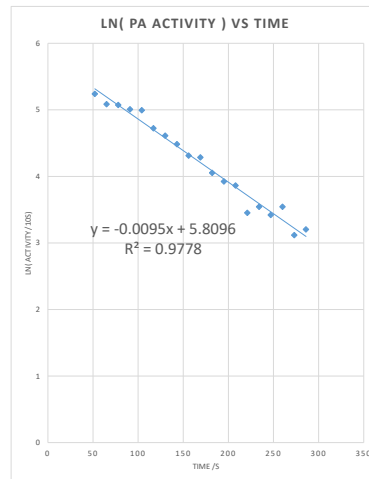


# HALF LIFE OF PROTACTINIUM 17/03/2020

A			
Count rate /10s	t /s	Count rate /10s - background	ln(A)
160	0	152.6	5.03
221	13	213.6	5.36
187	26	179.6	5.19
189	39	181.6	5.2
196	52	188.6	5.24
169	65	161.6	5.09
167	78	159.6	5.07
157	91	149.6	5.01
155	104	147.6	4.99
120	117	112.6	4.72
108	130	100.6	4.61
96	143	88.6	4.48
82	156	74.6	4.31
80	169	72.6	4.28
65	182	57.6	4.05
58	195	50.6	3.92
55	208	47.6	3.86
39	221	31.6	3.45
42	234	34.6	3.54
38	247	30.6	3.42
42	260	34.6	3.54
30	273	22.6	3.12
32	286	24.6	3.2

## BACKGROUND (/10) 7.4



$$A = \frac{A_0}{2^{t/t_{1/2}}} \quad \therefore \ln A = \ln A_0 - \frac{t}{t_{1/2}} \ln 2$$

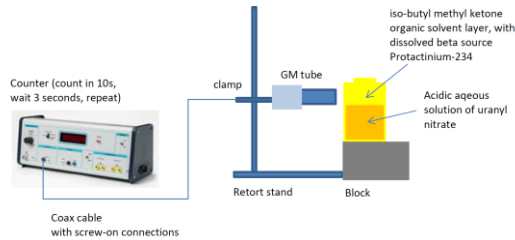
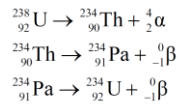
$$\frac{\ln 2}{t_{1/2}} = 0.0095 \quad \therefore t_{1/2} = \frac{\ln 2}{0.0095} = 73.0s$$

$$\ln A_0 = 5.8096 \quad \therefore A_0 = e^{5.8096} = 333.5$$

$$\therefore A(t) = \frac{333.5}{2^{t/73.0s}}$$

## MODEL

t /s	A + background
0	341
1	338
2	335
3	332
4	328
5	325
6	322
7	319
8	317
9	314
10	311
11	308
12	305
13	302
14	299
15	297
16	294
17	291
18	289
19	286
20	283
21	281
22	278
23	275
24	273
25	270
26	268
27	265
28	263
29	261
30	258
31	256
32	254
33	251
34	249
35	247
36	244
37	242
38	240
39	238
40	236
41	233
42	231
43	229
44	227
45	225
46	223
47	221
48	219
49	217
50	215
51	213
52	211
53	209
54	207
55	205



Shake bottle before use to introduce Protactinium into solvent layer. The other atoms in the decay chain are not soluble in this layer.

Note Thorium-234 has a half life of 24 days. Uranium-238 and Uranium-234 have long half lives of 4.5 billion years and 246,000 years respectively, so their activity can be assumed to be constant!



56	203
57	202
58	200
59	198
60	196
61	194
62	193
63	191
64	189
65	187
66	186
67	184
68	182
69	181
70	179
71	177
72	176
73	174
74	173
75	171
76	169
77	168
78	166
79	165
80	163
81	162
82	160
83	159
84	158
85	156
86	155
87	153
88	152
89	151
90	149
91	148
92	147
93	145
94	144
95	143
96	141
97	140
98	139
99	138
100	136
101	135
102	134
103	133
104	132
105	130
106	129
107	128
108	127
109	126
110	125
111	124
112	123
113	121
114	120
115	119
116	118
117	117
118	116
119	115
120	114
121	113
122	112
123	111
124	110
125	109
126	108
127	107
128	106
129	105
130	104
131	104
132	103
133	102
134	101
135	100
136	99.1
137	98.2
138	97.4
139	96.5
140	95.7
141	94.8
142	94
143	93.2

144	92.4
145	91.6
146	90.8
147	90
148	89.2
149	88.4
150	87.7
151	86.9
152	86.2
153	85.4
154	84.7
155	83.9
156	83.2
157	82.5
158	81.8
159	81.1
160	80.4
161	79.7
162	79
163	78.3
164	77.7
165	77
166	76.4
167	75.7
168	75.1
169	74.4
170	73.8
171	73.2
172	72.5
173	71.9
174	71.3
175	70.7
176	70.1
177	69.5
178	68.9
179	68.3
180	67.8
181	67.2
182	66.6
183	66.1
184	65.5
185	65
186	64.4
187	63.9
188	63.4
189	62.8
190	62.3
191	61.8
192	61.3
193	60.8
194	60.3
195	59.8
196	59.3
197	58.8
198	58.3
199	57.8
200	57.3
201	56.9
202	56.4
203	55.9
204	55.5
205	55
206	54.6
207	54.1
208	53.7
209	53.2
210	52.8
211	52.4
212	52
213	51.5
214	51.1
215	50.7
216	50.3
217	49.9
218	49.5
219	49.1
220	48.7
221	48.3
222	47.9
223	47.5
224	47.2
225	46.8
226	46.4
227	46
228	45.7
229	45.3
230	45
231	44.6

232	44.2
233	43.9
234	43.6
235	43.2
236	42.9
237	42.5
238	42.2
239	41.9
240	41.6
241	41.2
242	40.9
243	40.6
244	40.3
245	40
246	39.7
247	39.4
248	39.1
249	38.8
250	38.5
251	38.2
252	37.9
253	37.6
254	37.3
255	37
256	36.7
257	36.5
258	36.2
259	35.9
260	35.6
261	35.4
262	35.1
263	34.9
264	34.6
265	34.3
266	34.1
267	33.8
268	33.6
269	33.3
270	33.1
271	32.8
272	32.6
273	32.4
274	32.1
275	31.9
276	31.7
277	31.4
278	31.2
279	31
280	30.8
281	30.5
282	30.3
283	30.1
284	29.9
285	29.7
286	29.5
287	29.3
288	29.1
289	28.8
290	28.6
291	28.4
292	28.2
293	28
294	27.9
295	27.7
296	27.5
297	27.3
298	27.1
299	26.9
300	26.7
301	26.5
302	26.4
303	26.2
304	26
305	25.8
306	25.6
307	25.5
308	25.3
309	25.1
310	25
311	24.8
312	24.6
313	24.5
314	24.3
315	24.2
316	24
317	23.8
318	23.7
319	23.5

320	23.4
321	23.2
322	23.1
323	22.9
324	22.8
325	22.6
326	22.5
327	22.4
328	22.2
329	22.1
330	21.9
331	21.8
332	21.7
333	21.5
334	21.4
335	21.3
336	21.1
337	21
338	20.9
339	20.7
340	20.6
341	20.5
342	20.4
343	20.2
344	20.1
345	20
346	19.9
347	19.8
348	19.6
349	19.5
350	19.4
351	19.3
352	19.2
353	19.1
354	19
355	18.9
356	18.8
357	18.6
358	18.5
359	18.4
360	18.3
361	18.2
362	18.1
363	18
364	17.9
365	17.8
366	17.7
367	17.6
368	17.5
369	17.4
370	17.3
371	17.2
372	17.2
373	17.1
374	17
375	16.9
376	16.8
377	16.7
378	16.6
379	16.5
380	16.4
381	16.4
382	16.3
383	16.2
384	16.1
385	16
386	15.9
387	15.9
388	15.8
389	15.7
390	15.6
391	15.5
392	15.5
393	15.4
394	15.3
395	15.2
396	15.2
397	15.1
398	15
399	14.9
400	14.9
401	14.8
402	14.7
403	14.7
404	14.6
405	14.5
406	14.5
407	14.4

408	14.3
409	14.3
410	14.2
411	14.1
412	14.1
413	14
414	13.9
415	13.9
416	13.8
417	13.8
418	13.7
419	13.6