

### Example 6.2-2 Fruit in a warehouse.EEZ

The quality of frozen fruit is particularly susceptible to changes in its storage temperature. A large warehouse full of fruit is cooled by several evaporators. The nominal temperature of the air in the warehouse is  $T_{\infty,ini} = -5^{\circ}\text{C}$  and the fruit is initially at this temperature. However, each of the evaporators must be periodically defrosted by running hot gas through the refrigeration tubes. Because the remaining evaporators do not have sufficient capacity to meet the freezer load, the defrost process leads to an increase in the warehouse air temperature. The air temperature in the freezer ( $T_{\infty}$ ) following the initiation of a defrost is given by:

$$T_{\infty} = \begin{cases} T_{\infty,ini} + \Delta T_{\infty} \sin\left(\frac{\pi t}{t_{defrost}}\right) & \text{for } t < t_{defrost} \\ T_{\infty,ini} & \text{for } t > t_{defrost} \end{cases} \quad (1)$$

where  $\Delta T_{\infty} = 7 \text{ K}$  is the temperature rise and  $t_{defrost} = 60 \text{ min}$ . The fruit can be modeled as spheres with diameter  $D = 2.0 \text{ cm}$  and properties  $\rho = 1000 \text{ kg/m}^3$ ,  $c = 4000 \text{ J/kg}\cdot\text{K}$ , and  $k = 0.9 \text{ W/m}\cdot\text{K}$ .

- Can the fruit be treated using a lumped capacitance model?
- Determine the temperature variation of the fruit during a defrost process using a lumped capacitance model.

## Equations

### EXAMPLE 6.2-2: Fruit in a Warehouse

Heat Transfer

G.F. Nellis and S.A. Klein

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\$UnitSystem SI MASS RAD PA K J

\$Tabstops 0.2 0.4 0.6 3.5 in

Part\$ = 'b'      change 'a' to 'b' to solve part b (1)

#### Inputs

$$D = 2 \text{ [cm]} \cdot \left| 0.01 \frac{\text{m}}{\text{cm}} \right| \quad \text{diameter of fruit} \quad (2)$$

$$\rho = 1000 \text{ [kg/m}^3\text{]} \quad \text{fruit density} \quad (3)$$

$$c = 4000 \text{ [J/kg}\cdot\text{K]} \quad \text{specific heat capacity} \quad (4)$$

$$k = 0.9 \text{ [W/m}\cdot\text{K]} \quad \text{conductivity} \quad (5)$$

$$T_{\infty,ini} = \text{ConvertTemp}(C, K, -5 \text{ [C]}) \quad \text{initial freezer air temperature} \quad (6)$$

$$\Delta T_{\infty} = 7 \text{ [K]} \quad \text{freezer air temperature change} \quad (7)$$

$$t_{defrost} = 60 \text{ [min]} \cdot \left| 60 \frac{\text{s}}{\text{min}} \right| \quad \text{defrost time} \quad (8)$$

\$if Part\$='a'

$$T_{\infty} = T_{\infty,ini} + DT_{\infty} \quad \text{maximum ambient temperature} \quad (9)$$

$$T = T_{\infty,ini} \quad \text{minimum fruit temperature} \quad (10)$$

\$endif

$$T_{film} = \frac{T_{\infty} + T}{2} \quad \text{film temperature} \quad (11)$$

$$\rho_a = \rho \left( Air, T = T_{film}, P = 1 \text{ [atm]} \cdot \left| 101325 \frac{\text{Pa}}{\text{atm}} \right| \right) \quad \text{density of air} \quad (12)$$

$$k_a = k(Air, T = T_{film}) \quad \text{conductivity of air} \quad (13)$$

$$c_a = c_p(Air, T = T_{film}) \quad \text{specific heat capacity of air} \quad (14)$$

$$\mu_a = \mu(Air, T = T_{film}) \quad \text{viscosity of air} \quad (15)$$

$$\beta_a = \beta(Air, T = T_{film}) \quad \text{volumetric expansion coefficient of air} \quad (16)$$

$$\nu_a = \mu_a / \rho_a \quad \text{kinematic viscosity of air} \quad (17)$$

$$\alpha_a = \frac{k_a}{(\rho_a \cdot c_a)} \quad \text{thermal diffusivity of air} \quad (18)$$

$$Pr_a = \nu_a / \alpha_a \quad \text{Prandtl number of air} \quad (19)$$

$$Ra_D = g \# \cdot D^3 \cdot \beta_a \cdot \frac{abs(T - T_{\infty})}{(\nu_a \cdot \alpha_a)} \quad \text{Rayleigh number} \quad (20)$$

$$\text{call } FC_{sphere,ND}(Ra_D, Pr_a : Nu_{sselt_D}) \quad \text{Nusselt number} \quad (21)$$

$$\bar{h} = Nu_{sselt_D} \cdot k_a / D \quad \text{heat transfer coefficient} \quad (22)$$

$$Biot = \bar{h} \cdot \frac{D}{(6 \cdot k)} \quad \text{Biot number} \quad (23)$$

\$ifnot Part\$='a'

$$M = \rho \cdot 4 \cdot \pi \cdot \frac{(D/2)^3}{3} \quad \text{mass} \quad (24)$$

$$A_s = 4 \cdot \pi \cdot (D/2)^2 \quad \text{surface area} \quad (25)$$

$$T_{\infty} = \text{If}(time, t_{defrost}, T_{\infty,ini} + DT_{\infty} \cdot \sin(\pi \cdot time / t_{defrost}), T_{\infty,ini}, T_{\infty,ini}) \quad \text{ambient air temperature} \quad (26)$$

$$dTdt = \bar{h} \cdot A_s \cdot \frac{T_{\infty} - T}{(M \cdot c)} \quad \text{rate of change of fruit temperature} \quad (27)$$

$$T = T_{\infty,ini} + \int_0^{2 \cdot t_{defrost}} dTdt \, dt \quad \text{integration of the state equation} \quad (28)$$

$$T_{\infty,C} = \text{ConvertTemp}(K, C, T_{\infty}) \quad \text{ambient temperature in C} \quad (29)$$

$$T_C = \text{ConvertTemp}(K, C, T) \quad \text{fruit temperature in C} \quad (30)$$

\$IntegralTable time:10, T\_infinity\_C, T\_C

\$endif

## Integral Table

Row	<i>time</i> [s]	$T_{\infty,C}$ [C]	$T_C$ [C]
1	0	-5	-5
2	10	-4.939	-5
3	20	-4.878	-5
4	30	-4.817	-4.999
5	40	-4.756	-4.998
6	50	-4.695	-4.997
7	60	-4.634	-4.996
8	70	-4.573	-4.995
9	80	-4.512	-4.993
10	90	-4.451	-4.991
11	100	-4.39	-4.989
12	110	-4.329	-4.987
13	120	-4.268	-4.984
14	130	-4.208	-4.981
15	140	-4.147	-4.978
16	150	-4.086	-4.974
17	160	-4.026	-4.971
18	170	-3.965	-4.967
19	180	-3.905	-4.962
20	190	-3.845	-4.958
21	200	-3.784	-4.953
22	210	-3.724	-4.948
23	220	-3.664	-4.943
24	230	-3.605	-4.937
25	240	-3.545	-4.93
26	250	-3.485	-4.924
27	260	-3.426	-4.918
28	270	-3.366	-4.911
29	280	-3.307	-4.905
30	290	-3.248	-4.897
31	300	-3.189	-4.889
32	310	-3.13	-4.882
33	320	-3.071	-4.874
34	330	-3.012	-4.866
35	340	-2.954	-4.858
36	350	-2.896	-4.848
37	360	-2.838	-4.839
38	370	-2.779	-4.83
39	380	-2.721	-4.82
40	390	-2.663	-4.811
41	400	-2.606	-4.801
42	410	-2.549	-4.79
43	420	-2.492	-4.779
44	430	-2.435	-4.769
45	440	-2.378	-4.758
46	450	-2.321	-4.747
47	460	-2.265	-4.735
48	470	-2.21	-4.723
49	480	-2.154	-4.711
50	490	-2.098	-4.699
51	500	-2.042	-4.687
52	510	-1.987	-4.674

53	520	-1.932	-4.66
54	530	-1.878	-4.647
55	540	-1.823	-4.633
56	550	-1.768	-4.62
57	560	-1.714	-4.607
58	570	-1.66	-4.592
59	580	-1.607	-4.577
60	590	-1.554	-4.563
61	600	-1.501	-4.548
62	610	-1.448	-4.533
63	620	-1.395	-4.518
64	630	-1.343	-4.502
65	640	-1.292	-4.487
66	650	-1.24	-4.471
67	660	-1.188	-4.455
68	670	-1.137	-4.439
69	680	-1.086	-4.422
70	690	-1.036	-4.405
71	700	-0.9862	-4.388
72	710	-0.9362	-4.371
73	720	-0.8862	-4.354
74	730	-0.8363	-4.337
75	740	-0.7881	-4.319
76	750	-0.7399	-4.301
77	760	-0.6917	-4.283
78	770	-0.6434	-4.265
79	780	-0.5952	-4.247
80	790	-0.5478	-4.229
81	800	-0.5015	-4.21
82	810	-0.4552	-4.191
83	820	-0.4089	-4.172
84	830	-0.3626	-4.153
85	840	-0.3163	-4.134
86	850	-0.2716	-4.114
87	860	-0.2273	-4.094
88	870	-0.183	-4.075
89	880	-0.1387	-4.055
90	890	-0.09436	-4.035
91	900	-0.05044	-4.015
92	910	-0.008253	-3.994
93	920	0.03393	-3.974
94	930	0.07612	-3.953
95	940	0.1183	-3.932
96	950	0.1605	-3.912
97	960	0.2014	-3.891
98	970	0.2414	-3.87
99	980	0.2814	-3.848
100	990	0.3214	-3.827
101	1,000	0.3613	-3.806
102	1,010	0.4013	-3.784
103	1,020	0.4391	-3.763
104	1,030	0.4768	-3.741
105	1,040	0.5144	-3.719
106	1,050	0.5521	-3.697

107	1,060	0.5897	-3.675
108	1,070	0.6266	-3.653
109	1,080	0.6619	-3.631
110	1,090	0.6971	-3.608
111	1,100	0.7324	-3.586
112	1,110	0.7676	-3.564
113	1,120	0.8029	-3.541
114	1,130	0.8364	-3.519
115	1,140	0.8692	-3.496
116	1,150	0.902	-3.473
117	1,160	0.9347	-3.451
118	1,170	0.9675	-3.428
119	1,180	1	-3.405
120	1,190	1.03	-3.382
121	1,200	1.06	-3.359
122	1,210	1.091	-3.336
123	1,220	1.121	-3.313
124	1,230	1.151	-3.29
125	1,240	1.18	-3.267
126	1,250	1.208	-3.243
127	1,260	1.235	-3.22
128	1,270	1.263	-3.197
129	1,280	1.29	-3.174
130	1,290	1.318	-3.15
131	1,300	1.343	-3.127
132	1,310	1.368	-3.104
133	1,320	1.393	-3.08
134	1,330	1.418	-3.057
135	1,340	1.443	-3.034
136	1,350	1.467	-3.01
137	1,360	1.489	-2.987
138	1,370	1.511	-2.964
139	1,380	1.533	-2.94
140	1,390	1.555	-2.917
141	1,400	1.577	-2.894
142	1,410	1.598	-2.87
143	1,420	1.617	-2.847
144	1,430	1.636	-2.824
145	1,440	1.656	-2.801
146	1,450	1.675	-2.777
147	1,460	1.694	-2.754
148	1,470	1.711	-2.731
149	1,480	1.727	-2.708
150	1,490	1.743	-2.685
151	1,500	1.76	-2.662
152	1,510	1.776	-2.639
153	1,520	1.792	-2.616
154	1,530	1.805	-2.593
155	1,540	1.819	-2.57
156	1,550	1.832	-2.547
157	1,560	1.846	-2.525
158	1,570	1.859	-2.502
159	1,580	1.871	-2.479
160	1,590	1.881	-2.457

161	1,600	1.892	-2.434
162	1,610	1.902	-2.412
163	1,620	1.913	-2.39
164	1,630	1.923	-2.367
165	1,640	1.931	-2.345
166	1,650	1.938	-2.323
167	1,660	1.946	-2.301
168	1,670	1.953	-2.279
169	1,680	1.961	-2.257
170	1,690	1.967	-2.235
171	1,700	1.972	-2.214
172	1,710	1.976	-2.192
173	1,720	1.981	-2.171
174	1,730	1.986	-2.15
175	1,740	1.99	-2.128
176	1,750	1.992	-2.107
177	1,760	1.994	-2.086
178	1,770	1.995	-2.065
179	1,780	1.997	-2.044
180	1,790	1.999	-2.024
181	1,800	2	-2.003
182	1,810	1.998	-1.983
183	1,820	1.997	-1.963
184	1,830	1.996	-1.942
185	1,840	1.994	-1.922
186	1,850	1.993	-1.902
187	1,860	1.99	-1.882
188	1,870	1.985	-1.863
189	1,880	1.981	-1.843
190	1,890	1.976	-1.824
191	1,900	1.972	-1.805
192	1,910	1.968	-1.785
193	1,920	1.96	-1.767
194	1,930	1.953	-1.748
195	1,940	1.946	-1.729
196	1,950	1.938	-1.711
197	1,960	1.931	-1.692
198	1,970	1.923	-1.674
199	1,980	1.912	-1.656
200	1,990	1.902	-1.638
201	2,000	1.892	-1.621
202	2,010	1.881	-1.603
203	2,020	1.871	-1.585
204	2,030	1.859	-1.568
205	2,040	1.845	-1.552
206	2,050	1.832	-1.535
207	2,060	1.819	-1.518
208	2,070	1.805	-1.501
209	2,080	1.792	-1.485
210	2,090	1.776	-1.469
211	2,100	1.76	-1.453
212	2,110	1.743	-1.437
213	2,120	1.727	-1.422
214	2,130	1.711	-1.406

215	2,140	1.694	-1.391
216	2,150	1.674	-1.376
217	2,160	1.655	-1.361
218	2,170	1.636	-1.346
219	2,180	1.617	-1.332
220	2,190	1.598	-1.317
221	2,200	1.577	-1.303
222	2,210	1.555	-1.29
223	2,220	1.533	-1.276
224	2,230	1.511	-1.262
225	2,240	1.489	-1.249
226	2,250	1.467	-1.235
227	2,260	1.442	-1.223
228	2,270	1.418	-1.211
229	2,280	1.393	-1.198
230	2,290	1.368	-1.186
231	2,300	1.344	-1.173
232	2,310	1.317	-1.161
233	2,320	1.29	-1.15
234	2,330	1.263	-1.139
235	2,340	1.235	-1.127
236	2,350	1.208	-1.116
237	2,360	1.181	-1.105
238	2,370	1.151	-1.095
239	2,380	1.121	-1.085
240	2,390	1.091	-1.075
241	2,400	1.061	-1.064
242	2,410	1.031	-1.054
243	2,420	0.9998	-1.045
244	2,430	0.9672	-1.036
245	2,440	0.9346	-1.027
246	2,450	0.902	-1.018
247	2,460	0.8694	-1.009
248	2,470	0.8368	-1
249	2,480	0.8025	-0.9923
250	2,490	0.7674	-0.9847
251	2,500	0.7323	-0.977
252	2,510	0.6972	-0.9694
253	2,520	0.6622	-0.9618
254	2,530	0.6269	-0.9542
255	2,540	0.5894	-0.9478
256	2,550	0.5519	-0.9414
257	2,560	0.5144	-0.935
258	2,570	0.4769	-0.9286
259	2,580	0.4394	-0.9222
260	2,590	0.4009	-0.9164
261	2,600	0.3611	-0.9112
262	2,610	0.3213	-0.9061
263	2,620	0.2814	-0.9009
264	2,630	0.2416	-0.8957
265	2,640	0.2018	-0.8906
266	2,650	0.1602	-0.8864
267	2,660	0.1181	-0.8825
268	2,670	0.07609	-0.8786

269	2,680	0.03404	-0.8746
270	2,690	-0.008004	-0.8707
271	2,700	-0.05043	-0.867
272	2,710	-0.09461	-0.8643
273	2,720	-0.1388	-0.8615
274	2,730	-0.1829	-0.8588
275	2,740	-0.2271	-0.8561
276	2,750	-0.2713	-0.8533
277	2,760	-0.3163	-0.8511
278	2,770	-0.362	-0.8492
279	2,780	-0.4077	-0.8474
280	2,790	-0.4543	-0.846
281	2,800	-0.5009	-0.8447
282	2,810	-0.5475	-0.8433
283	2,820	-0.5948	-0.8424
284	2,830	-0.6426	-0.8417
285	2,840	-0.6904	-0.841
286	2,850	-0.7387	-0.8406
287	2,860	-0.7873	-0.8404
288	2,870	-0.8362	-0.8403
289	2,880	-0.8855	-0.8404
290	2,890	-0.9351	-0.8406
291	2,900	-0.985	-0.841
292	2,910	-1.035	-0.8415
293	2,920	-1.086	-0.8423
294	2,930	-1.136	-0.8432
295	2,940	-1.188	-0.8443
296	2,950	-1.239	-0.8456
297	2,960	-1.291	-0.8472
298	2,970	-1.343	-0.8489
299	2,980	-1.395	-0.8509
300	2,990	-1.447	-0.8531
301	3,000	-1.5	-0.8555
302	3,010	-1.553	-0.8581
303	3,020	-1.606	-0.8609
304	3,030	-1.66	-0.864
305	3,040	-1.714	-0.8673
306	3,050	-1.768	-0.8708
307	3,060	-1.822	-0.8746
308	3,070	-1.877	-0.8786
309	3,080	-1.931	-0.8829
310	3,090	-1.986	-0.8874
311	3,100	-2.042	-0.8921
312	3,110	-2.097	-0.8971
313	3,120	-2.153	-0.9023
314	3,130	-2.209	-0.9078
315	3,140	-2.265	-0.9135
316	3,150	-2.321	-0.9194
317	3,160	-2.378	-0.9257
318	3,170	-2.435	-0.9323
319	3,180	-2.491	-0.9389
320	3,190	-2.549	-0.946
321	3,200	-2.606	-0.9531
322	3,210	-2.663	-0.9607



323	3,220	-2.721	-0.9684
324	3,230	-2.779	-0.9764
325	3,240	-2.837	-0.9847
326	3,250	-2.895	-0.9931
327	3,260	-2.953	-1.002
328	3,270	-3.012	-1.011
329	3,280	-3.071	-1.02
330	3,290	-3.129	-1.03
331	3,300	-3.188	-1.04
332	3,310	-3.247	-1.05
333	3,320	-3.307	-1.06
334	3,330	-3.366	-1.071
335	3,340	-3.426	-1.083
336	3,350	-3.485	-1.094
337	3,360	-3.545	-1.105
338	3,370	-3.605	-1.116
339	3,380	-3.665	-1.128
340	3,390	-3.725	-1.141
341	3,400	-3.785	-1.153
342	3,410	-3.845	-1.166
343	3,420	-3.905	-1.179
344	3,430	-3.965	-1.191
345	3,440	-4.026	-1.205
346	3,450	-4.087	-1.22
347	3,460	-4.147	-1.234
348	3,470	-4.208	-1.248
349	3,480	-4.268	-1.262
350	3,490	-4.329	-1.277
351	3,500	-4.39	-1.292
352	3,510	-4.451	-1.308
353	3,520	-4.512	-1.323
354	3,530	-4.573	-1.339
355	3,540	-4.634	-1.354
356	3,550	-4.695	-1.371
357	3,560	-4.756	-1.388
358	3,570	-4.817	-1.405
359	3,580	-4.878	-1.422
360	3,590	-4.939	-1.439
361	3,600	-4.985	-1.456
362	3,610	-4.988	-1.474
363	3,620	-4.991	-1.491
364	3,630	-4.993	-1.509
365	3,640	-4.996	-1.526
366	3,650	-4.999	-1.544
367	3,660	-5	-1.561
368	3,670	-5	-1.578
369	3,680	-5	-1.595
370	3,690	-5	-1.612
371	3,700	-5	-1.629
372	3,710	-5	-1.646
373	3,720	-5	-1.662
374	3,730	-5	-1.679
375	3,740	-5	-1.695
376	3,750	-5	-1.711

377	3,760	-5	-1.728
378	3,770	-5	-1.744
379	3,780	-5	-1.76
380	3,790	-5	-1.776
381	3,800	-5	-1.792
382	3,810	-5	-1.808
383	3,820	-5	-1.823
384	3,830	-5	-1.839
385	3,840	-5	-1.854
386	3,850	-5	-1.87
387	3,860	-5	-1.885
388	3,870	-5	-1.9
389	3,880	-5	-1.916
390	3,890	-5	-1.931
391	3,900	-5	-1.946
392	3,910	-5	-1.961
393	3,920	-5	-1.975
394	3,930	-5	-1.99
395	3,940	-5	-2.005
396	3,950	-5	-2.019
397	3,960	-5	-2.034
398	3,970	-5	-2.048
399	3,980	-5	-2.063
400	3,990	-5	-2.077
401	4,000	-5	-2.091
402	4,010	-5	-2.105
403	4,020	-5	-2.119
404	4,030	-5	-2.133
405	4,040	-5	-2.147
406	4,050	-5	-2.161
407	4,060	-5	-2.174
408	4,070	-5	-2.188
409	4,080	-5	-2.202
410	4,090	-5	-2.215
411	4,100	-5	-2.229
412	4,110	-5	-2.242
413	4,120	-5	-2.255
414	4,130	-5	-2.268
415	4,140	-5	-2.281
416	4,150	-5	-2.294
417	4,160	-5	-2.307
418	4,170	-5	-2.32
419	4,180	-5	-2.333
420	4,190	-5	-2.346
421	4,200	-5	-2.358
422	4,210	-5	-2.371
423	4,220	-5	-2.384
424	4,230	-5	-2.396
425	4,240	-5	-2.408
426	4,250	-5	-2.421
427	4,260	-5	-2.433
428	4,270	-5	-2.445
429	4,280	-5	-2.457
430	4,290	-5	-2.469

431	4,300	-5	-2.481
432	4,310	-5	-2.493
433	4,320	-5	-2.505
434	4,330	-5	-2.517
435	4,340	-5	-2.529
436	4,350	-5	-2.54
437	4,360	-5	-2.552
438	4,370	-5	-2.563
439	4,380	-5	-2.575
440	4,390	-5	-2.586
441	4,400	-5	-2.598
442	4,410	-5	-2.609
443	4,420	-5	-2.62
444	4,430	-5	-2.631
445	4,440	-5	-2.643
446	4,450	-5	-2.654
447	4,460	-5	-2.665
448	4,470	-5	-2.676
449	4,480	-5	-2.686
450	4,490	-5	-2.697
451	4,500	-5	-2.708
452	4,510	-5	-2.719
453	4,520	-5	-2.729
454	4,530	-5	-2.74
455	4,540	-5	-2.75
456	4,550	-5	-2.761
457	4,560	-5	-2.771
458	4,570	-5	-2.782
459	4,580	-5	-2.792
460	4,590	-5	-2.802
461	4,600	-5	-2.812
462	4,610	-5	-2.822
463	4,620	-5	-2.832
464	4,630	-5	-2.843
465	4,640	-5	-2.853
466	4,650	-5	-2.862
467	4,660	-5	-2.872
468	4,670	-5	-2.882
469	4,680	-5	-2.892
470	4,690	-5	-2.902
471	4,700	-5	-2.911
472	4,710	-5	-2.921
473	4,720	-5	-2.93
474	4,730	-5	-2.94
475	4,740	-5	-2.949
476	4,750	-5	-2.959
477	4,760	-5	-2.968
478	4,770	-5	-2.977
479	4,780	-5	-2.987
480	4,790	-5	-2.996
481	4,800	-5	-3.005
482	4,810	-5	-3.014
483	4,820	-5	-3.023
484	4,830	-5	-3.032

485	4,840	-5	-3.041
486	4,850	-5	-3.05
487	4,860	-5	-3.059
488	4,870	-5	-3.068
489	4,880	-5	-3.077
490	4,890	-5	-3.085
491	4,900	-5	-3.094
492	4,910	-5	-3.103
493	4,920	-5	-3.111
494	4,930	-5	-3.12
495	4,940	-5	-3.128
496	4,950	-5	-3.137
497	4,960	-5	-3.145
498	4,970	-5	-3.153
499	4,980	-5	-3.162
500	4,990	-5	-3.17
501	5,000	-5	-3.178
502	5,010	-5	-3.187
503	5,020	-5	-3.195
504	5,030	-5	-3.203
505	5,040	-5	-3.211
506	5,050	-5	-3.219
507	5,060	-5	-3.227
508	5,070	-5	-3.235
509	5,080	-5	-3.243
510	5,090	-5	-3.251
511	5,100	-5	-3.258
512	5,110	-5	-3.266
513	5,120	-5	-3.274
514	5,130	-5	-3.282
515	5,140	-5	-3.289
516	5,150	-5	-3.297
517	5,160	-5	-3.305
518	5,170	-5	-3.312
519	5,180	-5	-3.32
520	5,190	-5	-3.327
521	5,200	-5	-3.335
522	5,210	-5	-3.342
523	5,220	-5	-3.349
524	5,230	-5	-3.357
525	5,240	-5	-3.364
526	5,250	-5	-3.371
527	5,260	-5	-3.378
528	5,270	-5	-3.386
529	5,280	-5	-3.393
530	5,290	-5	-3.4
531	5,300	-5	-3.407
532	5,310	-5	-3.414
533	5,320	-5	-3.421
534	5,330	-5	-3.428
535	5,340	-5	-3.435
536	5,350	-5	-3.442
537	5,360	-5	-3.448
538	5,370	-5	-3.455

539	5,380	-5	-3.462
540	5,390	-5	-3.469
541	5,400	-5	-3.476
542	5,410	-5	-3.482
543	5,420	-5	-3.489
544	5,430	-5	-3.495
545	5,440	-5	-3.502
546	5,450	-5	-3.509
547	5,460	-5	-3.515
548	5,470	-5	-3.522
549	5,480	-5	-3.528
550	5,490	-5	-3.534
551	5,500	-5	-3.541
552	5,510	-5	-3.547
553	5,520	-5	-3.553
554	5,530	-5	-3.56
555	5,540	-5	-3.566
556	5,550	-5	-3.572
557	5,560	-5	-3.578
558	5,570	-5	-3.585
559	5,580	-5	-3.591
560	5,590	-5	-3.597
561	5,600	-5	-3.603
562	5,610	-5	-3.609
563	5,620	-5	-3.615
564	5,630	-5	-3.621
565	5,640	-5	-3.627
566	5,650	-5	-3.633
567	5,660	-5	-3.639
568	5,670	-5	-3.645
569	5,680	-5	-3.65
570	5,690	-5	-3.656
571	5,700	-5	-3.662
572	5,710	-5	-3.668
573	5,720	-5	-3.673
574	5,730	-5	-3.679
575	5,740	-5	-3.685
576	5,750	-5	-3.69
577	5,760	-5	-3.696
578	5,770	-5	-3.702
579	5,780	-5	-3.707
580	5,790	-5	-3.713
581	5,800	-5	-3.718
582	5,810	-5	-3.724
583	5,820	-5	-3.729
584	5,830	-5	-3.735
585	5,840	-5	-3.74
586	5,850	-5	-3.745
587	5,860	-5	-3.751
588	5,870	-5	-3.756
589	5,880	-5	-3.761
590	5,890	-5	-3.767
591	5,900	-5	-3.772
592	5,910	-5	-3.777

593	5,920	-5	-3.782
594	5,930	-5	-3.787
595	5,940	-5	-3.792
596	5,950	-5	-3.798
597	5,960	-5	-3.803
598	5,970	-5	-3.808
599	5,980	-5	-3.813
600	5,990	-5	-3.818
601	6,000	-5	-3.823
602	6,010	-5	-3.828
603	6,020	-5	-3.833
604	6,030	-5	-3.838
605	6,040	-5	-3.843
606	6,050	-5	-3.847
607	6,060	-5	-3.852
608	6,070	-5	-3.857
609	6,080	-5	-3.862
610	6,090	-5	-3.867
611	6,100	-5	-3.871
612	6,110	-5	-3.876
613	6,120	-5	-3.881
614	6,130	-5	-3.885
615	6,140	-5	-3.89
616	6,150	-5	-3.895
617	6,160	-5	-3.899
618	6,170	-5	-3.904
619	6,180	-5	-3.909
620	6,190	-5	-3.913
621	6,200	-5	-3.918
622	6,210	-5	-3.922
623	6,220	-5	-3.927
624	6,230	-5	-3.931
625	6,240	-5	-3.936
626	6,250	-5	-3.94
627	6,260	-5	-3.944
628	6,270	-5	-3.949
629	6,280	-5	-3.953
630	6,290	-5	-3.957
631	6,300	-5	-3.962
632	6,310	-5	-3.966
633	6,320	-5	-3.97
634	6,330	-5	-3.975
635	6,340	-5	-3.979
636	6,350	-5	-3.983
637	6,360	-5	-3.987
638	6,370	-5	-3.991
639	6,380	-5	-3.996
640	6,390	-5	-4
641	6,400	-5	-4.004
642	6,410	-5	-4.008
643	6,420	-5	-4.012
644	6,430	-5	-4.016
645	6,440	-5	-4.02
646	6,450	-5	-4.024

647	6,460	-5	-4.028
648	6,470	-5	-4.032
649	6,480	-5	-4.036
650	6,490	-5	-4.04
651	6,500	-5	-4.044
652	6,510	-5	-4.048
653	6,520	-5	-4.052
654	6,530	-5	-4.056
655	6,540	-5	-4.06
656	6,550	-5	-4.063
657	6,560	-5	-4.067
658	6,570	-5	-4.071
659	6,580	-5	-4.075
660	6,590	-5	-4.079
661	6,600	-5	-4.082
662	6,610	-5	-4.086
663	6,620	-5	-4.09
664	6,630	-5	-4.093
665	6,640	-5	-4.097
666	6,650	-5	-4.101
667	6,660	-5	-4.104
668	6,670	-5	-4.108
669	6,680	-5	-4.112
670	6,690	-5	-4.115
671	6,700	-5	-4.119
672	6,710	-5	-4.122
673	6,720	-5	-4.126
674	6,730	-5	-4.129
675	6,740	-5	-4.133
676	6,750	-5	-4.137
677	6,760	-5	-4.14
678	6,770	-5	-4.143
679	6,780	-5	-4.147
680	6,790	-5	-4.15
681	6,800	-5	-4.154
682	6,810	-5	-4.157
683	6,820	-5	-4.161
684	6,830	-5	-4.164
685	6,840	-5	-4.167
686	6,850	-5	-4.171
687	6,860	-5	-4.174
688	6,870	-5	-4.177
689	6,880	-5	-4.181
690	6,890	-5	-4.184
691	6,900	-5	-4.187
692	6,910	-5	-4.19
693	6,920	-5	-4.194
694	6,930	-5	-4.197
695	6,940	-5	-4.2
696	6,950	-5	-4.203
697	6,960	-5	-4.206
698	6,970	-5	-4.21
699	6,980	-5	-4.213
700	6,990	-5	-4.216

701	7,000	-5	-4.219
702	7,010	-5	-4.222
703	7,020	-5	-4.225
704	7,030	-5	-4.228
705	7,040	-5	-4.231
706	7,050	-5	-4.234
707	7,060	-5	-4.237
708	7,070	-5	-4.24
709	7,080	-5	-4.243
710	7,090	-5	-4.246
711	7,100	-5	-4.249
712	7,110	-5	-4.252
713	7,120	-5	-4.255
714	7,130	-5	-4.258
715	7,140	-5	-4.261
716	7,150	-5	-4.264
717	7,160	-5	-4.267
718	7,170	-5	-4.27
719	7,180	-5	-4.273
720	7,190	-5	-4.276
721	7,200	-5	-4.278

## Temperatures vs time

