

AE/ME 5830 Spring 2021 Homework I, Due: Thursday, February 11 by 5:00 pm

1. The non-dimensional displacement of an airplane wing tip ($f(t)$) obtained from an aeroelastic flutter study is represented by

$$f(t) = 2\sin(t^2) - 3t\sin(t^2) + t^2\sin(t^2)$$

where t is the non-dimensional time.

- (a) For three different starting points $t_0 = 2.2$, $t_0 = 2.3$, and $t_0 = 2.4$, find the roots of $f(t)$ (non-dimensional times at which the displacement is equal to zero) using Newton's Method. For each case, tabulate t_n , $f(t_n)$, $\Delta_n t = t_{n+1} - t_n$, and t_{n+1} at each iteration level n . Use a convergence criterion of $(\epsilon_n)_r < 10^{-8}$ where $(\epsilon_n)_r = \frac{|t_{n+1} - t_n|}{|t_n|}$.
- (b) Use the method of linear interpolation (Regula-Falsi) to find the root of $f(t) = 0$ for $3.2 \leq t \leq 3.8$ with the same convergence criterion given in part (a). Tabulate t_{n+1} , $f(t_{n+1})$, and $(\epsilon_n)_r$ at each iteration level n .

2. The free vibrations of a cantilever beam satisfy the equation

$$\cosh(\alpha) \times \cos(\alpha) = -1$$

where the dimensionless parameter α is proportional to the square root of the natural frequency. Using Secant Method, find the three smallest positive values of α satisfying this equation (pick the appropriate initial guesses for finding each root). For each root: (1) use a convergence criterion of $(\epsilon_n)_r = \frac{|\alpha_{n+1} - \alpha_n|}{|\alpha_n|} < 10^{-6}$, (2) tabulate the values of α_n , $f(\alpha_n)$, $\Delta_n \alpha = \alpha_{n+1} - \alpha_n$, and α_{n+1} at each iteration.

3. For $-1.0 \leq x \leq 0.0$, find the root of the function

$$f(x) = e^{6x} + 3(\ln 2)^2 e^{2x} - e^{4x} \ln 8 - (\ln 2)^3 = 0$$

- (a) Use Newton's Method with a starting point of $x_0 = -1.0$.
- (b) Use Modified Newton's Method with a starting point of $x_0 = -1.0$.

For each method: (1) approximate the root with a convergence criterion of $(\epsilon_n)_r = \frac{|x_{n+1} - x_n|}{|x_n|} < 10^{-5}$, (2) tabulate the values of x_n , $f(x_n)$, $\Delta_n x = x_{n+1} - x_n$, and x_{n+1} at each iteration, and (3) plot $|f(x_n)|/|f(x_0)|$ vs. iteration number on a semi-log plot. Comment on the convergence of each method.

4. (Modified from problem 8.35 in the textbook) Mechanical and Aerospace engineers use thermodynamics extensively in their work. The following polynomial (curve-fit) can be used to relate the specific heat at constant pressure of dry air, c_p (kJ/kgK) to temperature T for a range of values:

$$c_p = 0.99403 + 1.671 \times 10^{-4}T + 9.7215 \times 10^{-8}T^2 \\ - 9.5838 \times 10^{-11}T^3 + 1.9520 \times 10^{-14}T^4$$

Use a fixed point iteration scheme to determine the temperature that corresponds to specific heat of 1.2 (kJ/kgK) with a convergence criterion of $(\epsilon_n)_r = \frac{|T_{n+1} - T_n|}{|T_n|} < 10^{-5}$. Show the derivation of the fixed-point function $g(T)$ used in your scheme. Solve the problem with two different initial guesses, $T_0 = 500 K$ and $T_0 = 2000 K$. For each case, tabulate the values of T_n , T_{n+1} , and $(\epsilon_n)_r$ at each iteration level n and limit the maximum number of iterations to $N_{max} = 100$.

1a)

initial guess = some \pm

tol = some \pm

n = 0

while $E_n > tol$

$$\left\{ \begin{array}{l} t_{n+1} = t_n - \frac{f(t_n)}{f'(t_n)} \\ n = n + 1 \end{array} \right.$$

$$t_0 = 2.2, 2.3, 2.4 \quad tol = 10^{-8}$$

$t_0 = 2.2$ converges to zero with 538 iter.

$t_0 = 2.3$ converges to zero with 540 iter.

$t_0 = 2.4$ converges to 2.5 with 5 iter.

iteration (n)	t_n	f(t)	t_n+1 - t_n
0	2.2	-3.8087760280739045	-1.720350208122199
1	0.4796497918778011	-0.17557604024986012	-0.35088529526559986
2	0.12876449661220124	-0.01630464232083959	-0.0654924417121676
3	0.06327205490003364	-0.003987315445886372	-0.0317638702451786
4	0.03150818465485504	-0.0009917799535951435	-0.015769768751627382
5	0.015738415903227658	-0.0002476363784427203	-0.007871158263712843
6	0.007867257639514815	-6.188991189159556e-05	-0.003933872321933267
7	0.003933385317581548	-1.5471280688016014e-05	-0.001966723087614171
8	0.001966662229967377	-3.8677453672006665e-06	-0.000983334918307087
9	0.0009833273116602898	-9.669316668982455e-07	-0.0004916641312368355
10	0.0004916631804234543	-2.4173262454941386e-07	-0.0002458316496372906
11	0.00024583153078616373	-6.043313787650393e-08	-0.00012291577282126873
12	0.000122915757964895	-1.5108283327824418e-08	-6.14578799109706e-05
13	6.14578780539244e-05	-3.777070760624779e-09	-3.072893914302758e-05
14	3.072893891089682e-05	-9.44267685697987e-10	-1.536446946995658e-05
15	1.536446944094024e-05	-2.360669211458589e-10	-7.682234722283641e-06
16	7.682234718656599e-06	-5.901673026904986e-11	-3.84111735955499e-06
17	3.841117359101609e-06	-1.475418256617403e-11	-1.9205586795791406e-06
18	1.920558679522468e-06	-3.688545641475481e-12	-9.602793397647762e-07
19	9.60279339757692e-07	-9.221364103646184e-13	-4.801396698792887e-07
20	4.801396698784033e-07	-2.3053410259088894e-13	-2.40069834939257e-07
21	2.4006983493914634e-07	-5.763352564770565e-14	-1.200349174695801e-07
22	1.2003491746956623e-07	-1.4408381411925368e-14	-6.001745873478398e-08
23	6.001745873478226e-08	-3.602095352981278e-15	-3.000872936739124e-08
24	3.0008729367391016e-08	-9.005238382453152e-16	-1.500436468369552e-08
25	1.5004364683695495e-08	-2.2513095956132855e-16	-7.502182341847749e-09
26	7.502182341847746e-09	-5.628273989033212e-17	-3.751091170923874e-09
27	3.751091170923872e-09	-1.4070684972583025e-17	-1.875545585461936e-09
28	1.875545585461936e-09	-3.517671243145756e-18	-9.37772792730968e-10
29	9.37772792730968e-10	-8.79417810786439e-19	-4.68886396365484e-10
30	4.68886396365484e-10	-2.1985445269660977e-19	-2.34443198182742e-10
31	2.34443198182742e-10	-5.496361317415244e-20	-1.17221599091371e-10
32	1.17221599091371e-10	-1.374090329353811e-20	-5.86107995456855e-11
33	5.86107995456855e-11	-3.4352258233845276e-21	-2.930539977284275e-11
34	2.930539977284275e-11	-8.588064558461319e-22	-1.4652699886421375e-11
35	1.4652699886421375e-11	-2.1470161396153297e-22	-7.326349943210687e-12
36	7.326349943210687e-12	-5.367540349038324e-23	-3.663174971605344e-12
37	3.663174971605344e-12	-1.341885087259581e-23	-1.831587485802672e-12
38	1.831587485802672e-12	-3.354712718148953e-24	-9.15793742901336e-13
39	9.15793742901336e-13	-8.386781795372382e-25	-4.57896871450668e-13
40	4.57896871450668e-13	-2.0966954488430955e-25	-2.28948435725334e-13
41	2.28948435725334e-13	-5.241738622107739e-26	-1.14474217862667e-13
42	1.14474217862667e-13	-1.3104346555269347e-26	-5.72371089313335e-14
43	5.72371089313335e-14	-3.276086638817337e-27	-2.861855446566675e-14
44	2.861855446566675e-14	-8.190216597043342e-28	-1.4309277232833374e-14
45	1.4309277232833374e-14	-2.0475541492608354e-28	-7.154638616416687e-15

46	7.154638616416687e-15	-5.118885373152089e-29	-3.5773193082083435e-15
47	3.5773193082083435e-15	-1.279721343288022e-29	-1.7886596541041717e-15
48	1.7886596541041717e-15	-3.199303358220055e-30	-8.943298270520859e-16
49	8.943298270520859e-16	-7.998258395550138e-31	-4.471649135260429e-16
50	4.471649135260429e-16	-1.9995645988875346e-31	-2.2358245676302147e-16
51	2.2358245676302147e-16	-4.998911497218836e-32	-1.1179122838151073e-16
52	1.1179122838151073e-16	-1.249727874304709e-32	-5.589561419075537e-17
53	5.589561419075537e-17	-3.124319685761773e-33	-2.7947807095377684e-17
54	2.7947807095377684e-17	-7.810799214404432e-34	-1.3973903547688842e-17
55	1.3973903547688842e-17	-1.952699803601108e-34	-6.986951773844421e-18
56	6.986951773844421e-18	-4.88174950900277e-35	-3.4934758869222104e-18
57	3.4934758869222104e-18	-1.2204373772506925e-35	-1.7467379434611052e-18
58	1.7467379434611052e-18	-3.051093443126731e-36	-8.733689717305526e-19
59	8.733689717305526e-19	-7.627733607816828e-37	-4.366844858652763e-19
60	4.366844858652763e-19	-1.906933401954207e-37	-2.1834224293263815e-19
61	2.1834224293263815e-19	-4.767333504885518e-38	-1.0917112146631908e-19
62	1.0917112146631908e-19	-1.1918333762213794e-38	-5.458556073315954e-20
63	5.458556073315954e-20	-2.9795834405534485e-39	-2.729278036657977e-20
64	2.729278036657977e-20	-7.448958601383621e-40	-1.3646390183289885e-20
65	1.3646390183289885e-20	-1.8622396503459053e-40	-6.823195091644942e-21
66	6.823195091644942e-21	-4.655599125864763e-41	-3.411597545822471e-21
67	3.411597545822471e-21	-1.1638997814661908e-41	-1.7057987729112356e-21
68	1.7057987729112356e-21	-2.909749453665477e-42	-8.528993864556178e-22
69	8.528993864556178e-22	-7.274373634163693e-43	-4.264496932278089e-22
70	4.264496932278089e-22	-1.818593408540923e-43	-2.1322484661390445e-22
71	2.1322484661390445e-22	-4.546483521352308e-44	-1.0661242330695222e-22
72	1.0661242330695222e-22	-1.136620880338077e-44	-5.330621165347611e-23
73	5.330621165347611e-23	-2.8415522008451924e-45	-2.6653105826738056e-23
74	2.6653105826738056e-23	-7.103880502112981e-46	-1.3326552913369028e-23
75	1.3326552913369028e-23	-1.7759701255282452e-46	-6.663276456684514e-24
76	6.663276456684514e-24	-4.439925313820613e-47	-3.331638228342257e-24
77	3.331638228342257e-24	-1.1099813284551533e-47	-1.6658191141711285e-24
78	1.6658191141711285e-24	-2.774953321137883e-48	-8.329095570855642e-25
79	8.329095570855642e-25	-6.937383302844708e-49	-4.164547785427821e-25
80	4.164547785427821e-25	-1.734345825711177e-49	-2.0822738927139106e-25
81	2.0822738927139106e-25	-4.3358645642779425e-50	-1.0411369463569553e-25
82	1.0411369463569553e-25	-1.0839661410694856e-50	-5.205684731784777e-26
83	5.205684731784777e-26	-2.709915352673714e-51	-2.602842365892388e-26
84	2.602842365892388e-26	-6.774788381684285e-52	-1.301421182946194e-26
85	1.301421182946194e-26	-1.6936970954210713e-52	-6.50710591473097e-27
86	6.50710591473097e-27	-4.234242738552678e-53	-3.253552957365485e-27
87	3.253552957365485e-27	-1.0585606846381696e-53	-1.6267764786827427e-27
88	1.6267764786827427e-27	-2.646401711595424e-54	-8.133882393413713e-28
89	8.133882393413713e-28	-6.61600427898856e-55	-4.066941196706857e-28
90	4.066941196706857e-28	-1.65400106974714e-55	-2.0334705983534283e-28
91	2.0334705983534283e-28	-4.13500267436785e-56	-1.0167352991767142e-28
92	1.0167352991767142e-28	-1.0337506685919625e-56	-5.083676495883571e-29

93	5.083676495883571e-29	-2.584376671479906e-57	-2.5418382479417854e-29
94	2.5418382479417854e-29	-6.460941678699765e-58	-1.2709191239708927e-29
95	1.2709191239708927e-29	-1.6152354196749413e-58	-6.354595619854464e-30
96	6.354595619854464e-30	-4.038088549187353e-59	-3.177297809927232e-30
97	3.177297809927232e-30	-1.0095221372968383e-59	-1.588648904963616e-30
98	1.588648904963616e-30	-2.523805343242096e-60	-7.94324452481808e-31
99	7.94324452481808e-31	-6.30951335810524e-61	-3.97162226240904e-31
100	3.97162226240904e-31	-1.57737833952631e-61	-1.98581113120452e-31
101	1.98581113120452e-31	-3.943445848815775e-62	-9.9290556560226e-32
102	9.9290556560226e-32	-9.858614622039437e-63	-4.9645278280113e-32
103	4.9645278280113e-32	-2.464653655509859e-63	-2.48226391400565e-32
104	2.48226391400565e-32	-6.161634138774648e-64	-1.241131957002825e-32
105	1.241131957002825e-32	-1.540408534693662e-64	-6.205659785014125e-33
106	6.205659785014125e-33	-3.851021336734155e-65	-3.102829892507062e-33
107	3.102829892507062e-33	-9.627553341835388e-66	-1.551414946253531e-33
108	1.551414946253531e-33	-2.406888335458847e-66	-7.757074731267656e-34
109	7.757074731267656e-34	-6.017220838647117e-67	-3.878537365633828e-34
110	3.878537365633828e-34	-1.5043052096617793e-67	-1.939268682816914e-34
111	1.939268682816914e-34	-3.760763024154448e-68	-9.69634341408457e-35
112	9.69634341408457e-35	-9.40190756038612e-69	-4.848171707042285e-35
113	4.848171707042285e-35	-2.35047689009653e-69	-2.4240858535211424e-35
114	2.4240858535211424e-35	-5.876192225241325e-70	-1.2120429267605712e-35
115	1.2120429267605712e-35	-1.4690480563103314e-70	-6.060214633802856e-36
116	6.060214633802856e-36	-3.672620140775828e-71	-3.030107316901428e-36
117	3.030107316901428e-36	-9.18155035193957e-72	-1.515053658450714e-36
118	1.515053658450714e-36	-2.2953875879848927e-72	-7.57526829225357e-37
119	7.57526829225357e-37	-5.738468969962232e-73	-3.787634146126785e-37
120	3.787634146126785e-37	-1.434617242490558e-73	-1.8938170730633925e-37
121	1.8938170730633925e-37	-3.586543106226395e-74	-9.469085365316962e-38
122	9.469085365316962e-38	-8.966357765565987e-75	-4.734542682658481e-38
123	4.734542682658481e-38	-2.241589441391497e-75	-2.3672713413292406e-38
124	2.3672713413292406e-38	-5.603973603478742e-76	-1.1836356706646203e-38
125	1.1836356706646203e-38	-1.4009934008696855e-76	-5.918178353323102e-39
126	5.918178353323102e-39	-3.502483502174214e-77	-2.959089176661551e-39
127	2.959089176661551e-39	-8.756208755435534e-78	-1.4795445883307754e-39
128	1.4795445883307754e-39	-2.1890521888588836e-78	-7.397722941653877e-40
129	7.397722941653877e-40	-5.472630472147209e-79	-3.6988614708269385e-40
130	3.6988614708269385e-40	-1.3681576180368023e-79	-1.8494307354134692e-40
131	1.8494307354134692e-40	-3.420394045092006e-80	-9.247153677067346e-41
132	9.247153677067346e-41	-8.550985112730014e-81	-4.623576838533673e-41
133	4.623576838533673e-41	-2.1377462781825035e-81	-2.3117884192668365e-41
134	2.3117884192668365e-41	-5.344365695456259e-82	-1.1558942096334183e-41
135	1.1558942096334183e-41	-1.3360914238640647e-82	-5.779471048167091e-42
136	5.779471048167091e-42	-3.340228559660162e-83	-2.8897355240835457e-42
137	2.8897355240835457e-42	-8.350571399150404e-84	-1.4448677620417728e-42
138	1.4448677620417728e-42	-2.087642849787601e-84	-7.224338810208864e-43
139	7.224338810208864e-43	-5.219107124469003e-85	-3.612169405104432e-43

140	3.612169405104432e-43	-1.3047767811172507e-85	-1.806084702552216e-43
141	1.806084702552216e-43	-3.261941952793127e-86	-9.03042351276108e-44
142	9.03042351276108e-44	-8.154854881982817e-87	-4.51521175638054e-44
143	4.51521175638054e-44	-2.038713720495704e-87	-2.25760587819027e-44
144	2.25760587819027e-44	-5.09678430123926e-88	-1.128802939095135e-44
145	1.128802939095135e-44	-1.274196075309815e-88	-5.644014695475675e-45
146	5.644014695475675e-45	-3.185490188274538e-89	-2.8220073477378376e-45
147	2.8220073477378376e-45	-7.963725470686345e-90	-1.4110036738689188e-45
148	1.4110036738689188e-45	-1.990931367671586e-90	-7.055018369344594e-46
149	7.055018369344594e-46	-4.977328419178965e-91	-3.527509184672297e-46
150	3.527509184672297e-46	-1.2443321047947413e-91	-1.7637545923361485e-46
151	1.7637545923361485e-46	-3.110830261986853e-92	-8.818772961680742e-47
152	8.818772961680742e-47	-7.777075654967133e-93	-4.409386480840371e-47
153	4.409386480840371e-47	-1.9442689137417833e-93	-2.2046932404201856e-47
154	2.2046932404201856e-47	-4.860672284354458e-94	-1.1023466202100928e-47
155	1.1023466202100928e-47	-1.2151680710886146e-94	-5.511733101050464e-48
156	5.511733101050464e-48	-3.0379201777215365e-95	-2.755866550525232e-48
157	2.755866550525232e-48	-7.594800444303841e-96	-1.377933275262616e-48
158	1.377933275262616e-48	-1.8987001110759603e-96	-6.88966637631308e-49
159	6.88966637631308e-49	-4.746750277689901e-97	-3.44483318815654e-49
160	3.44483318815654e-49	-1.1866875694224752e-97	-1.72241659407827e-49
161	1.72241659407827e-49	-2.966718923556188e-98	-8.61208297039135e-50
162	8.61208297039135e-50	-7.41679730889047e-99	-4.306041485195675e-50
163	4.306041485195675e-50	-1.8541993272226175e-99	-2.1530207425978375e-50
164	2.1530207425978375e-50	-4.635498318056544e-100	-1.0765103712989188e-50
165	1.0765103712989188e-50	-1.158874579514136e-100	-5.382551856494594e-51
166	5.382551856494594e-51	-2.89718644878534e-101	-2.691275928247297e-51
167	2.691275928247297e-51	-7.24296612196335e-102	-1.3456379641236484e-51
168	1.3456379641236484e-51	-1.8107415304908374e-102	-6.728189820618242e-52
169	6.728189820618242e-52	-4.526853826227093e-103	-3.364094910309121e-52
170	3.364094910309121e-52	-1.1317134565567734e-103	-1.6820474551545606e-52
171	1.6820474551545606e-52	-2.8292836413919334e-104	-8.410237275772803e-53
172	8.410237275772803e-53	-7.073209103479833e-105	-4.205118637886401e-53
173	4.205118637886401e-53	-1.7683022758699584e-105	-2.1025593189432007e-53
174	2.1025593189432007e-53	-4.420755689674896e-106	-1.0512796594716003e-53
175	1.0512796594716003e-53	-1.105188922418724e-106	-5.256398297358002e-54
176	5.256398297358002e-54	-2.76297230604681e-107	-2.628199148679001e-54
177	2.628199148679001e-54	-6.907430765117025e-108	-1.3140995743395004e-54
178	1.3140995743395004e-54	-1.7268576912792562e-108	-6.570497871697502e-55
179	6.570497871697502e-55	-4.317144228198141e-109	-3.285248935848751e-55
180	3.285248935848751e-55	-1.0792860570495351e-109	-1.6426244679243755e-55
181	1.6426244679243755e-55	-2.698215142623838e-110	-8.213122339621878e-56
182	8.213122339621878e-56	-6.745537856559595e-111	-4.106561169810939e-56
183	4.106561169810939e-56	-1.6863844641398987e-111	-2.0532805849054694e-56
184	2.0532805849054694e-56	-4.215961160349747e-112	-1.0266402924527347e-56
185	1.0266402924527347e-56	-1.0539902900874367e-112	-5.133201462263674e-57
186	5.133201462263674e-57	-2.6349757252185916e-113	-2.566600731131837e-57

187	2.566600731131837e-57	-6.587439313046479e-114	-1.2833003655659184e-57
188	1.2833003655659184e-57	-1.6468598282616198e-114	-6.416501827829592e-58
189	6.416501827829592e-58	-4.117149570654049e-115	-3.208250913914796e-58
190	3.208250913914796e-58	-1.0292873926635124e-115	-1.604125456957398e-58
191	1.604125456957398e-58	-2.573218481658781e-116	-8.02062728478699e-59
192	8.02062728478699e-59	-6.433046204146952e-117	-4.010313642393495e-59
193	4.010313642393495e-59	-1.608261551036738e-117	-2.0051568211967475e-59
194	2.0051568211967475e-59	-4.020653877591845e-118	-1.0025784105983737e-59
195	1.0025784105983737e-59	-1.0051634693979613e-118	-5.012892052991869e-60
196	5.012892052991869e-60	-2.512908673494903e-119	-2.5064460264959344e-60
197	2.5064460264959344e-60	-6.282271683737258e-120	-1.2532230132479672e-60
198	1.2532230132479672e-60	-1.5705679209343145e-120	-6.266115066239836e-61
199	6.266115066239836e-61	-3.926419802335786e-121	-3.133057533119918e-61
200	3.133057533119918e-61	-9.816049505839466e-122	-1.566528766559959e-61
201	1.566528766559959e-61	-2.4540123764598664e-122	-7.832643832799795e-62
202	7.832643832799795e-62	-6.135030941149666e-123	-3.916321916399897e-62
203	3.916321916399897e-62	-1.5337577352874165e-123	-1.9581609581999487e-62
204	1.9581609581999487e-62	-3.834394338218541e-124	-9.790804790999744e-63
205	9.790804790999744e-63	-9.585985845546353e-125	-4.895402395499872e-63
206	4.895402395499872e-63	-2.3964964613865883e-125	-2.447701197749936e-63
207	2.447701197749936e-63	-5.991241153466471e-126	-1.223850598874968e-63
208	1.223850598874968e-63	-1.4978102883666177e-126	-6.11925299437484e-64
209	6.11925299437484e-64	-3.744525720916544e-127	-3.05962649718742e-64
210	3.05962649718742e-64	-9.36131430229136e-128	-1.52981324859371e-64
211	1.52981324859371e-64	-2.34032857557284e-128	-7.64906624296855e-65
212	7.64906624296855e-65	-5.8508214389321e-129	-3.824533121484275e-65
213	3.824533121484275e-65	-1.462705359733025e-129	-1.9122665607421374e-65
214	1.9122665607421374e-65	-3.656763399332563e-130	-9.561332803710687e-66
215	9.561332803710687e-66	-9.141908498331407e-131	-4.780666401855344e-66
216	4.780666401855344e-66	-2.2854771245828517e-131	-2.390333200927672e-66
217	2.390333200927672e-66	-5.713692811457129e-132	-1.195166600463836e-66
218	1.195166600463836e-66	-1.4284232028642823e-132	-5.97583300231918e-67
219	5.97583300231918e-67	-3.571058007160706e-133	-2.98791650115959e-67
220	2.98791650115959e-67	-8.927645017901764e-134	-1.493958250579795e-67
221	1.493958250579795e-67	-2.231911254475441e-134	-7.469791252898974e-68
222	7.469791252898974e-68	-5.579778136188603e-135	-3.734895626449487e-68
223	3.734895626449487e-68	-1.3949445340471507e-135	-1.8674478132247436e-68
224	1.8674478132247436e-68	-3.487361335117877e-136	-9.337239066123718e-69
225	9.337239066123718e-69	-8.718403337794692e-137	-4.668619533061859e-69
226	4.668619533061859e-69	-2.179600834448673e-137	-2.3343097665309295e-69
227	2.3343097665309295e-69	-5.449002086121682e-138	-1.1671548832654647e-69
228	1.1671548832654647e-69	-1.3622505215304206e-138	-5.835774416327324e-70
229	5.835774416327324e-70	-3.4056263038260515e-139	-2.917887208163662e-70
230	2.917887208163662e-70	-8.514065759565129e-140	-1.458943604081831e-70
231	1.458943604081831e-70	-2.128516439891282e-140	-7.294718020409155e-71
232	7.294718020409155e-71	-5.321291099728205e-141	-3.647359010204577e-71
233	3.647359010204577e-71	-1.3303227749320514e-141	-1.8236795051022886e-71

234	1.8236795051022886e-71	-3.3258069373301284e-142	-9.118397525511443e-72
235	9.118397525511443e-72	-8.314517343325321e-143	-4.559198762755722e-72
236	4.559198762755722e-72	-2.0786293358313303e-143	-2.279599381377861e-72
237	2.279599381377861e-72	-5.196573339578326e-144	-1.1397996906889304e-72
238	1.1397996906889304e-72	-1.2991433348945814e-144	-5.698998453444652e-73
239	5.698998453444652e-73	-3.2478583372364535e-145	-2.849499226722326e-73
240	2.849499226722326e-73	-8.119645843091134e-146	-1.424749613361163e-73
241	1.424749613361163e-73	-2.0299114607727835e-146	-7.123748066805815e-74
242	7.123748066805815e-74	-5.074778651931959e-147	-3.5618740334029075e-74
243	3.5618740334029075e-74	-1.2686946629829897e-147	-1.7809370167014538e-74
244	1.7809370167014538e-74	-3.171736657457474e-148	-8.904685083507269e-75
245	8.904685083507269e-75	-7.929341643643685e-149	-4.452342541753634e-75
246	4.452342541753634e-75	-1.9823354109109214e-149	-2.226171270876817e-75
247	2.226171270876817e-75	-4.955838527277303e-150	-1.1130856354384086e-75
248	1.1130856354384086e-75	-1.2389596318193258e-150	-5.565428177192043e-76
249	5.565428177192043e-76	-3.0973990795483146e-151	-2.7827140885960215e-76
250	2.7827140885960215e-76	-7.743497698870787e-152	-1.3913570442980107e-76
251	1.3913570442980107e-76	-1.9358744247176966e-152	-6.956785221490054e-77
252	6.956785221490054e-77	-4.839686061794242e-153	-3.478392610745027e-77
253	3.478392610745027e-77	-1.2099215154485604e-153	-1.7391963053725134e-77
254	1.7391963053725134e-77	-3.024803788621401e-154	-8.695981526862567e-78
255	8.695981526862567e-78	-7.562009471553502e-155	-4.347990763431284e-78
256	4.347990763431284e-78	-1.8905023678883756e-155	-2.173995381715642e-78
257	2.173995381715642e-78	-4.726255919720939e-156	-1.086997690857821e-78
258	1.086997690857821e-78	-1.1815639799302348e-156	-5.434988454289104e-79
259	5.434988454289104e-79	-2.953909949825587e-157	-2.717494227144552e-79
260	2.717494227144552e-79	-7.384774874563967e-158	-1.358747113572276e-79
261	1.358747113572276e-79	-1.846193718640992e-158	-6.79373556786138e-80
262	6.79373556786138e-80	-4.61548429660248e-159	-3.39686778393069e-80
263	3.39686778393069e-80	-1.15387107415062e-159	-1.698433891965345e-80
264	1.698433891965345e-80	-2.88467768537655e-160	-8.492169459826726e-81
265	8.492169459826726e-81	-7.211694213441374e-161	-4.246084729913363e-81
266	4.246084729913363e-81	-1.8029235533603436e-161	-2.1230423649566814e-81
267	2.1230423649566814e-81	-4.507308883400859e-162	-1.0615211824783407e-81
268	1.0615211824783407e-81	-1.1268272208502147e-162	-5.307605912391704e-82
269	5.307605912391704e-82	-2.817068052125537e-163	-2.653802956195852e-82
270	2.653802956195852e-82	-7.042670130313842e-164	-1.326901478097926e-82
271	1.326901478097926e-82	-1.7606675325784605e-164	-6.63450739048963e-83
272	6.63450739048963e-83	-4.401668831446151e-165	-3.317253695244815e-83
273	3.317253695244815e-83	-1.1004172078615378e-165	-1.6586268476224074e-83
274	1.6586268476224074e-83	-2.7510430196538446e-166	-8.293134238112037e-84
275	8.293134238112037e-84	-6.877607549134611e-167	-4.146567119056018e-84
276	4.146567119056018e-84	-1.719401887283653e-167	-2.073283559528009e-84
277	2.073283559528009e-84	-4.298504718209132e-168	-1.0366417797640046e-84
278	1.0366417797640046e-84	-1.074626179552283e-168	-5.183208898820023e-85
279	5.183208898820023e-85	-2.6865654488807076e-169	-2.5916044494100115e-85
280	2.5916044494100115e-85	-6.716413622201769e-170	-1.2958022247050058e-85

281	1.2958022247050058e-85	-1.6791034055504422e-170	-6.479011123525029e-86
282	6.479011123525029e-86	-4.197758513876106e-171	-3.2395055617625144e-86
283	3.2395055617625144e-86	-1.0494396284690264e-171	-1.6197527808812572e-86
284	1.6197527808812572e-86	-2.623599071172566e-172	-8.098763904406286e-87
285	8.098763904406286e-87	-6.558997677931415e-173	-4.049381952203143e-87
286	4.049381952203143e-87	-1.6397494194828537e-173	-2.0246909761015715e-87
287	2.0246909761015715e-87	-4.099373548707134e-174	-1.0123454880507857e-87
288	1.0123454880507857e-87	-1.0248433871767836e-174	-5.061727440253929e-88
289	5.061727440253929e-88	-2.562108467941959e-175	-2.5308637201269644e-88
290	2.5308637201269644e-88	-6.405271169854897e-176	-1.2654318600634822e-88
291	1.2654318600634822e-88	-1.6013177924637244e-176	-6.327159300317411e-89
292	6.327159300317411e-89	-4.003294481159311e-177	-3.1635796501587055e-89
293	3.1635796501587055e-89	-1.0008236202898277e-177	-1.5817898250793527e-89
294	1.5817898250793527e-89	-2.5020590507245693e-178	-7.908949125396764e-90
295	7.908949125396764e-90	-6.255147626811423e-179	-3.954474562698382e-90
296	3.954474562698382e-90	-1.5637869067028558e-179	-1.977237281349191e-90
297	1.977237281349191e-90	-3.9094672667571396e-180	-9.886186406745955e-91
298	9.886186406745955e-91	-9.773668166892849e-181	-4.943093203372977e-91
299	4.943093203372977e-91	-2.443417041723212e-181	-2.4715466016864886e-91
300	2.4715466016864886e-91	-6.10854260430803e-182	-1.2357733008432443e-91
301	1.2357733008432443e-91	-1.5271356510770076e-182	-6.178866504216222e-92
302	6.178866504216222e-92	-3.817839127692519e-183	-3.089433252108111e-92
303	3.089433252108111e-92	-9.544597819231298e-184	-1.5447166260540554e-92
304	1.5447166260540554e-92	-2.3861494548078244e-184	-7.723583130270277e-93
305	7.723583130270277e-93	-5.965373637019561e-185	-3.8617915651351385e-93
306	3.8617915651351385e-93	-1.4913434092548903e-185	-1.9308957825675693e-93
307	1.9308957825675693e-93	-3.728358523137226e-186	-9.654478912837846e-94
308	9.654478912837846e-94	-9.320896307843064e-187	-4.827239456418923e-94
309	4.827239456418923e-94	-2.330224076960766e-187	-2.4136197282094616e-94
310	2.4136197282094616e-94	-5.825560192401915e-188	-1.2068098641047308e-94
311	1.2068098641047308e-94	-1.4563900481004788e-188	-6.034049320523654e-95
312	6.034049320523654e-95	-3.640975120251197e-189	-3.017024660261827e-95
313	3.017024660261827e-95	-9.102437800627992e-190	-1.5085123301309135e-95
314	1.5085123301309135e-95	-2.275609450156998e-190	-7.542561650654567e-96
315	7.542561650654567e-96	-5.689023625392495e-191	-3.771280825327284e-96
316	3.771280825327284e-96	-1.4222559063481238e-191	-1.885640412663642e-96
317	1.885640412663642e-96	-3.5556397658703095e-192	-9.42820206331821e-97
318	9.42820206331821e-97	-8.889099414675774e-193	-4.714101031659105e-97
319	4.714101031659105e-97	-2.2222748536689435e-193	-2.3570505158295523e-97
320	2.3570505158295523e-97	-5.555687134172359e-194	-1.1785252579147762e-97
321	1.1785252579147762e-97	-1.3889217835430897e-194	-5.892626289573881e-98
322	5.892626289573881e-98	-3.472304458857724e-195	-2.9463131447869404e-98
323	2.9463131447869404e-98	-8.68076114714431e-196	-1.4731565723934702e-98
324	1.4731565723934702e-98	-2.1701902867860776e-196	-7.365782861967351e-99
325	7.365782861967351e-99	-5.425475716965194e-197	-3.6828914309836755e-99
326	3.6828914309836755e-99	-1.3563689292412985e-197	-1.8414457154918377e-99
327	1.8414457154918377e-99	-3.390922323103246e-198	-9.207228577459189e-100

328	9.207228577459189e-100	-8.477305807758116e-199	-4.603614288729594e-100
329	4.603614288729594e-100	-2.119326451939529e-199	-2.301807144364797e-100
330	2.301807144364797e-100	-5.298316129848822e-200	-1.1509035721823986e-100
331	1.1509035721823986e-100	-1.3245790324622056e-200	-5.754517860911993e-101
332	5.754517860911993e-101	-3.311447581155514e-201	-2.8772589304559965e-101
333	2.8772589304559965e-101	-8.278618952888785e-202	-1.4386294652279982e-101
334	1.4386294652279982e-101	-2.069654738222196e-202	-7.193147326139991e-102
335	7.193147326139991e-102	-5.17413684555549e-203	-3.5965736630699956e-102
336	3.5965736630699956e-102	-1.2935342113888726e-203	-1.7982868315349978e-102
337	1.7982868315349978e-102	-3.2338355284721815e-204	-8.991434157674989e-103
338	8.991434157674989e-103	-8.084588821180454e-205	-4.495717078837494e-103
339	4.495717078837494e-103	-2.0211472052951135e-205	-2.247858539418747e-103
340	2.247858539418747e-103	-5.052868013237784e-206	-1.1239292697093736e-103
341	1.1239292697093736e-103	-1.263217003309446e-206	-5.619646348546868e-104
342	5.619646348546868e-104	-3.158042508273615e-207	-2.809823174273434e-104
343	2.809823174273434e-104	-7.895106270684037e-208	-1.404911587136717e-104
344	1.404911587136717e-104	-1.9737765676710092e-208	-7.024557935683585e-105
345	7.024557935683585e-105	-4.934441419177523e-209	-3.5122789678417926e-105
346	3.5122789678417926e-105	-1.2336103547943808e-209	-1.7561394839208963e-105
347	1.7561394839208963e-105	-3.084025886985952e-210	-8.780697419604481e-106
348	8.780697419604481e-106	-7.71006471746488e-211	-4.390348709802241e-106
349	4.390348709802241e-106	-1.92751617936622e-211	-2.1951743549011204e-106
350	2.1951743549011204e-106	-4.81879044841555e-212	-1.0975871774505602e-106
351	1.0975871774505602e-106	-1.2046976121038875e-212	-5.487935887252801e-107
352	5.487935887252801e-107	-3.011744030259719e-213	-2.7439679436264004e-107
353	2.7439679436264004e-107	-7.529360075649297e-214	-1.3719839718132002e-107
354	1.3719839718132002e-107	-1.882340018912324e-214	-6.859919859066001e-108
355	6.859919859066001e-108	-4.70585004728081e-215	-3.4299599295330006e-108
356	3.4299599295330006e-108	-1.1764625118202026e-215	-1.7149799647665003e-108
357	1.7149799647665003e-108	-2.9411562795505065e-216	-8.574899823832501e-109
358	8.574899823832501e-109	-7.352890698876266e-217	-4.287449911916251e-109
359	4.287449911916251e-109	-1.8382226747190666e-217	-2.1437249559581253e-109
360	2.1437249559581253e-109	-4.595556686797666e-218	-1.0718624779790627e-109
361	1.0718624779790627e-109	-1.1488891716994166e-218	-5.359312389895313e-110
362	5.359312389895313e-110	-2.872222929485415e-219	-2.6796561949476567e-110
363	2.6796561949476567e-110	-7.180557323121354e-220	-1.3398280974738283e-110
364	1.3398280974738283e-110	-1.7951393307803385e-220	-6.699140487369142e-111
365	6.699140487369142e-111	-4.487848326950846e-221	-3.349570243684571e-111
366	3.349570243684571e-111	-1.1219620817377115e-221	-1.6747851218422854e-111
367	1.6747851218422854e-111	-2.804905204344279e-222	-8.373925609211427e-112
368	8.373925609211427e-112	-7.012263010860697e-223	-4.186962804605714e-112
369	4.186962804605714e-112	-1.7530657527151743e-223	-2.093481402302857e-112
370	2.093481402302857e-112	-4.382664381787936e-224	-1.0467407011514284e-112
371	1.0467407011514284e-112	-1.095666095446984e-224	-5.233703505757142e-113
372	5.233703505757142e-113	-2.73916523861746e-225	-2.616851752878571e-113
373	2.616851752878571e-113	-6.84791309654365e-226	-1.3084258764392855e-113
374	1.3084258764392855e-113	-1.7119782741359124e-226	-6.542129382196427e-114

375	6.542129382196427e-114	-4.279945685339781e-227	-3.271064691098214e-114
376	3.271064691098214e-114	-1.0699864213349452e-227	-1.635532345549107e-114
377	1.635532345549107e-114	-2.674966053337363e-228	-8.177661727745534e-115
378	8.177661727745534e-115	-6.687415133343408e-229	-4.088830863872767e-115
379	4.088830863872767e-115	-1.671853783335852e-229	-2.0444154319363836e-115
380	2.0444154319363836e-115	-4.17963445833963e-230	-1.0222077159681918e-115
381	1.0222077159681918e-115	-1.0449086145849075e-230	-5.111038579840959e-116
382	5.111038579840959e-116	-2.6122715364622687e-231	-2.5555192899204795e-116
383	2.5555192899204795e-116	-6.530678841155672e-232	-1.2777596449602397e-116
384	1.2777596449602397e-116	-1.632669710288918e-232	-6.388798224801199e-117
385	6.388798224801199e-117	-4.081674275722295e-233	-3.194399112400599e-117
386	3.194399112400599e-117	-1.0204185689305737e-233	-1.5971995562002997e-117
387	1.5971995562002997e-117	-2.551046422326434e-234	-7.985997781001498e-118
388	7.985997781001498e-118	-6.377616055816086e-235	-3.992998890500749e-118
389	3.992998890500749e-118	-1.5944040139540214e-235	-1.9964994452503746e-118
390	1.9964994452503746e-118	-3.9860100348850535e-236	-9.982497226251873e-119
391	9.982497226251873e-119	-9.965025087212634e-237	-4.991248613125936e-119
392	4.991248613125936e-119	-2.4912562718031584e-237	-2.495624306562968e-119
393	2.495624306562968e-119	-6.228140679507896e-238	-1.247812153281484e-119
394	1.247812153281484e-119	-1.557035169876974e-238	-6.23906076640742e-120
395	6.23906076640742e-120	-3.892587924692435e-239	-3.11953038320371e-120
396	3.11953038320371e-120	-9.731469811731088e-240	-1.559765191601855e-120
397	1.559765191601855e-120	-2.432867452932772e-240	-7.798825958009276e-121
398	7.798825958009276e-121	-6.08216863233193e-241	-3.899412979004638e-121
399	3.899412979004638e-121	-1.5205421580829824e-241	-1.949706489502319e-121
400	1.949706489502319e-121	-3.801355395207456e-242	-9.748532447511595e-122
401	9.748532447511595e-122	-9.50338848801864e-243	-4.874266223755797e-122
402	4.874266223755797e-122	-2.37584712200466e-243	-2.4371331118778987e-122
403	2.4371331118778987e-122	-5.93961780501165e-244	-1.2185665559389493e-122
404	1.2185665559389493e-122	-1.4849044512529125e-244	-6.092832779694747e-123
405	6.092832779694747e-123	-3.712261128132281e-245	-3.046416389847373e-123
406	3.046416389847373e-123	-9.280652820330703e-246	-1.5232081949236867e-123
407	1.5232081949236867e-123	-2.320163205082676e-246	-7.616040974618433e-124
408	7.616040974618433e-124	-5.80040801270669e-247	-3.808020487309217e-124
409	3.808020487309217e-124	-1.4501020031766724e-247	-1.9040102436546083e-124
410	1.9040102436546083e-124	-3.625255007941681e-248	-9.520051218273042e-125
411	9.520051218273042e-125	-9.063137519854202e-249	-4.760025609136521e-125
412	4.760025609136521e-125	-2.2657843799635506e-249	-2.3800128045682604e-125
413	2.3800128045682604e-125	-5.664460949908877e-250	-1.1900064022841302e-125
414	1.1900064022841302e-125	-1.416115237477219e-250	-5.950032011420651e-126
415	5.950032011420651e-126	-3.540288093693048e-251	-2.9750160057103255e-126
416	2.9750160057103255e-126	-8.85072023423262e-252	-1.4875080028551628e-126
417	1.4875080028551628e-126	-2.212680058558155e-252	-7.437540014275814e-127
418	7.437540014275814e-127	-5.531700146395387e-253	-3.718770007137907e-127
419	3.718770007137907e-127	-1.3829250365988468e-253	-1.8593850035689535e-127
420	1.8593850035689535e-127	-3.457312591497117e-254	-9.296925017844767e-128
421	9.296925017844767e-128	-8.643281478742793e-255	-4.648462508922384e-128

422	4.648462508922384e-128	-2.160820369685698e-255	-2.324231254461192e-128
423	2.324231254461192e-128	-5.402050924214245e-256	-1.162115627230596e-128
424	1.162115627230596e-128	-1.3505127310535613e-256	-5.81057813615298e-129
425	5.81057813615298e-129	-3.376281827633903e-257	-2.90528906807649e-129
426	2.90528906807649e-129	-8.440704569084758e-258	-1.452644534038245e-129
427	1.452644534038245e-129	-2.1101761422711896e-258	-7.263222670191224e-130
428	7.263222670191224e-130	-5.275440355677974e-259	-3.631611335095612e-130
429	3.631611335095612e-130	-1.3188600889194935e-259	-1.815805667547806e-130
430	1.815805667547806e-130	-3.297150222298734e-260	-9.07902833773903e-131
431	9.07902833773903e-131	-8.242875555746834e-261	-4.539514168869515e-131
432	4.539514168869515e-131	-2.0607188889367086e-261	-2.2697570844347576e-131
433	2.2697570844347576e-131	-5.151797222341771e-262	-1.1348785422173788e-131
434	1.1348785422173788e-131	-1.287949305585443e-262	-5.674392711086894e-132
435	5.674392711086894e-132	-3.219873263963607e-263	-2.837196355543447e-132
436	2.837196355543447e-132	-8.049683159909018e-264	-1.4185981777717235e-132
437	1.4185981777717235e-132	-2.0124207899772545e-264	-7.092990888858618e-133
438	7.092990888858618e-133	-5.031051974943136e-265	-3.546495444429309e-133
439	3.546495444429309e-133	-1.257762993735784e-265	-1.7732477222146544e-133
440	1.7732477222146544e-133	-3.14440748433946e-266	-8.866238611073272e-134
441	8.866238611073272e-134	-7.86101871084865e-267	-4.433119305536636e-134
442	4.433119305536636e-134	-1.9652546777121626e-267	-2.216559652768318e-134
443	2.216559652768318e-134	-4.913136694280406e-268	-1.108279826384159e-134
444	1.108279826384159e-134	-1.2282841735701016e-268	-5.541399131920795e-135
445	5.541399131920795e-135	-3.070710433925254e-269	-2.7706995659603975e-135
446	2.7706995659603975e-135	-7.676776084813135e-270	-1.3853497829801987e-135
447	1.3853497829801987e-135	-1.9191940212032838e-270	-6.926748914900994e-136
448	6.926748914900994e-136	-4.797985053008209e-271	-3.463374457450497e-136
449	3.463374457450497e-136	-1.1994962632520524e-271	-1.7316872287252484e-136
450	1.7316872287252484e-136	-2.998740658130131e-272	-8.658436143626242e-137
451	8.658436143626242e-137	-7.496851645325327e-273	-4.329218071813121e-137
452	4.329218071813121e-137	-1.874212911331332e-273	-2.1646090359065605e-137
453	2.1646090359065605e-137	-4.68553227832833e-274	-1.0823045179532803e-137
454	1.0823045179532803e-137	-1.1713830695820824e-274	-5.411522589766401e-138
455	5.411522589766401e-138	-2.928457673955206e-275	-2.7057612948832007e-138
456	2.7057612948832007e-138	-7.321144184888015e-276	-1.3528806474416003e-138
457	1.3528806474416003e-138	-1.8302860462220037e-276	-6.764403237208002e-139
458	6.764403237208002e-139	-4.575715115555009e-277	-3.382201618604001e-139
459	3.382201618604001e-139	-1.1439287788887523e-277	-1.6911008093020004e-139
460	1.6911008093020004e-139	-2.859821947221881e-278	-8.455504046510002e-140
461	8.455504046510002e-140	-7.149554868054702e-279	-4.227752023255001e-140
462	4.227752023255001e-140	-1.7873887170136755e-279	-2.1138760116275005e-140
463	2.1138760116275005e-140	-4.468471792534189e-280	-1.0569380058137503e-140
464	1.0569380058137503e-140	-1.1171179481335472e-280	-5.284690029068751e-141
465	5.284690029068751e-141	-2.792794870333868e-281	-2.6423450145343757e-141
466	2.6423450145343757e-141	-6.98198717583467e-282	-1.3211725072671878e-141
467	1.3211725072671878e-141	-1.7454967939586675e-282	-6.605862536335939e-142
468	6.605862536335939e-142	-4.363741984896669e-283	-3.3029312681679696e-142

469	3.3029312681679696e-142	-1.0909354962241672e-283	-1.6514656340839848e-142
470	1.6514656340839848e-142	-2.727338740560418e-284	-8.257328170419924e-143
471	8.257328170419924e-143	-6.818346851401045e-285	-4.128664085209962e-143
472	4.128664085209962e-143	-1.7045867128502612e-285	-2.064332042604981e-143
473	2.064332042604981e-143	-4.261466782125653e-286	-1.0321660213024905e-143
474	1.0321660213024905e-143	-1.0653666955314133e-286	-5.160830106512452e-144
475	5.160830106512452e-144	-2.663416738828533e-287	-2.580415053256226e-144
476	2.580415053256226e-144	-6.658541847071333e-288	-1.290207526628113e-144
477	1.290207526628113e-144	-1.6646354617678332e-288	-6.451037633140566e-145
478	6.451037633140566e-145	-4.161588654419583e-289	-3.225518816570283e-145
479	3.225518816570283e-145	-1.0403971636048958e-289	-1.6127594082851414e-145
480	1.6127594082851414e-145	-2.6009929090122394e-290	-8.063797041425707e-146
481	8.063797041425707e-146	-6.502482272530599e-291	-4.0318985207128535e-146
482	4.0318985207128535e-146	-1.6256205681326496e-291	-2.0159492603564267e-146
483	2.0159492603564267e-146	-4.064051420331624e-292	-1.0079746301782134e-146
484	1.0079746301782134e-146	-1.016012855082906e-292	-5.039873150891067e-147
485	5.039873150891067e-147	-2.540032137707265e-293	-2.5199365754455334e-147
486	2.5199365754455334e-147	-6.350080344268163e-294	-1.2599682877227667e-147
487	1.2599682877227667e-147	-1.5875200860670407e-294	-6.299841438613834e-148
488	6.299841438613834e-148	-3.968800215167602e-295	-3.149920719306917e-148
489	3.149920719306917e-148	-9.922000537919004e-296	-1.5749603596534584e-148
490	1.5749603596534584e-148	-2.480500134479751e-296	-7.874801798267292e-149
491	7.874801798267292e-149	-6.201250336199378e-297	-3.937400899133646e-149
492	3.937400899133646e-149	-1.5503125840498444e-297	-1.968700449566823e-149
493	1.968700449566823e-149	-3.875781460124611e-298	-9.843502247834115e-150
494	9.843502247834115e-150	-9.689453650311527e-299	-4.921751123917057e-150
495	4.921751123917057e-150	-2.422363412577882e-299	-2.460875561958529e-150
496	2.460875561958529e-150	-6.055908531444705e-300	-1.2304377809792644e-150
497	1.2304377809792644e-150	-1.513977132861176e-300	-6.152188904896322e-151
498	6.152188904896322e-151	-3.78494283215294e-301	-3.076094452448161e-151
499	3.076094452448161e-151	-9.46235708038235e-302	-1.5380472262240805e-151
500	1.5380472262240805e-151	-2.365589270095588e-302	-7.690236131120402e-152
501	7.690236131120402e-152	-5.91397317523897e-303	-3.845118065560201e-152
502	3.845118065560201e-152	-1.4784932938097423e-303	-1.9225590327801006e-152
503	1.9225590327801006e-152	-3.696233234524356e-304	-9.612795163900503e-153
504	9.612795163900503e-153	-9.24058308631089e-305	-4.806397581950251e-153
505	4.806397581950251e-153	-2.3101457715777224e-305	-2.4031987909751257e-153
506	2.4031987909751257e-153	-5.775364428944306e-306	-1.2015993954875629e-153
507	1.2015993954875629e-153	-1.4438411072360765e-306	-6.007996977437814e-154
508	6.007996977437814e-154	-3.609602768090191e-307	-3.003998488718907e-154
509	3.003998488718907e-154	-9.024006920225478e-308	-1.5019992443594536e-154
510	1.5019992443594536e-154	-2.2560017300563695e-308	-7.509996221797268e-155
511	7.509996221797268e-155	-5.640004325140925e-309	-3.754998110898635e-155
512	3.754998110898633e-155	-1.41000108128523e-309	-1.877499055449316e-155
513	1.877499055449317e-155	-3.5250027032131e-310	-9.387495277246612e-156
514	9.387495277246558e-156	-8.8125067580326e-311	-4.693747638623253e-156
515	4.693747638623305e-156	-2.203126689508e-311	-2.346873819311482e-156

516	2.3468738193118227e-156	-5.50781672377e-312	-1.173436909655919e-156
517	1.1734369096559036e-156	-1.376954180944e-312	-5.867184548284898e-157
518	5.867184548274138e-157	-3.44238545236e-313	-2.9335922741451386e-157
519	2.9335922741289996e-157	-8.605963631e-314	-1.466796137097656e-157
520	1.4667961370313435e-157	-2.151490908e-314	-7.333980685654062e-158
521	7.333980684659373e-158	-5.37872727e-315	-3.66699034223362e-158
522	3.666990342425753e-158	-1.34468182e-315	-1.833495172752943e-158
523	1.8334951696728103e-158	-3.3617045e-316	-9.167475804098404e-159
524	9.1674758926297e-159	-8.404261e-317	-4.583737812549737e-159
525	4.583738080079962e-159	-2.1010655e-317	-2.2918691088588725e-159
526	2.29186897122109e-159	-5.252664e-318	-1.145934588838884e-159
527	1.145934382382206e-159	-1.313167e-318	-5.729678849667976e-160
528	5.729664974154085e-160	-3.2829e-319	-2.8648428937208616e-160
529	2.8648220804332236e-160	-8.2074e-320	-1.432448207651633e-160
530	1.4323738727815905e-160	-2.052e-320	-7.162426885077529e-161
531	7.161311842738376e-161	-5.13e-321	-3.580629859759827e-161
532	3.580681982978549e-161	-1.285e-321	-1.793751421228821e-161
533	1.7869305617497275e-161	-3.2e-322	-8.98587434428212e-162
534	8.883431273215156e-162	-8e-323	-4.449322615516162e-162
535	4.434108657698994e-162	-2e-323	-2.2284778474401826e-162
536	2.2056308102588112e-162	-5e-324	-1.1200098483011133e-162
537	1.0856209619576979e-162	0.0	0.0
538	1.0856209619576979e-162	0.0	

539

iteration (n)	t_n	f(t)	t_n+1 - t_n
0	2.3	-3.594031069908271	0.519256124336466
1	2.8192561243364658	6.917384614192544	-3.588753024311158
2	-0.7694968999746923	-0.22764533892651378	-0.6733062550240343
3	-1.4428031549987266	0.943563609706169	0.9521419550745577
4	-0.4906611999241689	-0.18102799283614196	0.3697419021225226
5	-0.12091929780164629	-0.014407175644771916	0.061374727676410126
6	-0.05954457012523616	-0.003532977463078057	0.029878723888809005
7	-0.029665846236427155	-0.0008792878095346358	0.014846003869795836
8	-0.014819842366631319	-0.00021957948966770923	0.0074115494418320535
9	-0.007408292924799265	-5.487979190989863e-05	0.003704349782380792
10	-0.003703943142418473	-1.3719006585532455e-05	0.0018519969795813458
11	-0.0018519461628371274	-3.4296928271668616e-06	0.0009259762572581064
12	-0.000925969905579021	-8.574195308684033e-07	0.00046298534976298606
13	-0.0004629845558160349	-2.1435465297623255e-07	0.0002314923275294998
14	-0.0002314922282865351	-5.3588648885321653e-08	0.00011574612034594652
15	-0.00011574610794058858	-1.3397161323910447e-08	5.787305474562897e-05
16	-5.787305319495961e-05	-3.3492902748888797e-09	2.8936526694396635e-05
17	-2.8936526500562978e-05	-8.373225652166744e-10	1.4468263262396091e-05
18	-1.4468263238166887e-05	-2.0933064108507203e-10	7.234131620597768e-06
19	-7.234131617569119e-06	-5.233266025757449e-11	3.6170658089738504e-06
20	-3.617065808595268e-06	-1.3083165063537772e-11	1.8085329043212953e-06
21	-1.8085329042739729e-06	-3.2707912658309533e-12	9.042664521399442e-07
22	-9.042664521340287e-07	-8.17697816454395e-13	4.5213322606738403e-07
23	-4.5213322606664467e-07	-2.0442445411338985e-13	2.2606661303336858e-07
24	-2.260666130332761e-07	-5.1106113528334387e-14	1.1303330651664383e-07
25	-1.1303330651663226e-07	-1.277652838208278e-14	5.651665325831686e-08
26	-5.6516653258315404e-08	-3.1941320955206428e-15	2.825832662915779e-08
27	-2.8258326629157613e-08	-7.985330238801576e-16	1.412916331457882e-08
28	-1.4129163314578793e-08	-1.9963325597003914e-16	7.064581657289397e-09
29	-7.064581657289396e-09	-4.9908313992509785e-17	3.5322908286446983e-09
30	-3.5322908286446974e-09	-1.2477078498127443e-17	1.7661454143223487e-09
31	-1.7661454143223487e-09	-3.1192696245318608e-18	8.830727071611744e-10
32	-8.830727071611744e-10	-7.798174061329652e-19	4.415363535805872e-10
33	-4.415363535805872e-10	-1.949543515332413e-19	2.207681767902936e-10
34	-2.207681767902936e-10	-4.8738587883310325e-20	1.103840883951468e-10
35	-1.103840883951468e-10	-1.2184646970827581e-20	5.51920441975734e-11
36	-5.51920441975734e-11	-3.0461617427068953e-21	2.75960220987867e-11
37	-2.75960220987867e-11	-7.615404356767238e-22	1.379801104939335e-11
38	-1.379801104939335e-11	-1.9038510891918096e-22	6.899005524696675e-12
39	-6.899005524696675e-12	-4.759627722979524e-23	3.4495027623483373e-12
40	-3.4495027623483373e-12	-1.189906930744881e-23	1.7247513811741687e-12
41	-1.7247513811741687e-12	-2.9747673268622024e-24	8.623756905870843e-13
42	-8.623756905870843e-13	-7.436918317155506e-25	4.3118784529354217e-13
43	-4.3118784529354217e-13	-1.8592295792888765e-25	2.1559392264677108e-13
44	-2.1559392264677108e-13	-4.6480739482221913e-26	1.0779696132338554e-13
45	-1.0779696132338554e-13	-1.1620184870555478e-26	5.389848066169277e-14

46	-5.389848066169277e-14	-2.9050462176388696e-27	2.6949240330846385e-14
47	-2.6949240330846385e-14	-7.262615544097174e-28	1.3474620165423193e-14
48	-1.3474620165423193e-14	-1.8156538860242935e-28	6.737310082711596e-15
49	-6.737310082711596e-15	-4.5391347150607337e-29	3.368655041355798e-15
50	-3.368655041355798e-15	-1.1347836787651834e-29	1.684327520677899e-15
51	-1.684327520677899e-15	-2.8369591969129586e-30	8.421637603389495e-16
52	-8.421637603389495e-16	-7.092397992282396e-31	4.2108188016947477e-16
53	-4.2108188016947477e-16	-1.773099498070599e-31	2.1054094008473739e-16
54	-2.1054094008473739e-16	-4.432748745176498e-32	1.0527047004236869e-16
55	-1.0527047004236869e-16	-1.1081871862941244e-32	5.2635235021184347e-17
56	-5.2635235021184347e-17	-2.770467965735311e-33	2.6317617510592173e-17
57	-2.6317617510592173e-17	-6.926169914338278e-34	1.3158808755296087e-17
58	-1.3158808755296087e-17	-1.7315424785845694e-34	6.579404377648043e-18
59	-6.579404377648043e-18	-4.3288561964614236e-35	3.2897021888240217e-18
60	-3.2897021888240217e-18	-1.0822140491153559e-35	1.6448510944120108e-18
61	-1.6448510944120108e-18	-2.7055351227883897e-36	8.224255472060054e-19
62	-8.224255472060054e-19	-6.763837806970974e-37	4.112127736030027e-19
63	-4.112127736030027e-19	-1.6909594517427436e-37	2.0560638680150135e-19
64	-2.0560638680150135e-19	-4.227398629356859e-38	1.0280319340075068e-19
65	-1.0280319340075068e-19	-1.0568496573392147e-38	5.140159670037534e-20
66	-5.140159670037534e-20	-2.642124143348037e-39	2.570079835018767e-20
67	-2.570079835018767e-20	-6.605310358370092e-40	1.2850399175093835e-20
68	-1.2850399175093835e-20	-1.651327589592523e-40	6.425199587546917e-21
69	-6.425199587546917e-21	-4.1283189739813076e-41	3.2125997937734587e-21
70	-3.2125997937734587e-21	-1.0320797434953269e-41	1.6062998968867293e-21
71	-1.6062998968867293e-21	-2.5801993587383172e-42	8.031499484433647e-22
72	-8.031499484433647e-22	-6.450498396845793e-43	4.0157497422168233e-22
73	-4.0157497422168233e-22	-1.6126245992114483e-43	2.0078748711084117e-22
74	-2.0078748711084117e-22	-4.0315614980286207e-44	1.0039374355542058e-22
75	-1.0039374355542058e-22	-1.0078903745071552e-44	5.019687177771029e-23
76	-5.019687177771029e-23	-2.519725936267888e-45	2.5098435888855146e-23
77	-2.5098435888855146e-23	-6.29931484066972e-46	1.2549217944427573e-23
78	-1.2549217944427573e-23	-1.57482871016743e-46	6.2746089722137864e-24
79	-6.2746089722137864e-24	-3.937071775418575e-47	3.1373044861068932e-24
80	-3.1373044861068932e-24	-9.842679438546437e-48	1.5686522430534466e-24
81	-1.5686522430534466e-24	-2.4606698596366093e-48	7.843261215267233e-25
82	-7.843261215267233e-25	-6.151674649091523e-49	3.9216306076336165e-25
83	-3.9216306076336165e-25	-1.5379186622728808e-49	1.9608153038168083e-25
84	-1.9608153038168083e-25	-3.844796655682202e-50	9.804076519084041e-26
85	-9.804076519084041e-26	-9.611991639205505e-51	4.9020382595420206e-26
86	-4.9020382595420206e-26	-2.4029979098013763e-51	2.4510191297710103e-26
87	-2.4510191297710103e-26	-6.007494774503441e-52	1.2255095648855052e-26
88	-1.2255095648855052e-26	-1.5018736936258602e-52	6.127547824427526e-27
89	-6.127547824427526e-27	-3.7546842340646504e-53	3.063773912213763e-27
90	-3.063773912213763e-27	-9.386710585161626e-54	1.5318869561068815e-27
91	-1.5318869561068815e-27	-2.3466776462904065e-54	7.659434780534407e-28
92	-7.659434780534407e-28	-5.866694115726016e-55	3.8297173902672036e-28

93	-3.8297173902672036e-28	-1.466673528931504e-55	1.9148586951336018e-28
94	-1.9148586951336018e-28	-3.66668382232876e-56	9.574293475668009e-29
95	-9.574293475668009e-29	-9.1667095558219e-57	4.7871467378340045e-29
96	-4.7871467378340045e-29	-2.291677388955475e-57	2.3935733689170023e-29
97	-2.3935733689170023e-29	-5.729193472388688e-58	1.1967866844585011e-29
98	-1.1967866844585011e-29	-1.432298368097172e-58	5.983933422292506e-30
99	-5.983933422292506e-30	-3.58074592024293e-59	2.991966711146253e-30
100	-2.991966711146253e-30	-8.951864800607325e-60	1.4959833555731264e-30
101	-1.4959833555731264e-30	-2.2379662001518312e-60	7.479916777865632e-31
102	-7.479916777865632e-31	-5.594915500379578e-61	3.739958388932816e-31
103	-3.739958388932816e-31	-1.3987288750948945e-61	1.869979194466408e-31
104	-1.869979194466408e-31	-3.496822187737236e-62	9.34989597233204e-32
105	-9.34989597233204e-32	-8.74205546934309e-63	4.67494798616602e-32
106	-4.67494798616602e-32	-2.1855138673357726e-63	2.33747399308301e-32
107	-2.33747399308301e-32	-5.4637846683394316e-64	1.168736996541505e-32
108	-1.168736996541505e-32	-1.3659461670848579e-64	5.843684982707525e-33
109	-5.843684982707525e-33	-3.4148654177121447e-65	2.9218424913537625e-33
110	-2.9218424913537625e-33	-8.537163544280362e-66	1.4609212456768813e-33
111	-1.4609212456768813e-33	-2.1342908860700905e-66	7.304606228384406e-34
112	-7.304606228384406e-34	-5.335727215175226e-67	3.652303114192203e-34
113	-3.652303114192203e-34	-1.3339318037938065e-67	1.8261515570961016e-34
114	-1.8261515570961016e-34	-3.3348295094845163e-68	9.130757785480508e-35
115	-9.130757785480508e-35	-8.337073773711291e-69	4.565378892740254e-35
116	-4.565378892740254e-35	-2.0842684434278227e-69	2.282689446370127e-35
117	-2.282689446370127e-35	-5.210671108569557e-70	1.1413447231850635e-35
118	-1.1413447231850635e-35	-1.3026677771423892e-70	5.7067236159253175e-36
119	-5.7067236159253175e-36	-3.256669442855973e-71	2.8533618079626587e-36
120	-2.8533618079626587e-36	-8.141673607139932e-72	1.4266809039813294e-36
121	-1.4266809039813294e-36	-2.035418401784983e-72	7.133404519906647e-37
122	-7.133404519906647e-37	-5.088546004462458e-73	3.5667022599533234e-37
123	-3.5667022599533234e-37	-1.2721365011156144e-73	1.7833511299766617e-37
124	-1.7833511299766617e-37	-3.180341252789036e-74	8.916755649883309e-38
125	-8.916755649883309e-38	-7.95085313197259e-75	4.458377824941654e-38
126	-4.458377824941654e-38	-1.9877132829931476e-75	2.229188912470827e-38
127	-2.229188912470827e-38	-4.969283207482869e-76	1.1145944562354136e-38
128	-1.1145944562354136e-38	-1.2423208018707172e-76	5.572972281177068e-39
129	-5.572972281177068e-39	-3.105802004676793e-77	2.786486140588534e-39
130	-2.786486140588534e-39	-7.764505011691983e-78	1.393243070294267e-39
131	-1.393243070294267e-39	-1.9411262529229957e-78	6.966215351471335e-40
132	-6.966215351471335e-40	-4.852815632307489e-79	3.4831076757356674e-40
133	-3.4831076757356674e-40	-1.2132039080768723e-79	1.7415538378678337e-40
134	-1.7415538378678337e-40	-3.0330097701921807e-80	8.707769189339168e-41
135	-8.707769189339168e-41	-7.582524425480452e-81	4.353884594669584e-41
136	-4.353884594669584e-41	-1.895631106370113e-81	2.176942297334792e-41
137	-2.176942297334792e-41	-4.7390777659252824e-82	1.088471148667396e-41
138	-1.088471148667396e-41	-1.1847694414813206e-82	5.44235574333698e-42
139	-5.44235574333698e-42	-2.9619236037033015e-83	2.72117787166849e-42

140	-2.72117787166849e-42	-7.404809009258254e-84	1.360588935834245e-42
141	-1.360588935834245e-42	-1.8512022523145634e-84	6.802944679171225e-43
142	-6.802944679171225e-43	-4.6280056307864086e-85	3.4014723395856127e-43
143	-3.4014723395856127e-43	-1.1570014076966022e-85	1.7007361697928063e-43
144	-1.7007361697928063e-43	-2.8925035192415054e-86	8.503680848964032e-44
145	-8.503680848964032e-44	-7.231258798103763e-87	4.251840424482016e-44
146	-4.251840424482016e-44	-1.8078146995259409e-87	2.125920212241008e-44
147	-2.125920212241008e-44	-4.519536748814852e-88	1.062960106120504e-44
148	-1.062960106120504e-44	-1.129884187203713e-88	5.31480053060252e-45
149	-5.31480053060252e-45	-2.8247104680092826e-89	2.65740026530126e-45
150	-2.65740026530126e-45	-7.0617761700232065e-90	1.32870013265063e-45
151	-1.32870013265063e-45	-1.7654440425058016e-90	6.64350066325315e-46
152	-6.64350066325315e-46	-4.413610106264504e-91	3.321750331626575e-46
153	-3.321750331626575e-46	-1.103402526566126e-91	1.6608751658132874e-46
154	-1.6608751658132874e-46	-2.758506316415315e-92	8.304375829066437e-47
155	-8.304375829066437e-47	-6.896265791038288e-93	4.1521879145332186e-47
156	-4.1521879145332186e-47	-1.724066447759572e-93	2.0760939572666093e-47
157	-2.0760939572666093e-47	-4.31016611939893e-94	1.0380469786333047e-47
158	-1.0380469786333047e-47	-1.0775415298497324e-94	5.190234893166523e-48
159	-5.190234893166523e-48	-2.693853824624331e-95	2.5951174465832616e-48
160	-2.5951174465832616e-48	-6.734634561560828e-96	1.2975587232916308e-48
161	-1.2975587232916308e-48	-1.683658640390207e-96	6.487793616458154e-49
162	-6.487793616458154e-49	-4.2091466009755173e-97	3.243896808229077e-49
163	-3.243896808229077e-49	-1.0522866502438793e-97	1.6219484041145385e-49
164	-1.6219484041145385e-49	-2.6307166256096983e-98	8.109742020572693e-50
165	-8.109742020572693e-50	-6.576791564024246e-99	4.0548710102863463e-50
166	-4.0548710102863463e-50	-1.6441978910060615e-99	2.0274355051431732e-50
167	-2.0274355051431732e-50	-4.1104947275151536e-100	1.0137177525715866e-50
168	-1.0137177525715866e-50	-1.0276236818787884e-100	5.068588762857933e-51
169	-5.068588762857933e-51	-2.569059204696971e-101	2.5342943814289664e-51
170	-2.5342943814289664e-51	-6.4226480117424276e-102	1.2671471907144832e-51
171	-1.2671471907144832e-51	-1.6056620029356069e-102	6.335735953572416e-52
172	-6.335735953572416e-52	-4.014155007339017e-103	3.167867976786208e-52
173	-3.167867976786208e-52	-1.0035387518347543e-103	1.583933988393104e-52
174	-1.583933988393104e-52	-2.5088468795868858e-104	7.91966994196552e-53
175	-7.91966994196552e-53	-6.2721171989672144e-105	3.95983497098276e-53
176	-3.95983497098276e-53	-1.5680292997418036e-105	1.97991748549138e-53
177	-1.97991748549138e-53	-3.920073249354509e-106	9.8995874274569e-54
178	-9.8995874274569e-54	-9.800183123386273e-107	4.94979371372845e-54
179	-4.94979371372845e-54	-2.450045780846568e-107	2.474896856864225e-54
180	-2.474896856864225e-54	-6.12511445211642e-108	1.2374484284321125e-54
181	-1.2374484284321125e-54	-1.531278613029105e-108	6.1872421421605626e-55
182	-6.1872421421605626e-55	-3.8281965325727627e-109	3.0936210710802813e-55
183	-3.0936210710802813e-55	-9.570491331431907e-110	1.5468105355401406e-55
184	-1.5468105355401406e-55	-2.3926228328579767e-110	7.734052677700703e-56
185	-7.734052677700703e-56	-5.981557082144942e-111	3.8670263388503516e-56
186	-3.8670263388503516e-56	-1.4953892705362354e-111	1.9335131694251758e-56

187	-1.9335131694251758e-56	-3.7384731763405886e-112	9.667565847125879e-57
188	-9.667565847125879e-57	-9.346182940851471e-113	4.8337829235629395e-57
189	-4.8337829235629395e-57	-2.336545735212868e-113	2.4168914617814698e-57
190	-2.4168914617814698e-57	-5.84136433803217e-114	1.2084457308907349e-57
191	-1.2084457308907349e-57	-1.4603410845080424e-114	6.0422286544536744e-58
192	-6.0422286544536744e-58	-3.650852711270106e-115	3.0211143272268372e-58
193	-3.0211143272268372e-58	-9.127131778175265e-116	1.5105571636134186e-58
194	-1.5105571636134186e-58	-2.2817829445438163e-116	7.552785818067093e-59
195	-7.552785818067093e-59	-5.704457361359541e-117	3.7763929090335465e-59
196	-3.7763929090335465e-59	-1.4261143403398852e-117	1.8881964545167733e-59
197	-1.8881964545167733e-59	-3.565285850849713e-118	9.440982272583866e-60
198	-9.440982272583866e-60	-8.913214627124282e-119	4.720491136291933e-60
199	-4.720491136291933e-60	-2.2283036567810706e-119	2.3602455681459666e-60
200	-2.3602455681459666e-60	-5.5707591419526764e-120	1.1801227840729833e-60
201	-1.1801227840729833e-60	-1.3926897854881691e-120	5.9006139203649164e-61
202	-5.9006139203649164e-61	-3.4817244637204228e-121	2.9503069601824582e-61
203	-2.9503069601824582e-61	-8.704311159301057e-122	1.4751534800912291e-61
204	-1.4751534800912291e-61	-2.1760777898252642e-122	7.3757674004561455e-62
205	-7.3757674004561455e-62	-5.4401944745631606e-123	3.6878837002280728e-62
206	-3.6878837002280728e-62	-1.3600486186407901e-123	1.8439418501140364e-62
207	-1.8439418501140364e-62	-3.4001215466019754e-124	9.219709250570182e-63
208	-9.219709250570182e-63	-8.500303866504938e-125	4.609854625285091e-63
209	-4.609854625285091e-63	-2.1250759666262346e-125	2.3049273126425455e-63
210	-2.3049273126425455e-63	-5.3126899165655865e-126	1.1524636563212727e-63
211	-1.1524636563212727e-63	-1.3281724791413966e-126	5.762318281606364e-64
212	-5.762318281606364e-64	-3.3204311978534916e-127	2.881159140803182e-64
213	-2.881159140803182e-64	-8.301077994633729e-128	1.440579570401591e-64
214	-1.440579570401591e-64	-2.0752694986584322e-128	7.202897852007955e-65
215	-7.202897852007955e-65	-5.1881737466460806e-129	3.6014489260039773e-65
216	-3.6014489260039773e-65	-1.2970434366615201e-129	1.8007244630019887e-65
217	-1.8007244630019887e-65	-3.2426085916538004e-130	9.003622315009943e-66
218	-9.003622315009943e-66	-8.106521479134501e-131	4.5018111575049716e-66
219	-4.5018111575049716e-66	-2.0266303697836252e-131	2.2509055787524858e-66
220	-2.2509055787524858e-66	-5.066575924459063e-132	1.1254527893762429e-66
221	-1.1254527893762429e-66	-1.2666439811147658e-132	5.6272639468812145e-67
222	-5.6272639468812145e-67	-3.1666099527869144e-133	2.8136319734406073e-67
223	-2.8136319734406073e-67	-7.916524881967286e-134	1.4068159867203036e-67
224	-1.4068159867203036e-67	-1.9791312204918215e-134	7.034079933601518e-68
225	-7.034079933601518e-68	-4.947828051229554e-135	3.517039966800759e-68
226	-3.517039966800759e-68	-1.2369570128073884e-135	1.7585199834003795e-68
227	-1.7585199834003795e-68	-3.092392532018471e-136	8.792599917001898e-69
228	-8.792599917001898e-69	-7.730981330046178e-137	4.396299958500949e-69
229	-4.396299958500949e-69	-1.9327453325115444e-137	2.1981499792504744e-69
230	-2.1981499792504744e-69	-4.831863331278861e-138	1.0990749896252372e-69
231	-1.0990749896252372e-69	-1.2079658328197153e-138	5.495374948126186e-70
232	-5.495374948126186e-70	-3.0199145820492882e-139	2.747687474063093e-70
233	-2.747687474063093e-70	-7.5497864551232205e-140	1.3738437370315465e-70

234	-1.3738437370315465e-70	-1.8874466137808051e-140	6.8692186851577326e-71
235	-6.8692186851577326e-71	-4.718616534452013e-141	3.4346093425788663e-71
236	-3.4346093425788663e-71	-1.1796541336130032e-141	1.7173046712894331e-71
237	-1.7173046712894331e-71	-2.949135334032508e-142	8.586523356447166e-72
238	-8.586523356447166e-72	-7.37283833508127e-143	4.293261678223583e-72
239	-4.293261678223583e-72	-1.8432095837703175e-143	2.1466308391117914e-72
240	-2.1466308391117914e-72	-4.608023959425794e-144	1.0733154195558957e-72
241	-1.0733154195558957e-72	-1.1520059898564484e-144	5.3665770977794786e-73
242	-5.3665770977794786e-73	-2.880014974641121e-145	2.6832885488897393e-73
243	-2.6832885488897393e-73	-7.200037436602803e-146	1.3416442744448696e-73
244	-1.3416442744448696e-73	-1.8000093591507007e-146	6.708221372224348e-74
245	-6.708221372224348e-74	-4.5000233978767517e-147	3.354110686112174e-74
246	-3.354110686112174e-74	-1.1250058494691879e-147	1.677055343056087e-74
247	-1.677055343056087e-74	-2.8125146236729698e-148	8.385276715280435e-75
248	-8.385276715280435e-75	-7.0312865591824245e-149	4.1926383576402176e-75
249	-4.1926383576402176e-75	-1.7578216397956061e-149	2.0963191788201088e-75
250	-2.0963191788201088e-75	-4.3945540994890153e-150	1.0481595894100544e-75
251	-1.0481595894100544e-75	-1.0986385248722538e-150	5.240797947050272e-76
252	-5.240797947050272e-76	-2.7465963121806346e-151	2.620398973525136e-76
253	-2.620398973525136e-76	-6.8664907804515865e-152	1.310199486762568e-76
254	-1.310199486762568e-76	-1.7166226951128966e-152	6.55099743381284e-77
255	-6.55099743381284e-77	-4.2915567377822415e-153	3.27549871690642e-77
256	-3.27549871690642e-77	-1.0728891844455604e-153	1.63774935845321e-77
257	-1.63774935845321e-77	-2.682222961113901e-154	8.18874679226605e-78
258	-8.18874679226605e-78	-6.705557402784752e-155	4.094373396133025e-78
259	-4.094373396133025e-78	-1.676389350696188e-155	2.0471866980665125e-78
260	-2.0471866980665125e-78	-4.19097337674047e-156	1.0235933490332563e-78
261	-1.0235933490332563e-78	-1.0477433441851176e-156	5.1179667451662813e-79
262	-5.1179667451662813e-79	-2.619358360462794e-157	2.5589833725831407e-79
263	-2.5589833725831407e-79	-6.548395901156985e-158	1.2794916862915703e-79
264	-1.2794916862915703e-79	-1.6370989752892462e-158	6.397458431457852e-80
265	-6.397458431457852e-80	-4.0927474382231155e-159	3.198729215728926e-80
266	-3.198729215728926e-80	-1.0231868595557789e-159	1.599364607864463e-80
267	-1.599364607864463e-80	-2.5579671488894472e-160	7.996823039322315e-81
268	-7.996823039322315e-81	-6.394917872223618e-161	3.9984115196611573e-81
269	-3.9984115196611573e-81	-1.5987294680559045e-161	1.9992057598305786e-81
270	-1.9992057598305786e-81	-3.996823670139761e-162	9.996028799152893e-82
271	-9.996028799152893e-82	-9.992059175349403e-163	4.9980143995764466e-82
272	-4.9980143995764466e-82	-2.4980147938373508e-163	2.4990071997882233e-82
273	-2.4990071997882233e-82	-6.245036984593377e-164	1.2495035998941116e-82
274	-1.2495035998941116e-82	-1.5612592461483442e-164	6.247517999470558e-83
275	-6.247517999470558e-83	-3.9031481153708606e-165	3.123758999735279e-83
276	-3.123758999735279e-83	-9.757870288427151e-166	1.5618794998676396e-83
277	-1.5618794998676396e-83	-2.439467572106788e-166	7.809397499338198e-84
278	-7.809397499338198e-84	-6.09866893026697e-167	3.904698749669099e-84
279	-3.904698749669099e-84	-1.5246672325667424e-167	1.9523493748345494e-84
280	-1.9523493748345494e-84	-3.811668081416856e-168	9.761746874172747e-85

281	-9.761746874172747e-85	-9.52917020354214e-169	4.8808734370863736e-85
282	-4.8808734370863736e-85	-2.382292550885535e-169	2.4404367185431868e-85
283	-2.4404367185431868e-85	-5.9557313772138375e-170	1.2202183592715934e-85
284	-1.2202183592715934e-85	-1.4889328443034594e-170	6.101091796357967e-86
285	-6.101091796357967e-86	-3.7223321107586485e-171	3.0505458981789835e-86
286	-3.0505458981789835e-86	-9.305830276896621e-172	1.5252729490894918e-86
287	-1.5252729490894918e-86	-2.3264575692241553e-172	7.626364745447459e-87
288	-7.626364745447459e-87	-5.816143923060388e-173	3.8131823727237294e-87
289	-3.8131823727237294e-87	-1.454035980765097e-173	1.9065911863618647e-87
290	-1.9065911863618647e-87	-3.6350899519127426e-174	9.532955931809323e-88
291	-9.532955931809323e-88	-9.087724879781857e-175	4.766477965904662e-88
292	-4.766477965904662e-88	-2.2719312199454641e-175	2.383238982952331e-88
293	-2.383238982952331e-88	-5.6798280498636604e-176	1.1916194914761654e-88
294	-1.1916194914761654e-88	-1.4199570124659151e-176	5.958097457380827e-89
295	-5.958097457380827e-89	-3.5498925311647877e-177	2.9790487286904136e-89
296	-2.9790487286904136e-89	-8.874731327911969e-178	1.4895243643452068e-89
297	-1.4895243643452068e-89	-2.2186828319779923e-178	7.447621821726034e-90
298	-7.447621821726034e-90	-5.546707079944981e-179	3.723810910863017e-90
299	-3.723810910863017e-90	-1.3866767699862452e-179	1.8619054554315085e-90
300	-1.8619054554315085e-90	-3.466691924965613e-180	9.309527277157542e-91
301	-9.309527277157542e-91	-8.666729812414033e-181	4.654763638578771e-91
302	-4.654763638578771e-91	-2.166682453103508e-181	2.3273818192893856e-91
303	-2.3273818192893856e-91	-5.41670613275877e-182	1.1636909096446928e-91
304	-1.1636909096446928e-91	-1.3541765331896926e-182	5.818454548223464e-92
305	-5.818454548223464e-92	-3.3854413329742315e-183	2.909227274111732e-92
306	-2.909227274111732e-92	-8.463603332435579e-184	1.454613637055866e-92
307	-1.454613637055866e-92	-2.1159008331088947e-184	7.27306818527933e-93
308	-7.27306818527933e-93	-5.2897520827722367e-185	3.636534092639665e-93
309	-3.636534092639665e-93	-1.3224380206930592e-185	1.8182670463198325e-93
310	-1.8182670463198325e-93	-3.306095051732648e-186	9.091335231599163e-94
311	-9.091335231599163e-94	-8.26523762933162e-187	4.5456676157995813e-94
312	-4.5456676157995813e-94	-2.066309407332905e-187	2.2728338078997906e-94
313	-2.2728338078997906e-94	-5.1657735183322624e-188	1.1364169039498953e-94
314	-1.1364169039498953e-94	-1.2914433795830656e-188	5.6820845197494766e-95
315	-5.6820845197494766e-95	-3.228608448957664e-189	2.8410422598747383e-95
316	-2.8410422598747383e-95	-8.07152112239416e-190	1.4205211299373691e-95
317	-1.4205211299373691e-95	-2.01788028059854e-190	7.102605649686846e-96
318	-7.102605649686846e-96	-5.04470070149635e-191	3.551302824843423e-96
319	-3.551302824843423e-96	-1.2611751753740875e-191	1.7756514124217114e-96
320	-1.7756514124217114e-96	-3.1529379384352187e-192	8.878257062108557e-97
321	-8.878257062108557e-97	-7.882344846088047e-193	4.4391285310542786e-97
322	-4.4391285310542786e-97	-1.9705862115220117e-193	2.2195642655271393e-97
323	-2.2195642655271393e-97	-4.926465528805029e-194	1.1097821327635696e-97
324	-1.1097821327635696e-97	-1.2316163822012573e-194	5.548910663817848e-98
325	-5.548910663817848e-98	-3.0790409555031433e-195	2.774455331908924e-98
326	-2.774455331908924e-98	-7.697602388757858e-196	1.387227665954462e-98
327	-1.387227665954462e-98	-1.9244005971894646e-196	6.93613832977231e-99

328	-6.93613832977231e-99	-4.8110014929736614e-197	3.468069164886155e-99
329	-3.468069164886155e-99	-1.2027503732434153e-197	1.7340345824430776e-99
330	-1.7340345824430776e-99	-3.0068759331085384e-198	8.670172912215388e-100
331	-8.670172912215388e-100	-7.517189832771346e-199	4.335086456107694e-100
332	-4.335086456107694e-100	-1.8792974581928365e-199	2.167543228053847e-100
333	-2.167543228053847e-100	-4.698243645482091e-200	1.0837716140269235e-100
334	-1.0837716140269235e-100	-1.1745609113705228e-200	5.4188580701346174e-101
335	-5.4188580701346174e-101	-2.936402278426307e-201	2.7094290350673087e-101
336	-2.7094290350673087e-101	-7.3410056960657675e-202	1.3547145175336544e-101
337	-1.3547145175336544e-101	-1.8352514240164419e-202	6.773572587668272e-102
338	-6.773572587668272e-102	-4.5881285600411047e-203	3.386786293834136e-102
339	-3.386786293834136e-102	-1.1470321400102762e-203	1.693393146917068e-102
340	-1.693393146917068e-102	-2.8675803500256904e-204	8.46696573458534e-103
341	-8.46696573458534e-103	-7.168950875064226e-205	4.23348286729267e-103
342	-4.23348286729267e-103	-1.7922377187660565e-205	2.116741433646335e-103
343	-2.116741433646335e-103	-4.4805942969151413e-206	1.0583707168231675e-103
344	-1.0583707168231675e-103	-1.1201485742287853e-206	5.2918535841158373e-104
345	-5.2918535841158373e-104	-2.8003714355719633e-207	2.6459267920579187e-104
346	-2.6459267920579187e-104	-7.000928588929908e-208	1.3229633960289593e-104
347	-1.3229633960289593e-104	-1.750232147232477e-208	6.614816980144797e-105
348	-6.614816980144797e-105	-4.3755803680811927e-209	3.3074084900723983e-105
349	-3.3074084900723983e-105	-1.0938950920202982e-209	1.6537042450361992e-105
350	-1.6537042450361992e-105	-2.7347377300507454e-210	8.268521225180996e-106
351	-8.268521225180996e-106	-6.8368443251268635e-211	4.134260612590498e-106
352	-4.134260612590498e-106	-1.7092110812817159e-211	2.067130306295249e-106
353	-2.067130306295249e-106	-4.2730277032042897e-212	1.0335651531476245e-106
354	-1.0335651531476245e-106	-1.0682569258010724e-212	5.1678257657381224e-107
355	-5.1678257657381224e-107	-2.670642314502681e-213	2.5839128828690612e-107
356	-2.5839128828690612e-107	-6.676605786256703e-214	1.2919564414345306e-107
357	-1.2919564414345306e-107	-1.6691514465641757e-214	6.459782207172653e-108
358	-6.459782207172653e-108	-4.172878616410439e-215	3.2298911035863265e-108
359	-3.2298911035863265e-108	-1.0432196541026098e-215	1.6149455517931632e-108
360	-1.6149455517931632e-108	-2.6080491352565245e-216	8.074727758965816e-109
361	-8.074727758965816e-109	-6.520122838141311e-217	4.037363879482908e-109
362	-4.037363879482908e-109	-1.6300307095353278e-217	2.018681939741454e-109
363	-2.018681939741454e-109	-4.0750767738383195e-218	1.009340969870727e-109
364	-1.009340969870727e-109	-1.0187691934595799e-218	5.046704849353635e-110
365	-5.046704849353635e-110	-2.5469229836489497e-219	2.5233524246768176e-110
366	-2.5233524246768176e-110	-6.367307459122374e-220	1.2616762123384088e-110
367	-1.2616762123384088e-110	-1.5918268647805936e-220	6.308381061692044e-111
368	-6.308381061692044e-111	-3.979567161951484e-221	3.154190530846022e-111
369	-3.154190530846022e-111	-9.94891790487871e-222	1.577095265423011e-111
370	-1.577095265423011e-111	-2.4872294762196774e-222	7.885476327115055e-112
371	-7.885476327115055e-112	-6.2180736905491936e-223	3.9427381635575275e-112
372	-3.9427381635575275e-112	-1.5545184226372984e-223	1.9713690817787637e-112
373	-1.9713690817787637e-112	-3.886296056593246e-224	9.856845408893819e-113
374	-9.856845408893819e-113	-9.715740141483115e-225	4.9284227044469093e-113

375	-4.9284227044469093e-113	-2.4289350353707787e-225	2.4642113522234547e-113
376	-2.4642113522234547e-113	-6.072337588426947e-226	1.2321056761117273e-113
377	-1.2321056761117273e-113	-1.5180843971067367e-226	6.160528380558637e-114
378	-6.160528380558637e-114	-3.795210992766842e-227	3.0802641902793183e-114
379	-3.0802641902793183e-114	-9.488027481917104e-228	1.5401320951396592e-114
380	-1.5401320951396592e-114	-2.372006870479276e-228	7.700660475698296e-115
381	-7.700660475698296e-115	-5.93001717619819e-229	3.850330237849148e-115
382	-3.850330237849148e-115	-1.4825042940495476e-229	1.925165118924574e-115
383	-1.925165118924574e-115	-3.706260735123869e-230	9.62582559462287e-116
384	-9.62582559462287e-116	-9.265651837809672e-231	4.812912797311435e-116
385	-4.812912797311435e-116	-2.316412959452418e-231	2.4064563986557174e-116
386	-2.4064563986557174e-116	-5.791032398631045e-232	1.2032281993278587e-116
387	-1.2032281993278587e-116	-1.4477580996577613e-232	6.0161409966392936e-117
388	-6.0161409966392936e-117	-3.6193952491444033e-233	3.0080704983196468e-117
389	-3.0080704983196468e-117	-9.048488122861008e-234	1.5040352491598234e-117
390	-1.5040352491598234e-117	-2.262122030715252e-234	7.520176245799117e-118
391	-7.520176245799117e-118	-5.65530507678813e-235	3.7600881228995585e-118
392	-3.7600881228995585e-118	-1.4138262691970325e-235	1.8800440614497793e-118
393	-1.8800440614497793e-118	-3.5345656729925813e-236	9.400220307248896e-119
394	-9.400220307248896e-119	-8.836414182481453e-237	4.700110153624448e-119
395	-4.700110153624448e-119	-2.2091035456203633e-237	2.350055076812224e-119
396	-2.350055076812224e-119	-5.522758864050908e-238	1.175027538406112e-119
397	-1.175027538406112e-119	-1.380689716012727e-238	5.87513769203056e-120
398	-5.87513769203056e-120	-3.4517242900318177e-239	2.93756884601528e-120
399	-2.93756884601528e-120	-8.629310725079544e-240	1.46878442300764e-120
400	-1.46878442300764e-120	-2.157327681269886e-240	7.3439221150382e-121
401	-7.3439221150382e-121	-5.393319203174715e-241	3.6719610575191e-121
402	-3.6719610575191e-121	-1.3483298007936788e-241	1.83598052875955e-121
403	-1.83598052875955e-121	-3.370824501984197e-242	9.17990264379775e-122
404	-9.17990264379775e-122	-8.427061254960492e-243	4.589951321898875e-122
405	-4.589951321898875e-122	-2.106765313740123e-243	2.2949756609494376e-122
406	-2.2949756609494376e-122	-5.266913284350308e-244	1.1474878304747188e-122
407	-1.1474878304747188e-122	-1.316728321087577e-244	5.737439152373594e-123
408	-5.737439152373594e-123	-3.2918208027189423e-245	2.868719576186797e-123
409	-2.868719576186797e-123	-8.229552006797356e-246	1.4343597880933985e-123
410	-1.4343597880933985e-123	-2.057388001699339e-246	7.171798940466992e-124
411	-7.171798940466992e-124	-5.1434700042483474e-247	3.585899470233496e-124
412	-3.585899470233496e-124	-1.2858675010620868e-247	1.792949735116748e-124
413	-1.792949735116748e-124	-3.214668752655217e-248	8.96474867558374e-125
414	-8.96474867558374e-125	-8.036671881638043e-249	4.48237433779187e-125
415	-4.48237433779187e-125	-2.0091679704095107e-249	2.241187168895935e-125
416	-2.241187168895935e-125	-5.022919926023777e-250	1.1205935844479676e-125
417	-1.1205935844479676e-125	-1.2557299815059442e-250	5.602967922239838e-126
418	-5.602967922239838e-126	-3.1393249537648605e-251	2.801483961119919e-126
419	-2.801483961119919e-126	-7.848312384412151e-252	1.4007419805599594e-126
420	-1.4007419805599594e-126	-1.9620780961030378e-252	7.003709902799797e-127
421	-7.003709902799797e-127	-4.9051952402575945e-253	3.5018549513998986e-127

422	-3.5018549513998986e-127	-1.2262988100643986e-253	1.7509274756999493e-127
423	-1.7509274756999493e-127	-3.0657470251609966e-254	8.754637378499747e-128
424	-8.754637378499747e-128	-7.664367562902491e-255	4.3773186892498733e-128
425	-4.3773186892498733e-128	-1.9160918907256228e-255	2.1886593446249366e-128
426	-2.1886593446249366e-128	-4.790229726814057e-256	1.0943296723124683e-128
427	-1.0943296723124683e-128	-1.1975574317035143e-256	5.4716483615623416e-129
428	-5.4716483615623416e-129	-2.9938935792587857e-257	2.7358241807811708e-129
429	-2.7358241807811708e-129	-7.484733948146964e-258	1.3679120903905854e-129
430	-1.3679120903905854e-129	-1.871183487036741e-258	6.839560451952927e-130
431	-6.839560451952927e-130	-4.6779587175918527e-259	3.4197802259764635e-130
432	-3.4197802259764635e-130	-1.1694896793979632e-259	1.7098901129882318e-130
433	-1.7098901129882318e-130	-2.923724198494908e-260	8.549450564941159e-131
434	-8.549450564941159e-131	-7.30931049623727e-261	4.2747252824705794e-131
435	-4.2747252824705794e-131	-1.8273276240593174e-261	2.1373626412352897e-131
436	-2.1373626412352897e-131	-4.5683190601482936e-262	1.0686813206176448e-131
437	-1.0686813206176448e-131	-1.1420797650370734e-262	5.343406603088224e-132
438	-5.343406603088224e-132	-2.8551994125926835e-263	2.671703301544112e-132
439	-2.671703301544112e-132	-7.137998531481709e-264	1.335851650772056e-132
440	-1.335851650772056e-132	-1.7844996328704272e-264	6.67925825386028e-133
441	-6.67925825386028e-133	-4.461249082176068e-265	3.33962912693014e-133
442	-3.33962912693014e-133	-1.115312270544017e-265	1.66981456346507e-133
443	-1.66981456346507e-133	-2.7882806763600425e-266	8.34907281732535e-134
444	-8.34907281732535e-134	-6.970701690900106e-267	4.174536408662675e-134
445	-4.174536408662675e-134	-1.7426754227250266e-267	2.0872682043313376e-134
446	-2.0872682043313376e-134	-4.3566885568125664e-268	1.0436341021656688e-134
447	-1.0436341021656688e-134	-1.0891721392031416e-268	5.218170510828344e-135
448	-5.218170510828344e-135	-2.722930348007854e-269	2.609085255414172e-135
449	-2.609085255414172e-135	-6.807325870019635e-270	1.304542627707086e-135
450	-1.304542627707086e-135	-1.7018314675049087e-270	6.52271313853543e-136
451	-6.52271313853543e-136	-4.254578668762272e-271	3.261356569267715e-136
452	-3.261356569267715e-136	-1.063644667190568e-271	1.6306782846338575e-136
453	-1.6306782846338575e-136	-2.65911166797642e-272	8.153391423169287e-137
454	-8.153391423169287e-137	-6.64777916994105e-273	4.0766957115846437e-137
455	-4.0766957115846437e-137	-1.6619447924852624e-273	2.0383478557923219e-137
456	-2.0383478557923219e-137	-4.154861981213156e-274	1.0191739278961609e-137
457	-1.0191739278961609e-137	-1.038715495303289e-274	5.0958696394808047e-138
458	-5.0958696394808047e-138	-2.5967887382582226e-275	2.5479348197404023e-138
459	-2.5479348197404023e-138	-6.4919718456455564e-276	1.2739674098702012e-138
460	-1.2739674098702012e-138	-1.6229929614113891e-276	6.369837049351006e-139
461	-6.369837049351006e-139	-4.057482403528473e-277	3.184918524675503e-139
462	-3.184918524675503e-139	-1.0143706008821182e-277	1.5924592623377515e-139
463	-1.5924592623377515e-139	-2.5359265022052955e-278	7.962296311688757e-140
464	-7.962296311688757e-140	-6.339816255513239e-279	3.9811481558443786e-140
465	-3.9811481558443786e-140	-1.5849540638783097e-279	1.9905740779221893e-140
466	-1.9905740779221893e-140	-3.962385159695774e-280	9.952870389610947e-141
467	-9.952870389610947e-141	-9.905962899239435e-281	4.9764351948054733e-141
468	-4.9764351948054733e-141	-2.476490724809859e-281	2.4882175974027366e-141

469	-2.4882175974027366e-141	-6.191226812024647e-282	1.2441087987013683e-141
470	-1.2441087987013683e-141	-1.5478067030061618e-282	6.2205439935068416e-142
471	-6.2205439935068416e-142	-3.8695167575154045e-283	3.1102719967534208e-142
472	-3.1102719967534208e-142	-9.673791893788511e-284	1.5551359983767104e-142
473	-1.5551359983767104e-142	-2.4184479734471278e-284	7.775679991883552e-143
474	-7.775679991883552e-143	-6.0461199336178195e-285	3.887839995941776e-143
475	-3.887839995941776e-143	-1.5115299834044549e-285	1.943919997970888e-143
476	-1.943919997970888e-143	-3.778824958511137e-286	9.71959998985444e-144
477	-9.71959998985444e-144	-9.447062396277843e-287	4.85979999492722e-144
478	-4.85979999492722e-144	-2.3617655990694607e-287	2.42989999746361e-144
479	-2.42989999746361e-144	-5.904413997673652e-288	1.214949998731805e-144
480	-1.214949998731805e-144	-1.476103499418413e-288	6.074749993659025e-145
481	-6.074749993659025e-145	-3.6902587485460324e-289	3.0373749968295125e-145
482	-3.0373749968295125e-145	-9.225646871365081e-290	1.5186874984147563e-145
483	-1.5186874984147563e-145	-2.3064117178412703e-290	7.593437492073781e-146
484	-7.593437492073781e-146	-5.7660292946031756e-291	3.7967187460368906e-146
485	-3.7967187460368906e-146	-1.4415073236507939e-291	1.8983593730184453e-146
486	-1.8983593730184453e-146	-3.6037683091269848e-292	9.491796865092227e-147
487	-9.491796865092227e-147	-9.009420772817462e-293	4.7458984325461133e-147
488	-4.7458984325461133e-147	-2.2523551932043655e-293	2.3729492162730566e-147
489	-2.3729492162730566e-147	-5.630887983010914e-294	1.1864746081365283e-147
490	-1.1864746081365283e-147	-1.4077219957527284e-294	5.9323730406826416e-148
491	-5.9323730406826416e-148	-3.519304989381821e-295	2.9661865203413208e-148
492	-2.9661865203413208e-148	-8.798262473454553e-296	1.4830932601706604e-148
493	-1.4830932601706604e-148	-2.1995656183636382e-296	7.415466300853302e-149
494	-7.415466300853302e-149	-5.4989140459090954e-297	3.707733150426651e-149
495	-3.707733150426651e-149	-1.3747285114772739e-297	1.8538665752133255e-149
496	-1.8538665752133255e-149	-3.4368212786931846e-298	9.269332876066628e-150
497	-9.269332876066628e-150	-8.592053196732962e-299	4.634666438033314e-150
498	-4.634666438033314e-150	-2.1480132991832404e-299	2.317333219016657e-150
499	-2.317333219016657e-150	-5.370033247958101e-300	1.1586666095083284e-150
500	-1.1586666095083284e-150	-1.3425083119895252e-300	5.793333047541642e-151
501	-5.793333047541642e-151	-3.356270779973813e-301	2.896666523770821e-151
502	-2.896666523770821e-151	-8.390676949934533e-302	1.4483332618854106e-151
503	-1.4483332618854106e-151	-2.0976692374836332e-302	7.241666309427053e-152
504	-7.241666309427053e-152	-5.244173093709083e-303	3.6208331547135264e-152
505	-3.6208331547135264e-152	-1.3110432734272708e-303	1.8104165773567632e-152
506	-1.8104165773567632e-152	-3.277608183568177e-304	9.052082886783816e-153
507	-9.052082886783816e-153	-8.194020458920442e-305	4.526041443391908e-153
508	-4.526041443391908e-153	-2.0485051147301105e-305	2.263020721695954e-153
509	-2.263020721695954e-153	-5.1212627868252764e-306	1.131510360847977e-153
510	-1.131510360847977e-153	-1.2803156967063191e-306	5.657551804239885e-154
511	-5.657551804239885e-154	-3.2007892417657977e-307	2.8287759021199425e-154
512	-2.8287759021199425e-154	-8.001973104414494e-308	1.4143879510599712e-154
513	-1.4143879510599712e-154	-2.0004932761036236e-308	7.071939755299856e-155
514	-7.071939755299856e-155	-5.00123319025906e-309	3.5359698776499273e-155
515	-3.535969877649929e-155	-1.250308297564766e-309	1.7679849388249649e-155

516	-1.767984938824964e-155	-3.1257707439119e-310	8.839924694124826e-156
517	-8.839924694124814e-156	-7.81442685978e-311	4.4199623470624163e-156
518	-4.4199623470623977e-156	-1.9536067149447e-311	2.2099811735309334e-156
519	-2.2099811735314643e-156	-4.884016787363e-312	1.1049905867656134e-156
520	-1.104990586765851e-156	-1.22100419684e-312	5.5249529338218845e-157
521	-5.524952933836625e-157	-3.0525104921e-313	2.762476466929613e-157
522	-2.762476466907012e-157	-7.63127623e-314	1.3812382334481007e-157
523	-1.3812382334589112e-157	-1.907819058e-314	6.906191168107722e-158
524	-6.90619116648139e-158	-4.76954764e-315	3.4530955826719556e-158
525	-3.453095583809435e-158	-1.192386913e-315	1.7265477946285841e-158
526	-1.7265477891808507e-158	-2.98096726e-316	8.632738915222728e-159
527	-8.632738976585779e-159	-7.452418e-317	4.316369370731075e-159
528	-4.316369605854704e-159	-1.8631048e-317	2.158184912742731e-159
529	-2.1581846931119728e-159	-4.65776e-318	1.0790919389628366e-159
530	-1.0790927541491362e-159	-1.164444e-318	5.395474826330213e-160
531	-5.395452715161149e-160	-2.9111e-319	2.697720048292798e-160
532	-2.697732666868351e-160	-7.2776e-320	1.3488339768835789e-160
533	-1.348898689984772e-160	-1.8196e-320	6.7449237928085365e-161
534	-6.744063107039184e-161	-4.55e-321	3.3735928371195196e-161
535	-3.3704702699196642e-161	-1.136e-321	1.6857454515715877e-161
536	-1.6847248183480765e-161	-2.8e-322	8.357964905082983e-162
537	-8.489283278397782e-162	-7.4e-323	4.3649059906370593e-162
538	-4.1243772877607224e-162	-1.5e-323	1.7968736055285565e-162
539	-2.327503682232166e-162	-5e-324	1.0613638328756981e-162
540	-1.2661398493564678e-162	0.0	0.0
541	-1.2661398493564678e-162	0.0	

iteration (n)	t_n	f(t)	t_n+1-t_n	eps
0	2.4	-2.3782953636364557	0.13673559200984675	0.056973
1	2.5367355920098467	0.8220987161758242	-0.029334899218623534	0.011564
2	2.507400692791223	0.02047633955669373	-0.0007717377242539847	0.000308
3	2.506628955066969	1.802201620675752e-05	-6.804354368838972e-07	2.71E-07
4	2.5066282746315323	1.4085324346507245e-11	-5.32018873400375e-13	2.12E-13
5	2.5066282746310002	-5.986418372261646e-15		

1b)

initial guesses

$$a = 3.2$$

$$b = 3.8$$

$$\text{tol} = 10^{-8}$$

$n=0$
While $\epsilon_n > 0$

$$\left\{ \begin{array}{l} c = b - f(a) * f(b) / (f(b) - f(a)) \\ \therefore f(c) f(b) > 0 \end{array} \right.$$

$$\left. \begin{array}{l} \\ \} b = c \end{array} \right.$$

else

$$\left. \begin{array}{l} a = c \\ n = n + 1 \end{array} \right.$$

$$c = 3.54$$

$$n = 8$$

iteration (n)	t_n	t_n+1	f(n)	eps_n	Initial interval
0	3.2	3.8	-6.725591522	0.1875	3.2-3.8
1	3.8	3.406369685	12.82841858	0.103586925	
2	3.406369685	3.565491201	-8.704481116	0.046712932	
3	3.565491201	3.53938828	1.708125013	0.007320989	
4	3.53938828	3.544837003	-4.51E-01	0.001539453	
5	3.544837003	3.544906865	-5.80E-03	1.97E-05	
6	3.544906865	3.544907692	-6.87E-05	2.33E-07	
7	3.544907692	3.544907702	-8.12E-07	2.76E-09	
8	3.544907702		-9.60908E-09		

2)

$$a_0 = \text{some } \#$$

$$a_1 = \text{some } \#$$

$$\epsilon_{\text{tol}} = 10^{-6}$$

$$n=0$$

while $\epsilon_n > 0$

$$\left| \begin{array}{l} a_{n+1} = a_n - (f(a_n) + f'(a_n)) / (a_{n+1} - a_n) \\ n = n+1 \end{array} \right.$$

root1

1.875

root2

4.69

root3

7.85

iteration (n)	a_n	a_n+1	f(a)	a_n+1 - a_n	interval
0	0.1	2	1.999983333	1.9	.1-2
1	2	1.581117381	-0.565625835	-0.418882619	
2	1.581117381	1.846097084	1.999983333	0.264979703	
3	1.846097084	1.882453695	-0.565625835	0.036356611	
4	1.882453695	1.874945907	0.973856569	-0.007507788	
5	1.874945907	1.875103218	0.117497038	0.000157312	
6	1.875103218	1.875104069	-0.030578125	8.50E-07	
	1.875104069		0.00065442		

iteration (n)	a_n	a_n+1	f(a)	a_n+1 - a_n	interval
0	3	4.8	-8.966909834	1.8	3-4.8
1	4.8	4.056084055	6.316379052	-0.743915945	
2	4.056084055	4.595170375	-8.966909834	0.53908632	
3	4.595170375	4.813370669	6.316379052	0.218200294	
4	4.813370669	4.682285321	-16.62393093	-0.131085348	
5	4.682285321	4.692756671	-4.789925709	0.01047135	
6	4.692756671	4.694107323	7.207593025	1.35E-03	
7	4.694107323	4.694091111	-0.625741879	-1.62116E-05	
8	4.694091111	4.694091133	-0.071490351	2.20227E-08	
9	4.694091133		0.000868508		

iteration (n)	a_n	a_n+1	f(a)	a_n+1 - a_n
0	7	8	414.3774489	1
1	8	7.657489196	-215.8647684	-0.342510804
2	7.657489196	7.82540077	414.3774489	0.167911574
3	7.82540077	7.861542914	-215.8647684	0.036142144
4	7.861542914	7.854555381	207.5965224	-0.006987534
5	7.854555381	7.854756074	36.76964842	0.000200694
6	7.854756074	7.854757439	-8.812642506	1.36E-06
7	7.854757439		0.260598719	

3a)

$$x_0 = -1$$

$$\text{tol} = 10^{-6}$$

{Newton's Method}

3b)

$$x_0 = -1$$

$$\text{tol} = 10^{-6}$$

$n = 1$
while $\epsilon_n > \text{tol}$

$$x_{n+1} = x_n - \frac{f'(x_n)}{[f'(x_n)]^2 - f'(x_n)f''(x_n)}$$

$$n = n + 1$$

Iteration	x_n	x_n+1	x_n+1 - x_n	f(x)
0	-1	-0.59762	0.402376229	-0.17357
1	-0.59762	-0.31592	0.281699298	-0.05956
2	-0.31592	-0.1994	0.116525903	-0.00422
3	-0.1994	-0.18351	0.015884323	-1.07E-05
4	-0.18351	-0.18326	0.000257719	-4.56E-11
5	-0.18326	-0.18326	-3.36E-08	-5.55E-17
6	-0.18326			-1.67E-16

```

# Matthew Pahayo
# 2/11/2021
# computational methods
# hw 1
# question 3
# Mod. newtons method

import numpy
# create variable
import sympy as sym
x = sym.Symbol('x')

# define function, initial guess, and tol
f = sym.exp(6*x)+3*sym.ln(2)**2*sym.exp(2*x)-sym.exp(4*x)*sym.ln(8)-sym.ln(2)**3
t_0 = -1
tol = 10**-5

# lambdify funtion and its derivative
fp = sym.diff(f)
fpp = sym.diff(fp)
f = sym.lambdify(x, f)
fp = sym.lambdify(x, fp)
fpp = sym.lambdify(x, fpp)

# # get next iteration for t and declare lists
t_1 = t_0 - f(t_0)*fp(t_0)/((fp(t_0))**2-f(t_0)*fpp(t_0))
tl = [t_0, t_1]
fl = []
dtl = []

# newtons method
n = 0
while (abs(tl[n+1]-tl[n])/abs(tl[n])) > tol:
    t_np1 = tl[n+1] -
    f(tl[n+1])*fp(tl[n+1])/((fp(tl[n+1]))**2-f(tl[n+1])*fpp(tl[n+1]))
    tl.append(t_np1)
    n += 1

# define fl and dtl
for j in range(len(tl)):
    fl.append(f(tl[j]))
for k in range(len(tl)-1):
    dtl.append(tl[k+1]-tl[k])

data_fl = open("flm.txt", "a")
data_tl = open("tlm.txt", "a")
for i in range(len(tl)):
    data_tl.write(str(tl[i]) + "\n")
    data_fl.write(str(fl[i]) + "\n")
data_tl.close()

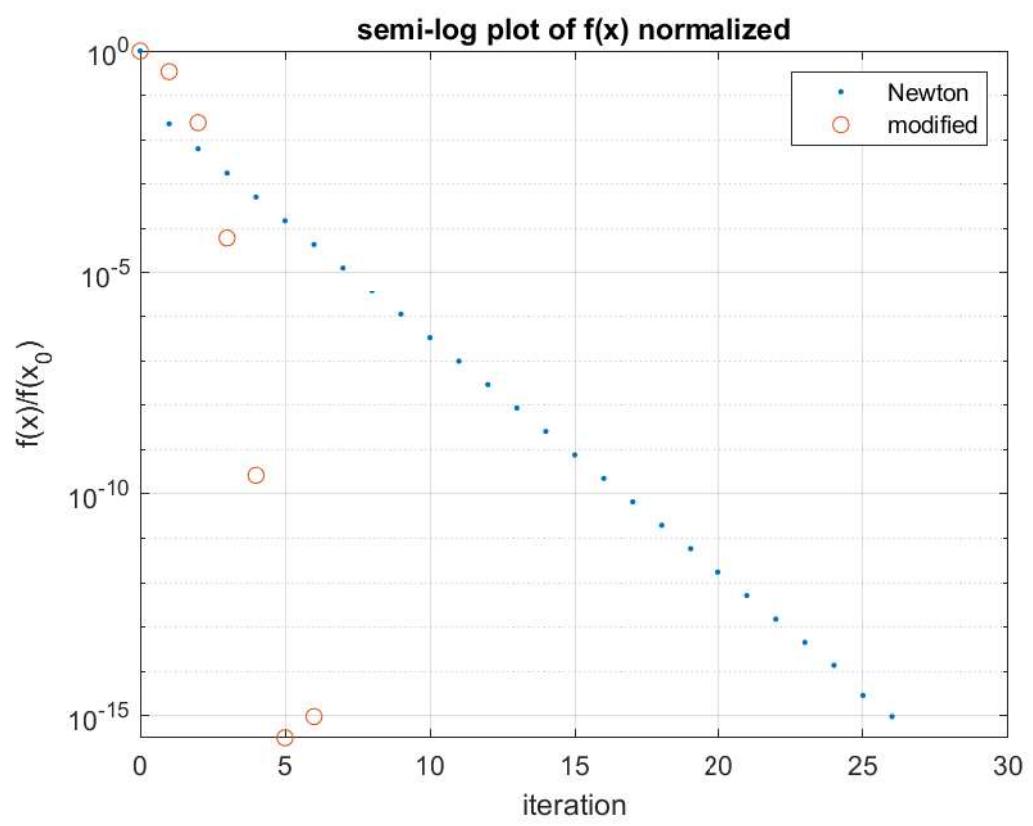
```

```
data_fl.close()

i = 0
data_dtl = open("dtlm.txt", "a")
for i in range(len(dtl)):
    data_dtl.write(str(dtl[i]) + "\n")
data_dtl.close()

print("t = " + str(t_np1))
print("total iterations = " + str(n))
print("final delta t = " + str(dtl[n-1]))

# keeps python console up; for non-IDE use
i = 1
while i == 1:
    i = input("Press enter to continue.\n")
```



$$4) C_p = 9.67 + 1.67 \times 10^{-4} T - 9.688 \times 10^{-7} T^2 \\ + 1.452 \times 10^{-10} T^3$$

$$C_p = 1.2$$

$$\Rightarrow g(T) = \frac{12 - 9.67 \times 10^{-4} T}{\left[9.67 \times 10^{-4} T - 9.688 \times 10^{-7} T^2 + 1.452 \times 10^{-10} T^3 \right]}$$

$$\epsilon_0 = 10^{-5}$$

$\epsilon_n > 0$
while $\epsilon_n > 0$

| $T_{n+1} = g(T_n)$
 $n = n + 1$

iteration	T_n	T_n+1	eps_n	T_n+1 - T_n
0	500	1060.673162	1.121346324	560.6731621
1	1060.673162	1109.238752	0.045787516	48.56558975
2	1109.238752	1121.499972	0.011053725	12.2612199
3	1121.499972	1124.783198	0.002927532	3.283226585
4	1124.783198	1125.675149	0.000792998	0.891951168
5	1125.675149	1125.918397	0.000216091	0.243247986
6	1125.918397	1125.984804	5.90E-05	0.066406365
7	1125.984804	1126.002938	1.61E-05	0.018133993
8	1126.002938	1126.00789	4.39816E-06	0.004952344
9	1126.00789			-1126.00789

iteration	T_n	T_n+1	eps_n	T_n+1 - T_n
0	2000	1533.222171	0.233388915	-466.7778291
1	1533.222171	1277.617812	0.166710581	-255.6043594
2	1277.617812	1173.118071	0.081792645	-104.4997403
3	1173.118071	1139.429205	0.02871737	-33.68886569
4	1139.429205	1129.719711	0.008521367	-9.709494318
5	1129.719711	1127.026405	0.002384048	-2.693306553
6	1127.026405	1126.287663	0.000655479	-0.73874162
7	1126.287663	1126.085669	0.000179345	-0.201993553
8	1126.085669	1126.030486	4.90E-05	-0.055183385
9	1126.030486	1126.015414	1.34E-05	-0.015072206
10	1126.015414	1126.011297	-3.65572E-06	-0.004116398
11	1126.011297			-1126.011297

```

# Matthew Pahayo
# 1/28/2021
# computational methods
# hw 1
# question 1
# newtons method
# q1_nm.py

# create variable
import sympy as sym
x = sym.Symbol('x')

# define function, initial guess, and tol
f = 2*sym.sin(x**2)-3*sym.sin(x**2)+x**2*sym.sin(x**2)
t_0 = 2.2
tol = 10**-8

# lambdify funtion and its derivative
fp = sym.diff(f)
f = sym.lambdify(x, f)
fp = sym.lambdify(x, fp)

# get next iteration for t and declare lists
t_1 = t_0 - f(t_0)/fp(t_0)
tl = [t_0, t_1]
fl = []
dtl = []

# newtons method
n = 0
while (abs(tl[n+1]-tl[n])/abs(tl[n])) > tol:
    t_np1 = tl[n+1] - f(tl[n+1])/fp(tl[n+1])
    tl.append(t_np1)
    n += 1

# define fl and dtl
for j in range(len(tl)):
    fl.append(f(tl[j]))
for k in range(len(tl)-1):
    dtl.append(tl[k+1]-tl[k])

data_fl = open("fl.txt", "a")
data_tl = open("tl.txt", "a")
for i in range(len(tl)):
    data_tl.write(str(tl[i]) + "\n")
    data_fl.write(str(fl[i]) + "\n")
data_tl.close()
data_fl.close()

i = 0

```

```
data_dtl = open("dtl.txt", "a")
for i in range(len(dtl)):
    data_dtl.write(str(dtl[i]) + "\n")
data_dtl.close()

print("t = " + str(t_np1))
print("total iterations = " + str(n))
print("final delta t = " + str(dtl[n-1]))

# keeps python console up; for non-IDE use
i = 1
while i == 1:
    i = input("Press enter to continue.\n")
```

```

# Matthew Pahayo
# 2/11/2021
# computational methods
# hw 1
# question 1
# false position
# q1_fp.py

import numpy as nu

def f(x):
    f = 2*nu.sin(x**2)-3*nu.sin(x**2)+x**2*nu.sin(x**2)
    return f

a = 3.2
b = 3.8
tol = .00000001
cl = [a, b]
fl = [f(a), f(b)]
eps = []

i = 0
while abs(cl[i+1] - cl[i])/abs(cl[i]) >= tol:
    c = b-f(b)*(b-a)/(f(b)-f(a))
    eps.append(abs(cl[i+1] - cl[i])/abs(cl[i]))
    if f(c)*f(b) > 0:
        b = c
    if f(c)*f(b) < 0:
        a = c
    cl.append(c)
    fl.append(f(c))
    i += 1

eps.append(abs(cl[i+1] - cl[i])/abs(cl[i]))

i=0
data_fl = open("fl.txt", "a")
data_cl = open("cl.txt", "a")
for i in range(len(cl)):
    data_cl.write(str(cl[i]) + "\n")
for g in range(len(fl)):
    data_fl.write(str(fl[g]) + "\n")
data_cl.close()
data_fl.close()

i = 0
data_eps = open("eps.txt", "a")
for i in range(len(eps)):
    data_eps.write(str(eps[i]) + "\n")
data_eps.close()

```

```
print(c)
n = 1
while n == 1:
    n = input("Press enter to continue.")
```

```

# Matthew Pahayo
# 2/11/2021
# computational methods
# hw 1
# question 2
# secant method
# q2.py

import numpy as np

def f(x):
    return np.cosh(x)*np.cos(x)+1

# define tol, guess a_0 and a_1
# a_0 != 0, because of stopping criteria
tol = 10**-6
a_0 = 7
a_1 = 8

# declare lists
al = [a_0, a_1]
fl = [f(a_0), f(a_1)]
dal = []

# secant method
# evaluates function at a_n
n = 0
while (abs(al[n+1]-al[n])/abs(al[n])) > tol:
    a_np1 = al[n+1] - f(al[n+1])/(f(al[n+1])-f(al[n]))*((al[n+1])-al[n])
    al.append(a_np1)
    fl.append(f(al[n]))
    n += 1

# defines dal list
for k in range(len(al)-1):
    dal.append(al[k+1]-al[k])

i=0
data_fl = open("fl.txt", "a")
data_al = open("al.txt", "a")
for i in range(len(al)):
    data_al.write(str(al[i]) + "\n")
    data_fl.write(str(fl[i]) + "\n")
data_al.close()
data_fl.close()

i = 0
data_dal = open("dal.txt", "a")
for i in range(len(dal)):
    data_dal.write(str(dal[i]) + "\n")

```

```
data_dal.close()

print("a = " + str(a_np1))
print("total iterations = " + str(n))
print("final delta a = " + str(dal[n-1]))
```

```

# Matthew Pahayo
# 1/28/2021
# computational methods
# hw 1
# question 3
# newtons method
# q3_nm

# create variable
import sympy as sym
x = sym.Symbol('x')

# define function, initial guess, and tol
f = sym.exp(6*x)+3*sym.ln(2)**2*sym.exp(2*x)-sym.exp(4*x)*sym.ln(8)-sym.ln(2)**3
t_0 = -1
tol = 10**-5

# lambdify funtion and its derivative
fp = sym.diff(f)
f = sym.lambdify(x, f)
fp = sym.lambdify(x, fp)

# get next iteration for t and declare lists
t_1 = t_0 - f(t_0)/fp(t_0)
tl = [t_0, t_1]
fl = []
dtl = []

# newtons method
n = 0
while (abs(tl[n+1]-tl[n])/abs(tl[n])) > tol:
    t_np1 = tl[n+1] - f(tl[n+1])/fp(tl[n+1])
    tl.append(t_np1)
    n += 1

# define fl and dtl
for j in range(len(tl)):
    fl.append(f(tl[j]))
for k in range(len(tl)-1):
    dtl.append(tl[k+1]-tl[k])

data_fl = open("fl.txt", "a")
data_tl = open("tl.txt", "a")
for i in range(len(tl)):
    data_tl.write(str(tl[i]) + "\n")
    data_fl.write(str(fl[i]) + "\n")
data_tl.close()
data_fl.close()

i = 0

```

```
data_dtl = open("dtl.txt", "a")
for i in range(len(dtl)):
    data_dtl.write(str(dtl[i]) + "\n")
data_dtl.close()

print("t = " + str(t_np1))
print("total iterations = " + str(n))
print("final delta t = " + str(dtl[n-1]))

# keeps python console up; for non-IDE use
i = 1
while i == 1:
    i = input("Press enter to continue.\n")
```

```

% 2/11/2020
% Matthew Pahayo
% hw 1
% % q3 plot
% file Name: plt.m

clc
clear all
close all

f_m = importdata("f1m.txt");
f = importdata("f1.txt");

g_m = abs(f_m/f_m(1));
g = abs(f/f(1));

a = 0:length(g)-1;
a_m = 0:length(g_m)-1;

semilogy(a,g,'.',a_m,g_m,'o')
title('semi-log plot of f(x) normalized')
xlabel('iteration')
ylabel('f(x)/f(x_0)')
grid on
legend('Newton', 'modified')

```

```

# Matthew Pahayo
# 2/11/2021
# computational methods
# hw 1
# question 4
# fixed point
# q4.py

def g(x):
    return
(1.2-.99403)/(1.671*10**-4+9.7215*10**-8*x-9.5838*10**-11*x**2+1.952*10**-14*x**3)

tol = 10**-5
T_0 = 500
T_1 = g(T_0)

Tl = [T_0,T_1]
fl = [g(T_0),g(T_1)]
eps = []

n = 0
while (abs(Tl[n+1]-Tl[n])/abs(Tl[n])) > tol and n<99:
    T_np1 = g(Tl[n+1])
    Tl.append(T_np1)
    fl.append(T_np1)
    eps.append((abs(Tl[n+1]-Tl[n])/abs(Tl[n])))
    n += 1

i=0
data_fl = open("fl.txt", "a")
data_Tl = open("cl.txt", "a")
for i in range(len(Tl)):
    data_Tl.write(str(Tl[i]) + "\n")
for g in range(len(fl)):
    data_fl.write(str(fl[g]) + "\n")
data_Tl.close()
data_fl.close()

i = 0
data_eps = open("eps.txt", "a")
for i in range(len(eps)):
    data_eps.write(str(eps[i]) + "\n")
data_eps.close()

# keeps python console up; for non-IDE use
i = 1
while i == 1:
    i = input("Press enter to continue.\n")

```