



**The University of Jordan**

**School of Engineering**

**Department of Mechatronics Engineering**

**Engineering Numerical Methods**

**Project**

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**Group 13**

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## Required Tasks:

Task Number	Task Description	Task Conditions	Task Details
3	Determination of the point of diminishing returns for functions using a number of significant figures	$F(x) = e^x, x = \pi$	
		$F(x) = e^x, x = e^1$	
		$F(x) = e^x, x = \ln 2$	
		$F(x) = e^x, x = \log 2$	
		$F(x) = \sin x, x = \pi$	
		$F(x) = \sin x, x = 2\pi$	
		$F(x) = \sin x, x = \pi/2$	
		$F(x) = \sin x, x = 3\pi/2$	

13	Regression	One Dimensional Quadratic Regression	<ol style="list-style-type: none"> <li>1. Generate your own Set of data points <math>(x, f(x))</math> that satisfy and fit the task description and conditions such that <math>(r^2)</math> is greater than 90%</li> <li>2. The number of data points should at least be 10 data points.</li> <li>3. Find the set of normal equations <math>xa = y</math>.</li> <li>4. Find the model coefficients.</li> <li>5. Find the values of <math>S_d</math> and <math>S_{y/x}</math>.</li> <li>6. Find the values of <math>S_t</math> and <math>S_r</math>.</li> <li>7. Find the coefficient of determination <math>(r^2)</math>.</li> </ol>
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			<p><b>8. Draw a figure that shows the data points and the regression curve.</b></p>
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14	Interpolation	Fourth Order Newton's Polynomial	<ol style="list-style-type: none"> <li>1. Generate your own Set of data points (x,f(x)) that satisfy and fit the task description and conditions.</li> <li>2. In case of newton's polynomial, find all finite divided differences.</li> <li>3. Write the polynomial in the finalized polynomial format  <math display="block">f(x) = a_0 + a_1x + \dots + a_nx^n.</math> </li> <li>4. Draw a figure that shows the data points and interpolation polynomial</li> </ol>
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### **Abstract:**

In this project we will talk about Maclaurin series expansion, and we will use numerical methods and computer to approximate value for given functions.



## **Introduction:**

Numerical analysis is a branch of Mathematics that deals with devising efficient methods for obtaining numerical solutions to difficult Mathematical problems.

Most of the Mathematical problems that arise in science and engineering are very hard and sometime impossible to solve exactly. Thus, an approximation to a difficult Mathematical problem is very important to make it easier to solve.

Computers are widely used in approximating value of functions because it makes it easier. Even though computers help us, but we need to learn and understand numerical methods because 1- it will help us develop new methods. 2- Sometimes we have more than one method to solve, so understanding them will help us choose the best method.

## **1. Chapter 1: Introduction to Numerical analysis:**

### **1.1 Section 10: Taylor and Maclaurin Series Expansion:**

#### **1.1.1 Task 1:**

- Problem Statement:

$$e^x = 1 + x + \frac{x^2}{2} + \frac{x^3}{6} + \frac{x^4}{24} + \dots \quad 1-1$$

At  $x = \pi, e, \ln(2), \log_{10}(2)$ .

- Requirements:

- A.** Calculate the exact root for the given value of  $x$ .
- B.** Find the approximate value of  $x$  using 3,6,9, and 12 significant figures using the chopping.
- C.** Calculate the Maclaurin series expansion for the approximate values of  $x$ .
- D.** Keep adding terms until point of diminishing returns then add 100 terms.
- E.** Draw a graph with the total numerical error on the vertical axis and  $\log(n)$  on horizontal axis.
- F.** Draw the number of used terms at point of diminishing returns and number of terms used.

- Solution:

$X = \pi = 3.141592653589793$ .

True Value Answer  $= e^{\pi} = 23.140692632779267$ .

# of significant Figures	Method	$x$ approximate( $X_a$ )
3	Chopping	3.14
6	Chopping	3.14159
9	Chopping	3.14159265
12	Chopping	3.14159265358

Table 1

The value of Maclaurin series for  $x = 3.14$

Number of Terms	Approximated Answer Based on Terms	Absolute True Error (Et)	Relative True Error (et)%	Status
1	1.0000000000000000	22.1406926327793000	95.6786081736228000	---
2	4.1400000000000000	19.0006926327793000	82.1094378387983000	Decreasing
3	9.0698000000000000	14.0708926327793000	60.8058404131238000	Decreasing
4	14.2296573333333000	8.9110352994459300	38.5080751075846000	Decreasing
5	18.2801453400000000	4.8605472927792600	21.0043293427363000	Decreasing
6	20.8238518081867000	2.3168408245926000	10.0119770024115000	Decreasing
7	22.1550581932044000	0.9856344395749050	4.2593126109748900	Decreasing
8	22.7521993430552000	0.3884932897241140	1.6788317268161800	Decreasing
9	22.9865772443716000	0.1541153884076780	0.6659929797838930	Decreasing
10	23.0683490899420000	0.0723435428372774	0.3126247947081810	Decreasing
11	23.0940254494511000	0.0466671833281715	0.2016671845944080	Decreasing
12	23.1013548829837000	0.0393377497955711	0.1699938304346530	Decreasing
13	23.1032727514247000	0.0374198813545412	0.1617059694295200	Decreasing
14	23.1037359904174000	0.0369566423618615	0.1597041322328940	Decreasing
15	23.1038398883058000	0.0368527444735030	0.1592551487473640	Decreasing
16	23.1038616375971000	0.0368309951822070	0.1591611615377280	Decreasing
17	23.1038659058955000	0.0368267268837918	0.1591427165478450	Decreasing
18	23.1038666942753000	0.0368259385039664	0.1591393096497110	Decreasing
19	23.1038668318038000	0.0368258009754854	0.1591387153352570	Decreasing
20	23.1038668545322000	0.0368257782470955	0.1591386171169790	Decreasing
21	23.1038668581005000	0.0368257746787393	0.1591386016967130	Decreasing
22	23.1038668586341000	0.0368257741451856	0.1591385993910190	Decreasing
23	23.1038668587102000	0.0368257740690332	0.1591385990619340	Decreasing

24	23.1038668587206000	0.0368257740586380	0.1591385990170130	Decreasing
25	23.1038668587220000	0.0368257740572773	0.1591385990111320	Decreasing
26	23.1038668587222000	0.0368257740571067	0.1591385990103960	Decreasing
27	23.1038668587222000	0.0368257740570854	0.1591385990103030	Decreasing
<b>28</b>	<b>23.1038668587222000</b>	<b>0.0368257740570819</b>	<b>0.1591385990102880</b>	<b>Decreasing</b>
29	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
30	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
31	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
32	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
33	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
34	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
35	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
36	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
37	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
38	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
39	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
40	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
41	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
42	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
43	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
44	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
45	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
46	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
47	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
48	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
49	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same

50	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
51	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
52	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
53	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
54	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
55	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
56	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
57	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
58	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
59	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
60	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
61	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
62	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
63	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
64	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
65	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
66	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
67	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
68	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
69	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
70	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
71	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
72	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
73	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
74	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
75	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same

76	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
77	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
78	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
79	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
80	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
81	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
82	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
83	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
84	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
85	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
86	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
87	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
88	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
89	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
90	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
91	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
92	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
93	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
94	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
95	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
96	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
97	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
98	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
99	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
100	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
101	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same

102	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
103	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
104	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
105	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
106	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
107	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
108	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
109	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
110	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
111	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
112	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
113	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
114	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
115	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
116	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
117	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
118	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
119	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
120	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
121	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
122	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
123	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
124	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
125	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
126	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
127	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same

128	23.1038668587222000	0.0368257740570819	0.1591385990102880	Same
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Table 2 Approximations and Errors

The Bolded line in the table is the **point of diminishing returns**.

The value of Maclaurin series for  $x = 3.14159$

Number of Terms	Approximated Answer Based on Terms	Absolute True Error (Et)	Relative True Error (et)%	Status
1	1.0000000000000000	22.1406926327793000	95.678608173622919	---
2	4.1415900000000000	18.9991026327793000	82.1025668257943000	Decreasing
3	9.0763838640500000	14.0643087687293000	60.7773889568322000	Decreasing
4	14.2440835491703000	8.8966090836089900	38.4457337763813000	Decreasing
5	18.3027819626145000	4.8379106701647400	20.9065076267931000	Decreasing
6	20.8529352323530000	2.2877574004262700	9.8862961309360900	Decreasing
7	22.1881912341326000	0.9525013986466570	4.1161317587245400	Decreasing
8	22.7874522202227000	0.3532404125565410	1.5264902315679600	Decreasing
9	23.0227812603841000	0.1179113723951840	0.5095412409054710	Decreasing
10	23.1049265225264000	0.0357661102529043	0.1545593765082070	Decreasing
11	23.1307331959357000	0.0099594368435483	0.0430386289710297	Decreasing
12	23.1381035584008000	0.0025890743784487	0.0111884048569108	Decreasing
13	23.1400331131522000	0.0006595196270531	0.0028500427256828	Decreasing
14	23.1404994108377000	0.0001932219415579	0.0008349877189251	Decreasing
15	23.1406040477053000	0.0000885850740033	0.0003828108147370	Decreasing
16	23.1406259627810000	0.0000666699982190	0.0002881071853683	Decreasing
17	23.1406302657925000	0.0000623669867856	0.0002695121869312	Decreasing
18	23.1406310609865000	0.0000615717928056	0.0002660758421657	Decreasing



19	23.1406311997739000	0.0000614330053921	0.0002654760873711	Decreasing
20	23.1406312227219000	0.0000614100573308	0.0002653769198069	Decreasing
21	23.1406312263266000	0.0000614064526623	0.0002653613426216	Decreasing
22	23.1406312268659000	0.0000614059134065	0.0002653590122862	Decreasing
23	23.1406312269429000	0.0000614058364015	0.0002653586795171	Decreasing
24	23.1406312269534000	0.0000614058258819	0.0002653586340579	Decreasing
25	23.1406312269548000	0.0000614058245034	0.0002653586281011	Decreasing
26	23.1406312269549000	0.0000614058243293	0.0002653586273488	Decreasing
27	23.1406312269550000	0.0000614058243080	0.0002653586272567	Decreasing
<b>28</b>	<b>23.1406312269550000</b>	<b>0.0000614058243045</b>	<b>0.0002653586272413</b>	<b>Decreasing</b>
29	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
30	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
31	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
32	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
33	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
34	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
35	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
36	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
37	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
38	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
39	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
40	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
41	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
42	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
43	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
44	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same

45	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
46	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
47	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
48	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
49	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
50	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
51	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
52	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
53	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
54	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
55	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
56	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
57	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
58	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
59	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
60	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
61	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
62	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
63	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
64	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
65	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
66	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
67	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
68	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
69	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
70	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same

71	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
72	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
73	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
74	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
75	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
76	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
77	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
78	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
79	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
80	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
81	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
82	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
83	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
84	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
85	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
86	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
87	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
88	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
89	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
90	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
91	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
92	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
93	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
94	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
95	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
96	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same

97	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
98	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
99	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
100	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
101	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
102	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
103	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
104	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
105	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
106	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
107	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
108	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
109	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
110	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
111	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
112	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
113	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
114	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
115	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
116	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
117	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
118	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
119	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
120	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
121	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
122	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same

123	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
124	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
125	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
126	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
127	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same
128	23.1406312269550000	0.0000614058243045	0.0002653586272413	Same

*Table 3 Approximations and Errors*

The Bolded line in the table is the **point of diminishing returns**.

The value of Maclaurin series for  $x = 3.14159265$

Number of Terms	Approximated Answer Based on Terms	Absolute True Error (Et)	Relative True Error (et)%	Status
1	1.0000000000000000	22.1406926327793000	95.678608173622919	---
2	4.1415926500000000	18.9990999827793000	82.1025553741060000	Decreasing
3	9.0763948392670100	14.0642977935123000	60.7773415286191000	Decreasing
4	14.2441076016021000	8.8965850311772000	38.4456298363991000	Decreasing
5	18.3028197094678000	4.8378729233114500	20.9063445078498000	Decreasing
6	20.8529837347752000	2.2877088980040400	9.8860865329651300	Decreasing
7	22.1882464944753000	0.9524461383040150	4.1158929571315200	Decreasing
8	22.7875110190027000	0.3531816137765420	1.5262361390006700	Decreasing
9	23.0228416472104000	0.1178509855688860	0.5092802857678840	Decreasing
10	23.1049875329767000	0.0357050998025450	0.1542957264467010	Decreasing
11	23.1307944240718000	0.0098982087074191	0.0427740382040167	Decreasing
12	23.1381648549249000	0.0025277778543469	0.0109235185586720	Decreasing
13	23.1400944292079000	0.0005982035713998	0.0025850720239569	Decreasing

14	23.1405607320067000	0.0001319007725584	0.0005699949204268	Decreasing
15	23.1406653701100000	0.0000272626693061	0.0001178126763045	Decreasing
16	23.1406872854630000	0.0000053473162325	0.0000231078486601	Decreasing
17	23.1406915885325000	0.0000010442467229	0.0000045125992529	Decreasing
18	23.1406923837379000	0.0000002490413387	0.0000010762052053	Decreasing
19	23.1406925225274000	0.0000001102518183	0.0000004764413066	Decreasing
20	23.1406925454759000	0.0000000873033912	0.0000003772721611	Decreasing
21	23.1406925490806000	0.0000000836986622	0.0000003616947148	Decreasing
22	23.1406925496199000	0.0000000831593958	0.0000003593643334	Decreasing
23	23.1406925496969000	0.0000000830823872	0.0000003590315489	Decreasing
24	23.1406925497074000	0.0000000830718676	0.0000003589860897	Decreasing
25	23.1406925497088000	0.0000000830704892	0.0000003589801328	Decreasing
26	23.1406925497090000	0.0000000830703151	0.0000003589793806	Decreasing
27	23.1406925497090000	0.0000000830702938	0.0000003589792884	Decreasing
<b>28</b>	<b>23.1406925497090000</b>	<b>0.0000000830702902</b>	<b>0.0000003589792731</b>	<b>Decreasing</b>
29	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
30	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
31	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
32	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
33	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
34	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
35	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
36	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
37	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
38	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
39	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same

40	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
41	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
42	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
43	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
44	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
45	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
46	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
47	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
48	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
49	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
50	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
51	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
52	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
53	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
54	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
55	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
56	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
57	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
58	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
59	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
60	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
61	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
62	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
63	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
64	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
65	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same

66	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
67	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
68	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
69	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
70	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
71	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
72	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
73	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
74	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
75	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
76	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
77	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
78	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
79	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
80	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
81	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
82	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
83	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
84	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
85	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
86	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
87	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
88	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
89	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
90	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
91	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same



92	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
93	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
94	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
95	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
96	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
97	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
98	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
99	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
100	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
101	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
102	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
103	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
104	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
105	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
106	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
107	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
108	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
109	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
110	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
111	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
112	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
113	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
114	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
115	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
116	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
117	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same

118	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
119	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
120	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
121	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
122	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
123	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
124	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
125	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
126	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
127	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same
128	23.1406925497090000	0.0000000830702902	0.0000003589792731	Same

*Table 4 Approximations and Errors*

The Bolded line in the table is the **point of diminishing returns**.

The value of Maclaurin series for  $x = 3.14159265358$ .

Number of Terms	Approximated Answer Based on Terms	Absolute True Error (Et)	Relative True Error (et)%	Status
1	1.0000000000000000	22.1406926327793000	95.678608173622919	---
2	4.1415926535800000	18.9990999791993000	82.1025553586354000	Decreasing
3	9.0763948540939100	14.0642977786854000	60.7773414645463000	Decreasing
4	14.2441076340956000	8.8965849986837100	38.4456296959820000	Decreasing
5	18.3028197604617000	4.8378728723175500	20.9063442874852000	Decreasing
6	20.8529838002993000	2.2877088324799500	9.8860862498098600	Decreasing
7	22.1882465691289000	0.9524460636503380	4.1158926345237400	Decreasing
8	22.7875110984366000	0.3531815343426250	1.5262357957355900	Decreasing

9	23.0228417287897000	0.1178509039895990	0.5092799332318180	Decreasing
10	23.1049876153985000	0.0357050173807743	0.1542953702699350	Decreasing
11	23.1307945067877000	0.0098981259915654	0.0427736807564025	Decreasing
12	23.1381649377332000	0.0025276950461048	0.0109231607118117	Decreasing
13	23.1400945120425000	0.0005981207367718	0.0025847140630723	Decreasing
14	23.1405608148482000	0.0001318179310239	0.0005696369296967	Decreasing
15	23.1406654529532000	0.0000271798261053	0.0001174546783740	Decreasing
16	23.1406873683066000	0.0000052644726587	0.0000227498491175	Decreasing
17	23.1406916713762000	0.0000009614030709	0.0000041545993726	Decreasing
18	23.1406924665816000	0.0000001661976725	0.0000007182052636	Decreasing
19	23.1406926053711000	0.0000000274081486	0.0000001184413495	Decreasing
20	23.1406926283195000	0.0000000044597179	0.0000000192721886	Decreasing
21	23.1406926319243000	0.0000000008549854	0.0000000036947270	Decreasing
22	23.1406926324635000	0.0000000003157190	0.0000000013643455	Decreasing
23	23.1406926325406000	0.0000000002387104	0.0000000010315611	Decreasing
24	23.1406926325511000	0.0000000002281908	0.0000000009861019	Decreasing
25	23.1406926325525000	0.0000000002268123	0.0000000009801450	Decreasing
26	23.1406926325526000	0.0000000002266383	0.0000000009793927	Decreasing
27	23.1406926325526000	0.0000000002266169	0.0000000009793006	Decreasing
<b>28</b>	<b>23.1406926325527000</b>	<b>0.0000000002266134</b>	<b>0.0000000009792853</b>	<b>Decreasing</b>
29	23.1406926325527000	0.0000000002266134	0.0000000009792853	Same
30	23.1406926325527000	0.0000000002266134	0.0000000009792853	Same
31	23.1406926325527000	0.0000000002266134	0.0000000009792853	Same
32	23.1406926325527000	0.0000000002266134	0.0000000009792853	Same
33	23.1406926325527000	0.0000000002266134	0.0000000009792853	Same
34	23.1406926325527000	0.0000000002266134	0.0000000009792853	Same

[illegible]

[illegible]

87	23.1406926325527000	0.0000000002266134	0.0000000009792853	Same
88	23.1406926325527000	0.0000000002266134	0.0000000009792853	Same
89	23.1406926325527000	0.0000000002266134	0.0000000009792853	Same
90	23.1406926325527000	0.0000000002266134	0.0000000009792853	Same
91	23.1406926325527000	0.0000000002266134	0.0000000009792853	Same
92	23.1406926325527000	0.0000000002266134	0.0000000009792853	Same
93	23.1406926325527000	0.0000000002266134	0.0000000009792853	Same
94	23.1406926325527000	0.0000000002266134	0.0000000009792853	Same
95	23.1406926325527000	0.0000000002266134	0.0000000009792853	Same
96	23.1406926325527000	0.0000000002266134	0.0000000009792853	Same
97	23.1406926325527000	0.0000000002266134	0.0000000009792853	Same
98	23.1406926325527000	0.0000000002266134	0.0000000009792853	Same
99	23.1406926325527000	0.0000000002266134	0.0000000009792853	Same
100	23.1406926325527000	0.0000000002266134	0.0000000009792853	Same
101	23.1406926325527000	0.0000000002266134	0.0000000009792853	Same
102	23.1406926325527000	0.0000000002266134	0.0000000009792853	Same
103	23.1406926325527000	0.0000000002266134	0.0000000009792853	Same
104	23.1406926325527000	0.0000000002266134	0.0000000009792853	Same
105	23.1406926325527000	0.0000000002266134	0.0000000009792853	Same
106	23.1406926325527000	0.0000000002266134	0.0000000009792853	Same
107	23.1406926325527000	0.0000000002266134	0.0000000009792853	Same
108	23.1406926325527000	0.0000000002266134	0.0000000009792853	Same
109	23.1406926325527000	0.0000000002266134	0.0000000009792853	Same
110	23.1406926325527000	0.0000000002266134	0.0000000009792853	Same
111	23.1406926325527000	0.0000000002266134	0.0000000009792853	Same
112	23.1406926325527000	0.0000000002266134	0.0000000009792853	Same

113	23.1406926325527000	0.0000000002266134	0.0000000009792853	Same
114	23.1406926325527000	0.0000000002266134	0.0000000009792853	Same
115	23.1406926325527000	0.0000000002266134	0.0000000009792853	Same
116	23.1406926325527000	0.0000000002266134	0.0000000009792853	Same
117	23.1406926325527000	0.0000000002266134	0.0000000009792853	Same
118	23.1406926325527000	0.0000000002266134	0.0000000009792853	Same
119	23.1406926325527000	0.0000000002266134	0.0000000009792853	Same
120	23.1406926325527000	0.0000000002266134	0.0000000009792853	Same
121	23.1406926325527000	0.0000000002266134	0.0000000009792853	Same
122	23.1406926325527000	0.0000000002266134	0.0000000009792853	Same
123	23.1406926325527000	0.0000000002266134	0.0000000009792853	Same
124	23.1406926325527000	0.0000000002266134	0.0000000009792853	Same
125	23.1406926325527000	0.0000000002266134	0.0000000009792853	Same
126	23.1406926325527000	0.0000000002266134	0.0000000009792853	Same
127	23.1406926325527000	0.0000000002266134	0.0000000009792853	Same
128	23.1406926325527000	0.0000000002266134	0.0000000009792853	Same

*Table 5 Approximations and Errors*

The Bolded line in the table is the **point of diminishing returns**.

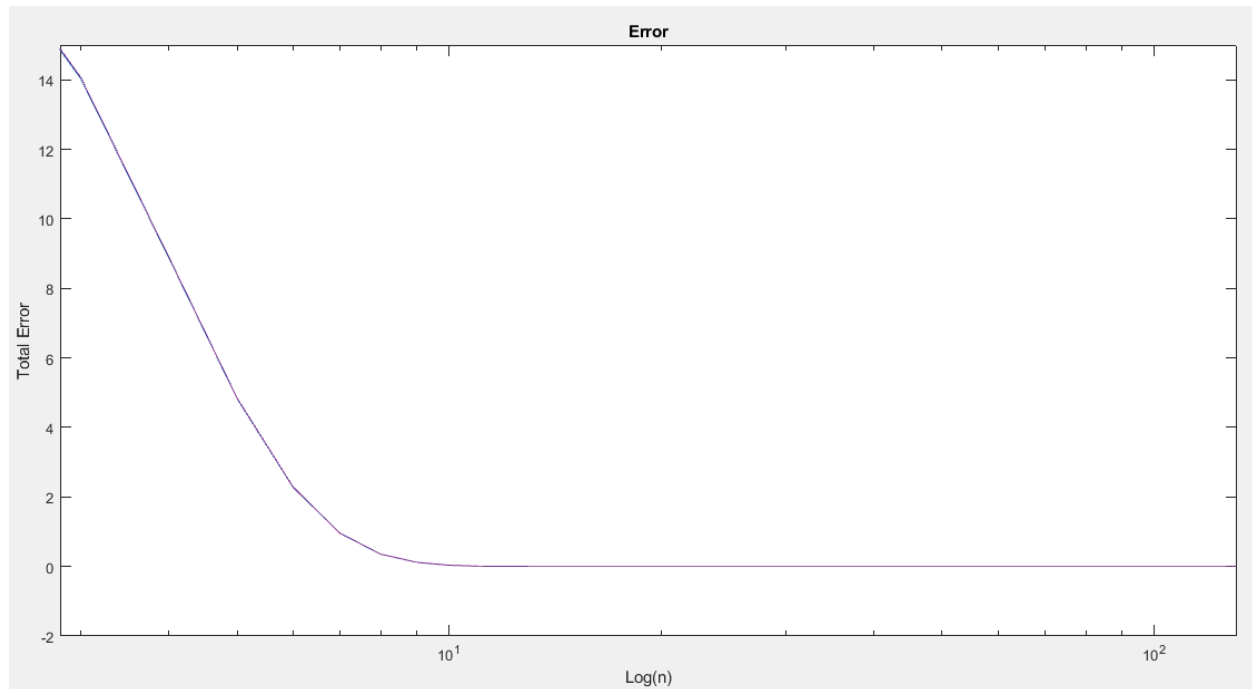


Figure 1 Total Error vs Log(n)

The Figure below shows the total error vs logarithm of number of terms for all approximations of pi.

### 1.1.2 Task 2:

- Problem Statement:

$$e^x = 1 + x + \frac{x^2}{2} + \frac{x^3}{6} + \frac{x^4}{24} + \dots \quad 1-1$$

At  $x = e^1$ .

- Solution:

$$X = e^1 = 2.718281828459046.$$

$$\text{True Value Answer} = e^{(e^1)} = 15.154262241479270.$$

# of significant Figures	Method	x approximate(Xa)
3	Chopping	2.71
6	Chopping	2.71828
9	Chopping	2.71828182



Table 6

The value of Maclaurin series for  $x = 2.71$

Number of Terms	Approximated Answer Based on Terms	Absolute True Error (Et)	Relative True Error (et)%	Status
1	1.0000000000000000	14.1542622414793000	93.4011964154687000	---
2	3.7100000000000000	11.4442622414793000	75.5184387013891000	Decreasing
3	7.3820500000000000	7.7722122414792800	51.2873019988111000	Decreasing
4	10.6991351666667000	4.4551270748126100	29.3985085108157000	Decreasing
5	12.9464603670833000	2.2078018743959400	14.5688509226988000	Decreasing
6	14.1645106257092000	0.9897516157701090	6.5311765099393900	Decreasing
7	14.7146633258552000	0.4395989156241080	2.9008269001764200	Decreasing
8	14.9276510140545000	0.2266112274247280	1.4953629798253200	Decreasing
9	14.9998005934321000	0.1544616480471890	1.0192620768063900	Decreasing
10	15.0215256334447000	0.1327366080346180	0.8759028048973550	Decreasing
11	15.0274131192881000	0.1268491221912120	0.8370524422100110	Decreasing
12	15.0288635817095000	0.1253986597697910	0.8274811255843140	Decreasing
13	15.0291911444730000	0.1250710970062880	0.8253196032463460	Decreasing
14	15.0292594287106000	0.1250028127686650	0.8248690089743560	Decreasing
15	15.0292726465880000	0.1249895948912400	0.8247817867974210	Decreasing
16	15.0292750346179000	0.1249872068613840	0.8247660286574490	Decreasing
17	15.0292754390904000	0.1249868023888270	0.8247633596224920	Decreasing
18	15.0292755035681000	0.1249867379111440	0.8247629341469220	Decreasing
19	15.0292755132756000	0.1249867282036700	0.8247628700892080	Decreasing
20	15.0292755146602000	0.1249867268190780	0.8247628609525570	Decreasing

21	15.0292755148478000	0.1249867266314660	0.8247628597145450	Decreasing
22	15.0292755148720000	0.1249867266072540	0.8247628595547760	Decreasing
23	15.0292755148750000	0.1249867266042720	0.8247628595350950	Decreasing
24	15.0292755148754000	0.1249867266039200	0.8247628595327740	Decreasing
25	15.0292755148754000	0.1249867266038810	0.8247628595325160	Decreasing
<b>26</b>	<b>15.0292755148754000</b>	<b>0.1249867266038770</b>	<b>0.8247628595324930</b>	<b>Decreasing</b>
27	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
28	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
29	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
30	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
31	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
32	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
33	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
34	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
35	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
36	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
37	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
38	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
39	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
40	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
41	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
42	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
43	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
44	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
45	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
46	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same

47	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
48	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
49	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
50	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
51	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
52	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
53	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
54	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
55	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
56	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
57	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
58	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
59	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
60	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
61	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
62	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
63	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
64	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
65	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
66	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
67	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
68	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
69	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
70	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
71	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
72	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same

73	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
74	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
75	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
76	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
77	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
78	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
79	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
80	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
81	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
82	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
83	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
84	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
85	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
86	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
87	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
88	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
89	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
90	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
91	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
92	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
93	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
94	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
95	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
96	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
97	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
98	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same

99	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
100	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
101	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
102	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
103	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
104	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
105	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
106	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
107	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
108	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
109	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
110	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
111	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
112	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
113	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
114	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
115	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
116	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
117	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
118	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
119	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
120	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
121	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
122	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
123	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
124	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same

125	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same
126	15.0292755148754000	0.1249867266038770	0.8247628595324930	Same

*Table 7 Approximations and Errors*

The Bolded line in the table is the **point of diminishing returns**.

The value of Maclaurin series for  $x = 2.71828$ .

Number of Terms	Approximated Answer Based on Terms	Absolute True Error (Et)	Relative True Error (et)%	Status
1	1.0000000000000000	14.1542622414793000	93.4011964154689450	---
2	3.7182800000000000	11.4359822414793000	75.4638006077091000	Decreasing
3	7.4128030792000000	7.7414591622792800	51.0843684695508000	Decreasing
4	10.7603858111093000	4.3938764303700200	28.9943275387130000	Decreasing
5	13.0353026082328000	2.1189596332464400	13.9825984233436000	Decreasing
6	14.2720747744898000	0.8821874669894270	5.8213818193983700	Decreasing
7	14.8323902818387000	0.3218719596405750	2.1239698410363200	Decreasing
8	15.0499752014553000	0.1042870400239690	0.6881696935303220	Decreasing
9	15.1239072933672000	0.0303549481120413	0.2003063404099980	Decreasing
10	15.1462370852342000	0.0080251562451128	0.0529564297966737	Decreasing
11	15.1523069478978000	0.0019552935815099	0.0129025982944786	Decreasing
12	15.1538069102870000	0.0004553311923079	0.0030046411039502	Decreasing
13	15.1541466867672000	0.0001155547120320	0.0007625228479659	Decreasing
14	15.1542177335065000	0.0000445079727385	0.0002936993700469	Decreasing
15	15.1542315281444000	0.0000307133348461	0.0002026712640751	Decreasing
16	15.1542340279903000	0.0000282134889602	0.0001861752720827	Decreasing
17	15.1542344526954000	0.0000277887838926	0.0001833727267606	Decreasing

18	15.1542345206052000	0.0000277208740513	0.0001829246030563	Decreasing
19	15.1542345308607000	0.0000277106186086	0.0001828569294042	Decreasing
20	15.1542345323279000	0.0000277091513894	0.0001828472475126	Decreasing
21	15.1542345325273000	0.0000277089519738	0.0001828459316083	Decreasing
22	15.1542345325531000	0.0000277089261616	0.0001828457612784	Decreasing
23	15.1542345325563000	0.0000277089229730	0.0001828457402377	Decreasing
24	15.1542345325567000	0.0000277089225964	0.0001828457377526	Decreasing
25	15.1542345325567000	0.0000277089225538	0.0001828457374713	Decreasing
<b>26</b>	<b>15.1542345325567000</b>	<b>0.0000277089225484</b>	<b>0.0001828457374362</b>	<b>Decreasing</b>
27	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
28	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
29	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
30	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
31	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
32	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
33	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
34	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
35	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
36	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
37	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
38	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
39	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
40	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
41	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
42	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
43	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same

44	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
45	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
46	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
47	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
48	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
49	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
50	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
51	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
52	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
53	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
54	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
55	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
56	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
57	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
58	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
59	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
60	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
61	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
62	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
63	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
64	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
65	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
66	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
67	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
68	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
69	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same



70	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
71	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
72	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
73	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
74	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
75	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
76	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
77	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
78	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
79	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
80	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
81	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
82	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
83	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
84	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
85	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
86	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
87	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
88	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
89	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
90	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
91	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
92	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
93	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
94	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
95	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same

96	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
97	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
98	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
99	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
100	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
101	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
102	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
103	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
104	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
105	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
106	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
107	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
108	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
109	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
110	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
111	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
112	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
113	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
114	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
115	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
116	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
117	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
118	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
119	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
120	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
121	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same

122	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
123	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
124	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
125	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same
126	15.1542345325567000	0.0000277089225484	0.0001828457374362	Same

*Table 8 Approximations and Errors*

The Bolded line in the table is the **point of diminishing returns.**

The value of Maclaurin series for  $x = 2.71828182$ .

Number of Terms	Approximated Answer Based on Terms	Absolute True Error (Et)	Relative True Error (et)%	Status
1	1.0000000000000000	14.1542622414793000	93.4011964154689450	---
2	3.7182818200000000	11.4359804214793000	75.4637885978866000	Decreasing
3	7.4128098464712600	7.7414523950080200	51.0843238136569000	Decreasing
4	10.7603993024170000	4.3938629390622500	28.9942385122230000	Decreasing
5	13.0353221921473000	2.1189400493319900	13.9824691929387000	Decreasing
6	14.2720984987584000	0.8821637427208560	5.8212252676098900	Decreasing
7	14.8324162570364000	0.3218459844428930	2.1237984358087500	Decreasing
8	15.0500021964293000	0.1042600450500150	0.6879915589994300	Decreasing
9	15.1239346843467000	0.0303275571326047	0.2001255927167080	Decreasing
10	15.1462646107704000	0.0079976307089087	0.0527747941897038	Decreasing
11	15.1523345140743000	0.0019277274049614	0.0127206945098583	Decreasing
12	15.1538344875107000	0.0004277539685731	0.0028226644211176	Decreasing
13	15.1541742667209000	0.0000879747583546	0.0005805281507789	Decreasing
14	15.1542453140786000	0.0000169274006669	0.0001117005921978	Decreasing

15	15.1542591088458000	0.0000031326334700	0.0000206716329706	Decreasing
16	15.1542616087168000	0.0000006327624771	0.0000041754753019	Decreasing
17	15.1542620334264000	0.0000002080528603	0.0000013728999601	Decreasing
18	15.1542621013370000	0.0000001401422463	0.0000009247711569	Decreasing
19	15.1542621115926000	0.0000001298866810	0.0000008570966959	Decreasing
20	15.1542621130598000	0.0000001284194440	0.0000008474146872	Decreasing
21	15.1542621132593000	0.0000001282200248	0.0000008460987594	Decreasing
22	15.1542621132851000	0.0000001281942126	0.0000008459284295	Decreasing
23	15.1542621132883000	0.0000001281910240	0.0000008459073888	Decreasing
24	15.1542621132886000	0.0000001281906474	0.0000008459049038	Decreasing
25	15.1542621132887000	0.0000001281906048	0.0000008459046224	Decreasing
<b>26</b>	<b>15.1542621132887000</b>	<b>0.0000001281905995</b>	<b>0.0000008459045873</b>	<b>Decreasing</b>
27	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
28	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
29	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
30	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
31	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
32	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
33	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
34	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
35	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
36	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
37	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
38	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
39	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
40	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same

41	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
42	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
43	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
44	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
45	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
46	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
47	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
48	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
49	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
50	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
51	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
52	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
53	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
54	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
55	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
56	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
57	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
58	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
59	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
60	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
61	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
62	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
63	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
64	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
65	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
66	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same

67	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
68	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
69	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
70	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
71	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
72	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
73	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
74	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
75	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
76	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
77	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
78	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
79	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
80	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
81	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
82	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
83	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
84	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
85	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
86	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
87	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
88	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
89	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
90	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
91	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
92	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same

93	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
94	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
95	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
96	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
97	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
98	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
99	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
100	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
101	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
102	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
103	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
104	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
105	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
106	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
107	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
108	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
109	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
110	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
111	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
112	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
113	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
114	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
115	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
116	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
117	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
118	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same

119	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
120	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
121	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
122	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
123	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
124	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
125	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same
126	15.1542621132887000	0.0000001281905995	0.0000008459045873	Same

*Table 9 Approximations and Errors*

The Bolded line in the table is the **point of diminishing returns.**

The value of Maclaurin series for  $x = 2.71828182845$ .

Number of Terms	Approximated Answer Based on Terms	Absolute True Error (Et)	Relative True Error (et)%	Status
1	1.0000000000000000	14.1542622414793000	0	---
2	3.7182818284500000	11.4359804130293000	75.4637885421267000	Decreasing
3	7.4128098778907400	7.7414523635885400	51.0843236063260000	Decreasing
4	10.7603993650553000	4.3938628764240100	28.9942380988855000	Decreasing
5	13.0353222830727000	2.1189399584066200	13.9824685929401000	Decreasing
6	14.2720986089069000	0.8821636325723880	5.8212245407617800	Decreasing
7	14.8324163776356000	0.3218458638436650	2.1237976399981300	Decreasing
8	15.0500023217632000	0.1042599197161030	0.6879907319455620	Decreasing
9	15.1239348115192000	0.0303274299600922	0.2001247535302770	Decreasing
10	15.1462647385676000	0.0079975029116657	0.0527739508807986	Decreasing



11	15.1523346420602000	0.0019275994190302	0.0127198499558368	Decreasing
12	15.1538346155479000	0.0004276259313514	0.0028218195286400	Decreasing
13	15.1541743947708000	0.0000878467084586	0.0005796831746661	Decreasing
14	15.1542454421314000	0.0000167993478986	0.0001108555971308	Decreasing
15	15.1542592368992000	0.0000030045801012	0.0000198266339416	Decreasing
16	15.1542617367703000	0.0000005047089928	0.0000033304755110	Decreasing
17	15.1542621614799000	0.0000000799993547	0.0000005279000285	Decreasing
18	15.1542622293905000	0.0000000120887371	0.0000000797712019	Decreasing
19	15.1542622396461000	0.0000000018331701	0.0000000120967292	Decreasing
20	15.1542622411133000	0.0000000003659313	0.0000000024147087	Decreasing
21	15.1542622413128000	0.0000000001665121	0.0000000010987809	Decreasing
22	15.1542622413386000	0.0000000001406999	0.0000000009284510	Decreasing
23	15.1542622413418000	0.0000000001375113	0.0000000009074103	Decreasing
24	15.1542622413421000	0.0000000001371347	0.0000000009049253	Decreasing
25	15.1542622413422000	0.0000000001370921	0.0000000009046439	Decreasing
<b>26</b>	<b>15.1542622413422000</b>	<b>0.0000000001370868</b>	<b>0.0000000009046088</b>	<b>Decreasing</b>
27	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
28	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
29	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
30	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
31	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
32	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
33	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
34	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
35	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
36	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same

[illegible]

63	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
64	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
65	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
66	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
67	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
68	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
69	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
70	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
71	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
72	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
73	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
74	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
75	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
76	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
77	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
78	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
79	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
80	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
81	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
82	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
83	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
84	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
85	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
86	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
87	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
88	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same

89	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
90	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
91	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
92	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
93	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
94	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
95	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
96	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
97	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
98	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
99	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
100	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
101	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
102	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
103	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
104	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
105	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
106	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
107	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
108	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
109	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
110	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
111	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
112	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
113	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
114	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same

115	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
116	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
117	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
118	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
119	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
120	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
121	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
122	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
123	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
124	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
125	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same
126	15.1542622413422000	0.0000000001370868	0.0000000009046088	Same

Table 10 Approximations and Errors

The Bolded line in the table is the **point of diminishing returns.**

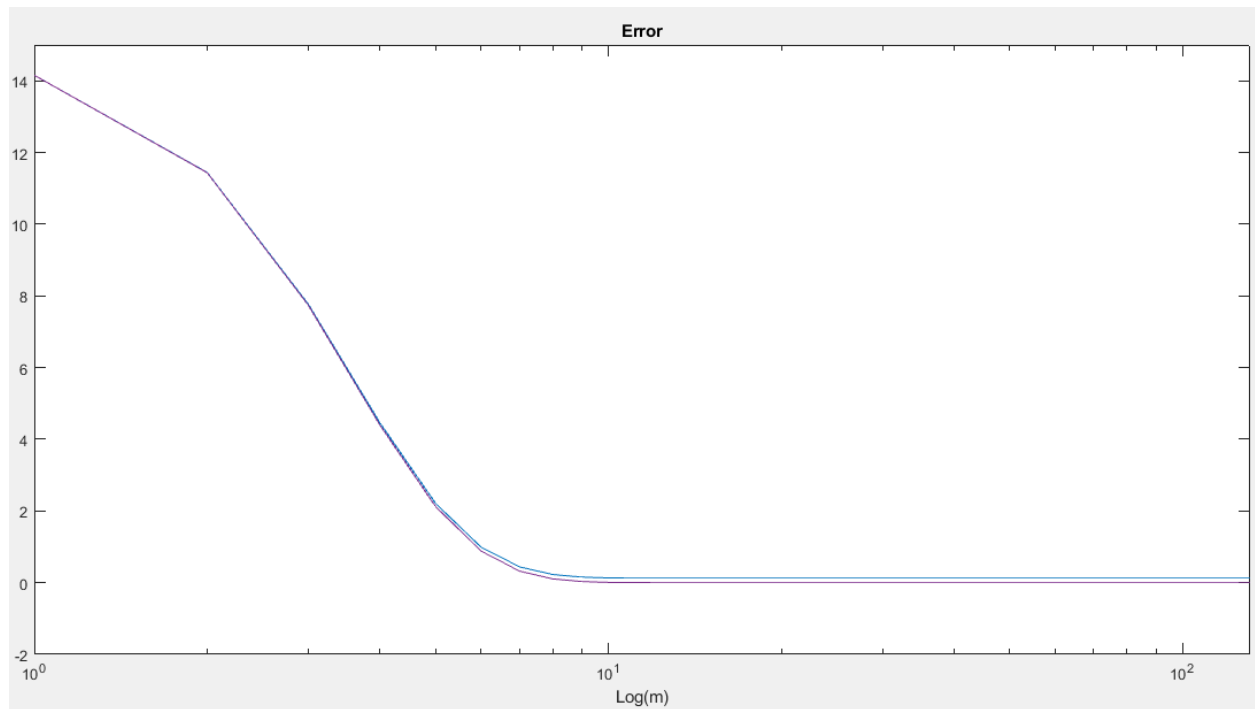


Figure 2 Total Error vs log(n)

### 1.1.3 Task 3:

- Problem Statement:

$$e^x = 1 + x + \frac{x^2}{2} + \frac{x^3}{6} + \frac{x^4}{24} + \dots \quad 1-1$$

At  $x = \ln 2$ .

- Solution:

$$X = \ln(2) = 0.693147180559945.$$

$$\text{True Value Answer} = e^{\ln(2)} = 2.$$

# of significant Figures	Method	x approximate(Xa)
3	Chopping	0.693
6	Chopping	0.693147
9	Chopping	0.693147180
12	Chopping	0.693147180559

Table 11

The value of Maclaurin series for  $X=0.693$

Number of Terms	Approximated Answer Based on Terms	Absolute True Error (Et)	Relative True Error (et)%	Status
1	1.0000000000000000	1.0000000000000000	50.0000000000000000	---
2	1.6930000000000000	0.3070000000000000	15.3500000000000000	Decreasing
3	1.9331245000000000	0.0668755000000000	3.3437750000000000	Decreasing
4	1.9885932595000000	0.0114067405000000	0.5703370250000001	Decreasing
5	1.998203222083370	0.001796777916625	0.089838895831251	Decreasing
6	1.999535162897430	0.000464837102569	0.023241855128464	Decreasing

7	1.999689002061450	0.000310997938546	0.015549896927292	Decreasing
8	1.999704232138690	0.000295767861308	0.014788393065379	Decreasing
9	1.999705551444130	0.000294448555867	0.014722427793346	Decreasing
10	1.999705653030650	0.000294346969348	0.014717348467397	Decreasing
11	1.999705660070600	0.000294339929402	0.014716996470110	Decreasing
12	1.999705660514110	0.000294339485886	0.014716974294282	Decreasing
13	1.999705660539730	0.000294339460273	0.014716973013629	Decreasing
14	1.999705660541090	0.000294339458907	0.014716972945361	Decreasing
15	1.999705660541160	0.000294339458840	0.014716972941986	Decreasing
16	1.999705660541160	0.000294339458837	0.014716972941831	Decreasing
<b>17</b>	<b>1.999705660541160</b>	<b>0.000294339458836</b>	<b>0.014716972941820</b>	<b>Decreasing</b>
18	1.999705660541160	0.000294339458836	0.014716972941820	Same
19	1.999705660541160	0.000294339458836	0.014716972941820	Same
20	1.999705660541160	0.000294339458836	0.014716972941820	Same
21	1.999705660541160	0.000294339458836	0.014716972941820	Same
22	1.999705660541160	0.000294339458836	0.014716972941820	Same
23	1.999705660541160	0.000294339458836	0.014716972941820	Same
24	1.999705660541160	0.000294339458836	0.014716972941820	Same
25	1.999705660541160	0.000294339458836	0.014716972941820	Same
26	1.999705660541160	0.000294339458836	0.014716972941820	Same
27	1.999705660541160	0.000294339458836	0.014716972941820	Same
28	1.999705660541160	0.000294339458836	0.014716972941820	Same
29	1.999705660541160	0.000294339458836	0.014716972941820	Same
30	1.999705660541160	0.000294339458836	0.014716972941820	Same
31	1.999705660541160	0.000294339458836	0.014716972941820	Same
32	1.999705660541160	0.000294339458836	0.014716972941820	Same

33	1.999705660541160	0.000294339458836	0.014716972941820	Same
34	1.999705660541160	0.000294339458836	0.014716972941820	Same
35	1.999705660541160	0.000294339458836	0.014716972941820	Same
36	1.999705660541160	0.000294339458836	0.014716972941820	Same
37	1.999705660541160	0.000294339458836	0.014716972941820	Same
38	1.999705660541160	0.000294339458836	0.014716972941820	Same
39	1.999705660541160	0.000294339458836	0.014716972941820	Same
40	1.999705660541160	0.000294339458836	0.014716972941820	Same
41	1.999705660541160	0.000294339458836	0.014716972941820	Same
42	1.999705660541160	0.000294339458836	0.014716972941820	Same
43	1.999705660541160	0.000294339458836	0.014716972941820	Same
44	1.999705660541160	0.000294339458836	0.014716972941820	Same
45	1.999705660541160	0.000294339458836	0.014716972941820	Same
46	1.999705660541160	0.000294339458836	0.014716972941820	Same
47	1.999705660541160	0.000294339458836	0.014716972941820	Same
48	1.999705660541160	0.000294339458836	0.014716972941820	Same
49	1.999705660541160	0.000294339458836	0.014716972941820	Same
50	1.999705660541160	0.000294339458836	0.014716972941820	Same
51	1.999705660541160	0.000294339458836	0.014716972941820	Same
52	1.999705660541160	0.000294339458836	0.014716972941820	Same
53	1.999705660541160	0.000294339458836	0.014716972941820	Same
54	1.999705660541160	0.000294339458836	0.014716972941820	Same
55	1.999705660541160	0.000294339458836	0.014716972941820	Same
56	1.999705660541160	0.000294339458836	0.014716972941820	Same
57	1.999705660541160	0.000294339458836	0.014716972941820	Same
58	1.999705660541160	0.000294339458836	0.014716972941820	Same



59	1.999705660541160	0.000294339458836	0.014716972941820	Same
60	1.999705660541160	0.000294339458836	0.014716972941820	Same
61	1.999705660541160	0.000294339458836	0.014716972941820	Same
62	1.999705660541160	0.000294339458836	0.014716972941820	Same
63	1.999705660541160	0.000294339458836	0.014716972941820	Same
64	1.999705660541160	0.000294339458836	0.014716972941820	Same
65	1.999705660541160	0.000294339458836	0.014716972941820	Same
66	1.999705660541160	0.000294339458836	0.014716972941820	Same
67	1.999705660541160	0.000294339458836	0.014716972941820	Same
68	1.999705660541160	0.000294339458836	0.014716972941820	Same
69	1.999705660541160	0.000294339458836	0.014716972941820	Same
70	1.999705660541160	0.000294339458836	0.014716972941820	Same
71	1.999705660541160	0.000294339458836	0.014716972941820	Same
72	1.999705660541160	0.000294339458836	0.014716972941820	Same
73	1.999705660541160	0.000294339458836	0.014716972941820	Same
74	1.999705660541160	0.000294339458836	0.014716972941820	Same
75	1.999705660541160	0.000294339458836	0.014716972941820	Same
76	1.999705660541160	0.000294339458836	0.014716972941820	Same
77	1.999705660541160	0.000294339458836	0.014716972941820	Same
78	1.999705660541160	0.000294339458836	0.014716972941820	Same
79	1.999705660541160	0.000294339458836	0.014716972941820	Same
80	1.999705660541160	0.000294339458836	0.014716972941820	Same
81	1.999705660541160	0.000294339458836	0.014716972941820	Same
82	1.999705660541160	0.000294339458836	0.014716972941820	Same
83	1.999705660541160	0.000294339458836	0.014716972941820	Same
84	1.999705660541160	0.000294339458836	0.014716972941820	Same

85	1.999705660541160	0.000294339458836	0.014716972941820	Same
86	1.999705660541160	0.000294339458836	0.014716972941820	Same
87	1.999705660541160	0.000294339458836	0.014716972941820	Same
88	1.999705660541160	0.000294339458836	0.014716972941820	Same
89	1.999705660541160	0.000294339458836	0.014716972941820	Same
90	1.999705660541160	0.000294339458836	0.014716972941820	Same
91	1.999705660541160	0.000294339458836	0.014716972941820	Same
92	1.999705660541160	0.000294339458836	0.014716972941820	Same
93	1.999705660541160	0.000294339458836	0.014716972941820	Same
94	1.999705660541160	0.000294339458836	0.014716972941820	Same
95	1.999705660541160	0.000294339458836	0.014716972941820	Same
96	1.999705660541160	0.000294339458836	0.014716972941820	Same
97	1.999705660541160	0.000294339458836	0.014716972941820	Same
98	1.999705660541160	0.000294339458836	0.014716972941820	Same
99	1.999705660541160	0.000294339458836	0.014716972941820	Same
100	1.999705660541160	0.000294339458836	0.014716972941820	Same
101	1.999705660541160	0.000294339458836	0.014716972941820	Same
102	1.999705660541160	0.000294339458836	0.014716972941820	Same
103	1.999705660541160	0.000294339458836	0.014716972941820	Same
104	1.999705660541160	0.000294339458836	0.014716972941820	Same
105	1.999705660541160	0.000294339458836	0.014716972941820	Same
106	1.999705660541160	0.000294339458836	0.014716972941820	Same
107	1.999705660541160	0.000294339458836	0.014716972941820	Same
108	1.999705660541160	0.000294339458836	0.014716972941820	Same
109	1.999705660541160	0.000294339458836	0.014716972941820	Same
110	1.999705660541160	0.000294339458836	0.014716972941820	Same

111	1.999705660541160	0.000294339458836	0.014716972941820	Same
112	1.999705660541160	0.000294339458836	0.014716972941820	Same
113	1.999705660541160	0.000294339458836	0.014716972941820	Same
114	1.999705660541160	0.000294339458836	0.014716972941820	Same
115	1.999705660541160	0.000294339458836	0.014716972941820	Same
116	1.999705660541160	0.000294339458836	0.014716972941820	Same
117	1.999705660541160	0.000294339458836	0.014716972941820	Same

Table 12 Approximations and Errors

The Bolded line in the table is the **point of diminishing returns.**

The value of Maclaurin series for  $X=0.693147$

Number of Terms	Approximated Answer Based on Terms	Absolute True Error (Et)	Relative True Error (et)%	Status
1	1.000000000000000	1.000000000000000	50.00000000000000	---
2	1.693147000000000	0.306853000000000	15.342650000000000	Decreasing
3	1.933373381804500	0.066626618195500	3.331330909775000	Decreasing
4	1.988877447094050	0.011122552905952	0.556127645297599	Decreasing
5	1.998495566179860	0.001504433820138	0.075221691006921	Decreasing
6	1.999828920257860	0.000171079742143	0.008553987107174	Decreasing
7	1.999982955321040	0.000017044678960	0.000852233948012	Decreasing
8	1.999998208027030	0.000001791972969	0.000089598648434	Decreasing
9	1.999999529572960	0.000000470427044	0.000023521352188	Decreasing
10	1.999999631353580	0.000000368646422	0.000018432321114	Decreasing
11	1.999999638408470	0.000000361591529	0.000018079576447	Decreasing
12	1.999999638853020	0.000000361146976	0.000018057348816	Decreasing
13	1.999999638878700	0.000000361121298	0.000018056064899	Decreasing

14	1.999999638880070	0.000000361119929	0.000018055996442	Decreasing
15	1.999999638880140	0.000000361119861	0.000018055993056	Decreasing
16	1.999999638880140	0.000000361119858	0.000018055992901	Decreasing
<b>17</b>	<b>1.999999638880140</b>	<b>0.000000361119858</b>	<b>0.000018055992890</b>	<b>Decreasing</b>
18	1.999999638880140	0.000000361119858	0.000018055992890	Same
19	1.999999638880140	0.000000361119858	0.000018055992890	Same
20	1.999999638880140	0.000000361119858	0.000018055992890	Same
21	1.999999638880140	0.000000361119858	0.000018055992890	Same
22	1.999999638880140	0.000000361119858	0.000018055992890	Same
23	1.999999638880140	0.000000361119858	0.000018055992890	Same
24	1.999999638880140	0.000000361119858	0.000018055992890	Same
25	1.999999638880140	0.000000361119858	0.000018055992890	Same
26	1.999999638880140	0.000000361119858	0.000018055992890	Same
27	1.999999638880140	0.000000361119858	0.000018055992890	Same
28	1.999999638880140	0.000000361119858	0.000018055992890	Same
29	1.999999638880140	0.000000361119858	0.000018055992890	Same
30	1.999999638880140	0.000000361119858	0.000018055992890	Same
31	1.999999638880140	0.000000361119858	0.000018055992890	Same
32	1.999999638880140	0.000000361119858	0.000018055992890	Same
33	1.999999638880140	0.000000361119858	0.000018055992890	Same
34	1.999999638880140	0.000000361119858	0.000018055992890	Same
35	1.999999638880140	0.000000361119858	0.000018055992890	Same
36	1.999999638880140	0.000000361119858	0.000018055992890	Same
37	1.999999638880140	0.000000361119858	0.000018055992890	Same
38	1.999999638880140	0.000000361119858	0.000018055992890	Same
39	1.999999638880140	0.000000361119858	0.000018055992890	Same

40	1.999999638880140	0.000000361119858	0.000018055992890	Same
41	1.999999638880140	0.000000361119858	0.000018055992890	Same
42	1.999999638880140	0.000000361119858	0.000018055992890	Same
43	1.999999638880140	0.000000361119858	0.000018055992890	Same
44	1.999999638880140	0.000000361119858	0.000018055992890	Same
45	1.999999638880140	0.000000361119858	0.000018055992890	Same
46	1.999999638880140	0.000000361119858	0.000018055992890	Same
47	1.999999638880140	0.000000361119858	0.000018055992890	Same
48	1.999999638880140	0.000000361119858	0.000018055992890	Same
49	1.999999638880140	0.000000361119858	0.000018055992890	Same
50	1.999999638880140	0.000000361119858	0.000018055992890	Same
51	1.999999638880140	0.000000361119858	0.000018055992890	Same
52	1.999999638880140	0.000000361119858	0.000018055992890	Same
53	1.999999638880140	0.000000361119858	0.000018055992890	Same
54	1.999999638880140	0.000000361119858	0.000018055992890	Same
55	1.999999638880140	0.000000361119858	0.000018055992890	Same
56	1.999999638880140	0.000000361119858	0.000018055992890	Same
57	1.999999638880140	0.000000361119858	0.000018055992890	Same
58	1.999999638880140	0.000000361119858	0.000018055992890	Same
59	1.999999638880140	0.000000361119858	0.000018055992890	Same
60	1.999999638880140	0.000000361119858	0.000018055992890	Same
61	1.999999638880140	0.000000361119858	0.000018055992890	Same
62	1.999999638880140	0.000000361119858	0.000018055992890	Same
63	1.999999638880140	0.000000361119858	0.000018055992890	Same
64	1.999999638880140	0.000000361119858	0.000018055992890	Same
65	1.999999638880140	0.000000361119858	0.000018055992890	Same

66	1.999999638880140	0.000000361119858	0.000018055992890	Same
67	1.999999638880140	0.000000361119858	0.000018055992890	Same
68	1.999999638880140	0.000000361119858	0.000018055992890	Same
69	1.999999638880140	0.000000361119858	0.000018055992890	Same
70	1.999999638880140	0.000000361119858	0.000018055992890	Same
71	1.999999638880140	0.000000361119858	0.000018055992890	Same
72	1.999999638880140	0.000000361119858	0.000018055992890	Same
73	1.999999638880140	0.000000361119858	0.000018055992890	Same
74	1.999999638880140	0.000000361119858	0.000018055992890	Same
75	1.999999638880140	0.000000361119858	0.000018055992890	Same
76	1.999999638880140	0.000000361119858	0.000018055992890	Same
77	1.999999638880140	0.000000361119858	0.000018055992890	Same
78	1.999999638880140	0.000000361119858	0.000018055992890	Same
79	1.999999638880140	0.000000361119858	0.000018055992890	Same
80	1.999999638880140	0.000000361119858	0.000018055992890	Same
81	1.999999638880140	0.000000361119858	0.000018055992890	Same
82	1.999999638880140	0.000000361119858	0.000018055992890	Same
83	1.999999638880140	0.000000361119858	0.000018055992890	Same
84	1.999999638880140	0.000000361119858	0.000018055992890	Same
85	1.999999638880140	0.000000361119858	0.000018055992890	Same
86	1.999999638880140	0.000000361119858	0.000018055992890	Same
87	1.999999638880140	0.000000361119858	0.000018055992890	Same
88	1.999999638880140	0.000000361119858	0.000018055992890	Same
89	1.999999638880140	0.000000361119858	0.000018055992890	Same
90	1.999999638880140	0.000000361119858	0.000018055992890	Same
91	1.999999638880140	0.000000361119858	0.000018055992890	Same

92	1.999999638880140	0.000000361119858	0.000018055992890	Same
93	1.999999638880140	0.000000361119858	0.000018055992890	Same
94	1.999999638880140	0.000000361119858	0.000018055992890	Same
95	1.999999638880140	0.000000361119858	0.000018055992890	Same
96	1.999999638880140	0.000000361119858	0.000018055992890	Same
97	1.999999638880140	0.000000361119858	0.000018055992890	Same
98	1.999999638880140	0.000000361119858	0.000018055992890	Same
99	1.999999638880140	0.000000361119858	0.000018055992890	Same
100	1.999999638880140	0.000000361119858	0.000018055992890	Same
101	1.999999638880140	0.000000361119858	0.000018055992890	Same
102	1.999999638880140	0.000000361119858	0.000018055992890	Same
103	1.999999638880140	0.000000361119858	0.000018055992890	Same
104	1.999999638880140	0.000000361119858	0.000018055992890	Same
105	1.999999638880140	0.000000361119858	0.000018055992890	Same
106	1.999999638880140	0.000000361119858	0.000018055992890	Same
107	1.999999638880140	0.000000361119858	0.000018055992890	Same
108	1.999999638880140	0.000000361119858	0.000018055992890	Same
109	1.999999638880140	0.000000361119858	0.000018055992890	Same
110	1.999999638880140	0.000000361119858	0.000018055992890	Same
111	1.999999638880140	0.000000361119858	0.000018055992890	Same
112	1.999999638880140	0.000000361119858	0.000018055992890	Same
113	1.999999638880140	0.000000361119858	0.000018055992890	Same
114	1.999999638880140	0.000000361119858	0.000018055992890	Same
115	1.999999638880140	0.000000361119858	0.000018055992890	Same
116	1.999999638880140	0.000000361119858	0.000018055992890	Same
117	1.999999638880140	0.000000361119858	0.000018055992890	Same

*Table 13 Approximations and Errors*

The Bolded line in the table is the **point of diminishing returns.**

The value of Maclaurin series for  $X=0.693147180$

Number of Terms	Approximated Answer Based on Terms	Absolute True Error (Et)	Relative True Error (et)%	Status
1	1.0000000000000000	1.0000000000000000	50.000000000000000	---
2	1.6931471800000000	0.3068528200000000	15.342641000000000	Decreasing
3	1.933373686570980	0.066626313429024	3.331315671451200	Decreasing
4	1.988877795101280	0.011122204898716	0.556110244935804	Decreasing
5	1.998495924177830	0.001504075822167	0.075203791108347	Decreasing
6	1.999829279987090	0.000170720012910	0.008536000645487	Decreasing
7	1.999983315290280	0.000016684709722	0.000834235486125	Decreasing
8	1.999998568024000	0.000001431976005	0.000071598800233	Decreasing
9	1.999999889572670	0.000000110427334	0.000005521366708	Decreasing
10	1.999999991353530	0.000000008646475	0.000000432323743	Decreasing
11	1.999999998408440	0.000000001591563	0.000000079578166	Decreasing
12	1.999999998852990	0.000000001147010	0.000000057350480	Decreasing
13	1.999999998878670	0.000000001121331	0.000000056066563	Decreasing
14	1.999999998880040	0.000000001119962	0.000000055998106	Decreasing
15	1.999999998880110	0.000000001119894	0.000000055994720	Decreasing
16	1.999999998880110	0.000000001119891	0.000000055994565	Decreasing
<b>17</b>	<b>1.999999998880110</b>	<b>0.000000001119891</b>	<b>0.000000055994553</b>	<b>Decreasing</b>
18	1.999999998880110	0.000000001119891	0.000000055994553	Same
19	1.999999998880110	0.000000001119891	0.000000055994553	Same
20	1.999999998880110	0.000000001119891	0.000000055994553	Same
21	1.999999998880110	0.000000001119891	0.000000055994553	Same



22	1.999999998880110	0.000000001119891	0.000000055994553	Same
23	1.999999998880110	0.000000001119891	0.000000055994553	Same
24	1.999999998880110	0.000000001119891	0.000000055994553	Same
25	1.999999998880110	0.000000001119891	0.000000055994553	Same
26	1.999999998880110	0.000000001119891	0.000000055994553	Same
27	1.999999998880110	0.000000001119891	0.000000055994553	Same
28	1.999999998880110	0.000000001119891	0.000000055994553	Same
29	1.999999998880110	0.000000001119891	0.000000055994553	Same
30	1.999999998880110	0.000000001119891	0.000000055994553	Same
31	1.999999998880110	0.000000001119891	0.000000055994553	Same
32	1.999999998880110	0.000000001119891	0.000000055994553	Same
33	1.999999998880110	0.000000001119891	0.000000055994553	Same
34	1.999999998880110	0.000000001119891	0.000000055994553	Same
35	1.999999998880110	0.000000001119891	0.000000055994553	Same
36	1.999999998880110	0.000000001119891	0.000000055994553	Same
37	1.999999998880110	0.000000001119891	0.000000055994553	Same
38	1.999999998880110	0.000000001119891	0.000000055994553	Same
39	1.999999998880110	0.000000001119891	0.000000055994553	Same
40	1.999999998880110	0.000000001119891	0.000000055994553	Same
41	1.999999998880110	0.000000001119891	0.000000055994553	Same
42	1.999999998880110	0.000000001119891	0.000000055994553	Same
43	1.999999998880110	0.000000001119891	0.000000055994553	Same
44	1.999999998880110	0.000000001119891	0.000000055994553	Same
45	1.999999998880110	0.000000001119891	0.000000055994553	Same
46	1.999999998880110	0.000000001119891	0.000000055994553	Same
47	1.999999998880110	0.000000001119891	0.000000055994553	Same

48	1.999999998880110	0.000000001119891	0.000000055994553	Same
49	1.999999998880110	0.000000001119891	0.000000055994553	Same
50	1.999999998880110	0.000000001119891	0.000000055994553	Same
51	1.999999998880110	0.000000001119891	0.000000055994553	Same
52	1.999999998880110	0.000000001119891	0.000000055994553	Same
53	1.999999998880110	0.000000001119891	0.000000055994553	Same
54	1.999999998880110	0.000000001119891	0.000000055994553	Same
55	1.999999998880110	0.000000001119891	0.000000055994553	Same
56	1.999999998880110	0.000000001119891	0.000000055994553	Same
57	1.999999998880110	0.000000001119891	0.000000055994553	Same
58	1.999999998880110	0.000000001119891	0.000000055994553	Same
59	1.999999998880110	0.000000001119891	0.000000055994553	Same
60	1.999999998880110	0.000000001119891	0.000000055994553	Same
61	1.999999998880110	0.000000001119891	0.000000055994553	Same
62	1.999999998880110	0.000000001119891	0.000000055994553	Same
63	1.999999998880110	0.000000001119891	0.000000055994553	Same
64	1.999999998880110	0.000000001119891	0.000000055994553	Same
65	1.999999998880110	0.000000001119891	0.000000055994553	Same
66	1.999999998880110	0.000000001119891	0.000000055994553	Same
67	1.999999998880110	0.000000001119891	0.000000055994553	Same
68	1.999999998880110	0.000000001119891	0.000000055994553	Same
69	1.999999998880110	0.000000001119891	0.000000055994553	Same
70	1.999999998880110	0.000000001119891	0.000000055994553	Same
71	1.999999998880110	0.000000001119891	0.000000055994553	Same
72	1.999999998880110	0.000000001119891	0.000000055994553	Same
73	1.999999998880110	0.000000001119891	0.000000055994553	Same

74	1.999999998880110	0.000000001119891	0.000000055994553	Same
75	1.999999998880110	0.000000001119891	0.000000055994553	Same
76	1.999999998880110	0.000000001119891	0.000000055994553	Same
77	1.999999998880110	0.000000001119891	0.000000055994553	Same
78	1.999999998880110	0.000000001119891	0.000000055994553	Same
79	1.999999998880110	0.000000001119891	0.000000055994553	Same
80	1.999999998880110	0.000000001119891	0.000000055994553	Same
81	1.999999998880110	0.000000001119891	0.000000055994553	Same
82	1.999999998880110	0.000000001119891	0.000000055994553	Same
83	1.999999998880110	0.000000001119891	0.000000055994553	Same
84	1.999999998880110	0.000000001119891	0.000000055994553	Same
85	1.999999998880110	0.000000001119891	0.000000055994553	Same
86	1.999999998880110	0.000000001119891	0.000000055994553	Same
87	1.999999998880110	0.000000001119891	0.000000055994553	Same
88	1.999999998880110	0.000000001119891	0.000000055994553	Same
89	1.999999998880110	0.000000001119891	0.000000055994553	Same
90	1.999999998880110	0.000000001119891	0.000000055994553	Same
91	1.999999998880110	0.000000001119891	0.000000055994553	Same
92	1.999999998880110	0.000000001119891	0.000000055994553	Same
93	1.999999998880110	0.000000001119891	0.000000055994553	Same
94	1.999999998880110	0.000000001119891	0.000000055994553	Same
95	1.999999998880110	0.000000001119891	0.000000055994553	Same
96	1.999999998880110	0.000000001119891	0.000000055994553	Same
97	1.999999998880110	0.000000001119891	0.000000055994553	Same
98	1.999999998880110	0.000000001119891	0.000000055994553	Same
99	1.999999998880110	0.000000001119891	0.000000055994553	Same

100	1.999999998880110	0.000000001119891	0.000000055994553	Same
101	1.999999998880110	0.000000001119891	0.000000055994553	Same
102	1.999999998880110	0.000000001119891	0.000000055994553	Same
103	1.999999998880110	0.000000001119891	0.000000055994553	Same
104	1.999999998880110	0.000000001119891	0.000000055994553	Same
105	1.999999998880110	0.000000001119891	0.000000055994553	Same
106	1.999999998880110	0.000000001119891	0.000000055994553	Same
107	1.999999998880110	0.000000001119891	0.000000055994553	Same
108	1.999999998880110	0.000000001119891	0.000000055994553	Same
109	1.999999998880110	0.000000001119891	0.000000055994553	Same
110	1.999999998880110	0.000000001119891	0.000000055994553	Same
111	1.999999998880110	0.000000001119891	0.000000055994553	Same
112	1.999999998880110	0.000000001119891	0.000000055994553	Same
113	1.999999998880110	0.000000001119891	0.000000055994553	Same
114	1.999999998880110	0.000000001119891	0.000000055994553	Same
115	1.999999998880110	0.000000001119891	0.000000055994553	Same
116	1.999999998880110	0.000000001119891	0.000000055994553	Same
117	1.999999998880110	0.000000001119891	0.000000055994553	Same

*Table 14 Approximations and Errors*

The Bolded line in the table is the **point of diminishing returns.**

The value of Maclaurin series for  $X=0.693147180559$

Number of Terms	Approximated Answer Based on Terms	Absolute True Error (Et)	Relative True Error (et)%	Status
1	1.000000000000000	1.000000000000000	50.00000000000000	---
2	1.693147180559000	0.306852819441000	15.342640972050000	Decreasing

3	1.933373687517450	0.066626312482555	3.331315624127730	Decreasing
4	1.988877796182040	0.011122203817960	0.556110190898007	Decreasing
5	1.998495925289620	0.001504074710384	0.075203735519203	Decreasing
6	1.999829281104250	0.000170718895750	0.008535944787513	Decreasing
7	1.999983316408180	0.000016683591818	0.000834179590881	Decreasing
8	1.999998569141990	0.000001430858014	0.000071542900681	Decreasing
9	1.999999890690670	0.000000109309335	0.000005465466735	Decreasing
10	1.999999992471530	0.000000007528475	0.000000376423726	Decreasing
11	1.99999999526440	0.000000000473563	0.000000023678148	Decreasing
12	1.99999999970990	0.000000000029009	0.000000001450462	Decreasing
13	1.99999999996670	0.000000000003331	0.000000000166545	Decreasing
14	1.99999999998040	0.000000000001962	0.000000000098088	Decreasing
15	1.99999999998110	0.000000000001894	0.000000000094702	Decreasing
16	1.99999999998110	0.000000000001891	0.000000000094547	Decreasing
<b>17</b>	<b>1.99999999998110</b>	<b>0.000000000001891</b>	<b>0.000000000094535</b>	<b>Decreasing</b>
18	1.99999999998110	0.000000000001891	0.000000000094535	Same
19	1.99999999998110	0.000000000001891	0.000000000094535	Same
20	1.99999999998110	0.000000000001891	0.000000000094535	Same
21	1.99999999998110	0.000000000001891	0.000000000094535	Same
22	1.99999999998110	0.000000000001891	0.000000000094535	Same
23	1.99999999998110	0.000000000001891	0.000000000094535	Same
24	1.99999999998110	0.000000000001891	0.000000000094535	Same
25	1.99999999998110	0.000000000001891	0.000000000094535	Same
26	1.99999999998110	0.000000000001891	0.000000000094535	Same
27	1.99999999998110	0.000000000001891	0.000000000094535	Same
28	1.99999999998110	0.000000000001891	0.000000000094535	Same

29	1.99999999998110	0.000000000001891	0.000000000094535	Same
30	1.99999999998110	0.000000000001891	0.000000000094535	Same
31	1.99999999998110	0.000000000001891	0.000000000094535	Same
32	1.99999999998110	0.000000000001891	0.000000000094535	Same
33	1.99999999998110	0.000000000001891	0.000000000094535	Same
34	1.99999999998110	0.000000000001891	0.000000000094535	Same
35	1.99999999998110	0.000000000001891	0.000000000094535	Same
36	1.99999999998110	0.000000000001891	0.000000000094535	Same
37	1.99999999998110	0.000000000001891	0.000000000094535	Same
38	1.99999999998110	0.000000000001891	0.000000000094535	Same
39	1.99999999998110	0.000000000001891	0.000000000094535	Same
40	1.99999999998110	0.000000000001891	0.000000000094535	Same
41	1.99999999998110	0.000000000001891	0.000000000094535	Same
42	1.99999999998110	0.000000000001891	0.000000000094535	Same
43	1.99999999998110	0.000000000001891	0.000000000094535	Same
44	1.99999999998110	0.000000000001891	0.000000000094535	Same
45	1.99999999998110	0.000000000001891	0.000000000094535	Same
46	1.99999999998110	0.000000000001891	0.000000000094535	Same
47	1.99999999998110	0.000000000001891	0.000000000094535	Same
48	1.99999999998110	0.000000000001891	0.000000000094535	Same
49	1.99999999998110	0.000000000001891	0.000000000094535	Same
50	1.99999999998110	0.000000000001891	0.000000000094535	Same
51	1.99999999998110	0.000000000001891	0.000000000094535	Same
52	1.99999999998110	0.000000000001891	0.000000000094535	Same
53	1.99999999998110	0.000000000001891	0.000000000094535	Same
54	1.99999999998110	0.000000000001891	0.000000000094535	Same

55	1.99999999998110	0.000000000001891	0.000000000094535	Same
56	1.99999999998110	0.000000000001891	0.000000000094535	Same
57	1.99999999998110	0.000000000001891	0.000000000094535	Same
58	1.99999999998110	0.000000000001891	0.000000000094535	Same
59	1.99999999998110	0.000000000001891	0.000000000094535	Same
60	1.99999999998110	0.000000000001891	0.000000000094535	Same
61	1.99999999998110	0.000000000001891	0.000000000094535	Same
62	1.99999999998110	0.000000000001891	0.000000000094535	Same
63	1.99999999998110	0.000000000001891	0.000000000094535	Same
64	1.99999999998110	0.000000000001891	0.000000000094535	Same
65	1.99999999998110	0.000000000001891	0.000000000094535	Same
66	1.99999999998110	0.000000000001891	0.000000000094535	Same
67	1.99999999998110	0.000000000001891	0.000000000094535	Same
68	1.99999999998110	0.000000000001891	0.000000000094535	Same
69	1.99999999998110	0.000000000001891	0.000000000094535	Same
70	1.99999999998110	0.000000000001891	0.000000000094535	Same
71	1.99999999998110	0.000000000001891	0.000000000094535	Same
72	1.99999999998110	0.000000000001891	0.000000000094535	Same
73	1.99999999998110	0.000000000001891	0.000000000094535	Same
74	1.99999999998110	0.000000000001891	0.000000000094535	Same
75	1.99999999998110	0.000000000001891	0.000000000094535	Same
76	1.99999999998110	0.000000000001891	0.000000000094535	Same
77	1.99999999998110	0.000000000001891	0.000000000094535	Same
78	1.99999999998110	0.000000000001891	0.000000000094535	Same
79	1.99999999998110	0.000000000001891	0.000000000094535	Same
80	1.99999999998110	0.000000000001891	0.000000000094535	Same

81	1.99999999998110	0.000000000001891	0.000000000094535	Same
82	1.99999999998110	0.000000000001891	0.000000000094535	Same
83	1.99999999998110	0.000000000001891	0.000000000094535	Same
84	1.99999999998110	0.000000000001891	0.000000000094535	Same
85	1.99999999998110	0.000000000001891	0.000000000094535	Same
86	1.99999999998110	0.000000000001891	0.000000000094535	Same
87	1.99999999998110	0.000000000001891	0.000000000094535	Same
88	1.99999999998110	0.000000000001891	0.000000000094535	Same
89	1.99999999998110	0.000000000001891	0.000000000094535	Same
90	1.99999999998110	0.000000000001891	0.000000000094535	Same
91	1.99999999998110	0.000000000001891	0.000000000094535	Same
92	1.99999999998110	0.000000000001891	0.000000000094535	Same
93	1.99999999998110	0.000000000001891	0.000000000094535	Same
94	1.99999999998110	0.000000000001891	0.000000000094535	Same
95	1.99999999998110	0.000000000001891	0.000000000094535	Same
96	1.99999999998110	0.000000000001891	0.000000000094535	Same
97	1.99999999998110	0.000000000001891	0.000000000094535	Same
98	1.99999999998110	0.000000000001891	0.000000000094535	Same
99	1.99999999998110	0.000000000001891	0.000000000094535	Same
100	1.99999999998110	0.000000000001891	0.000000000094535	Same
101	1.99999999998110	0.000000000001891	0.000000000094535	Same
102	1.99999999998110	0.000000000001891	0.000000000094535	Same
103	1.99999999998110	0.000000000001891	0.000000000094535	Same
104	1.99999999998110	0.000000000001891	0.000000000094535	Same
105	1.99999999998110	0.000000000001891	0.000000000094535	Same
106	1.99999999998110	0.000000000001891	0.000000000094535	Same



107	1.99999999998110	0.000000000001891	0.000000000094535	Same
108	1.99999999998110	0.000000000001891	0.000000000094535	Same
109	1.99999999998110	0.000000000001891	0.000000000094535	Same
110	1.99999999998110	0.000000000001891	0.000000000094535	Same
111	1.99999999998110	0.000000000001891	0.000000000094535	Same
112	1.99999999998110	0.000000000001891	0.000000000094535	Same
113	1.99999999998110	0.000000000001891	0.000000000094535	Same
114	1.99999999998110	0.000000000001891	0.000000000094535	Same
115	1.99999999998110	0.000000000001891	0.000000000094535	Same
116	1.99999999998110	0.000000000001891	0.000000000094535	Same
117	1.99999999998110	0.000000000001891	0.000000000094535	Same

Table 15 Approximations and Errors

The Bolded line in the table is the **point of diminishing returns.**

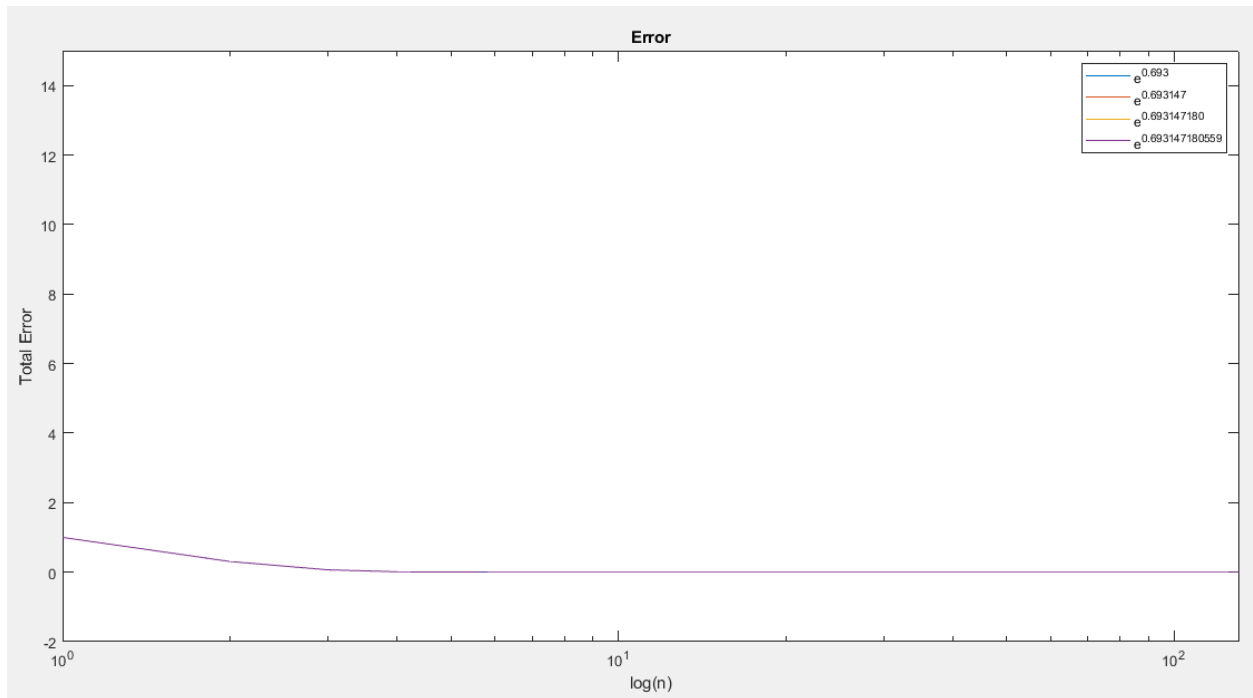


Figure 3 Total Error vs Number of Terms

#### 1.2.4Task 4:

- Problem Statement:

$$e^x = 1 + x + \frac{x^2}{2} + \frac{x^3}{6} + \frac{x^4}{24} + \dots \quad 1-1$$

At  $x = e^{\log_{10}(2)}$ .

- Solution:

$$X = \log_{10}(2) = 0.301029995663981.$$

$$\text{True Value Answer} = e^{(\log_{10}(2))} = 1.351249872567267.$$

# of significant Figures	Method	x approximate(Xa)
3	Chopping	0.301
6	Chopping	0.301029
9	Chopping	0.301029995
12	Chopping	0.301029995663

Table 16

The value of Maclaurin series for  $X=0.301$

Number of Terms	Approximated Answer Based on Terms	Absolute True Error (Et)	Relative True Error (et)%	Status
1	1.00000000000000000000	3.51249872567267000000E-01	25.99444260445480000000	---
2	1.30100000000000000000	5.02498725672673000000E-02	3.71876982839573000000	Decreasing
3	1.34630050000000000000	4.94937256726735000000E-03	0.36628107559884100000	Decreasing

4	1.35084565016667000000	4.04222400600673000000E-04	0.02991470406821820000	Decreasing
5	1.35118767271671000000	6.21998505589971000000E-05	0.00460313461053819000	Decreasing
6	1.35120826247422000000	4.16100930464847000000E-05	0.00307937812918560000	Decreasing
7	1.35120929539372000000	4.05771735445537000000E-05	0.00300293634570047000	Decreasing
8	1.35120933980926000000	4.05327580059733000000E-05	0.00299964934901080000	Decreasing
9	1.35120934148040000000	4.05310868714093000000E-05	0.00299952567576591000	Decreasing
10	1.35120934153629000000	4.05310309812279000000E-05	0.00299952153958188000	Decreasing
11	1.35120934153797000000	4.05310292990180000000E-05	0.00299952141508900000	Decreasing
12	1.35120934153801000000	4.05310292530547000000E-05	0.00299952141168746000	Decreasing
<b>13</b>	<b>1.35120934153802000000</b>	<b>4.05310292519445000000E-05</b>	<b>0.00299952141160530000</b>	<b>Decreasing</b>
14	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
15	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
16	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
17	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
18	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
19	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
20	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same

21	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
22	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
23	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
24	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
25	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
26	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
27	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
28	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
29	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
30	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
31	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
32	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
33	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
34	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
35	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
36	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
37	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same

38	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
39	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
40	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
41	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
42	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
43	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
44	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
45	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
46	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
47	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
48	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
49	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
50	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
51	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
52	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
53	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
54	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same

55	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
56	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
57	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
58	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
59	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
60	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
61	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
62	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
63	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
64	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
65	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
66	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
67	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
68	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
69	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
70	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
71	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same

72	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
73	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
74	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
75	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
76	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
77	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
78	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
79	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
80	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
81	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
82	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
83	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
84	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
85	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
86	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
87	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
88	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same

89	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
90	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
91	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
92	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
93	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
94	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
95	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
96	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
97	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
98	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
99	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
100	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
101	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
102	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
103	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
104	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
105	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same



106	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
107	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
108	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
109	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
110	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
111	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
112	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same
113	1.35120934153802000000	4.05310292519445000000E-05	0.00299952141160530000	Same

Table 17 Approximations and Errors

The bolded line is the **point of diminishing return**.

The value of Maclaurin series for X=0.301029

Number of Terms	Approximated Answer Based on Terms	Absolute True Error (Et)	Relative True Error (et)%	Status
1	1.0000000000000000	3.51249872567267000000E-01	25.99444260445479700000000	---
2	1.3010290000000000	5.02208725672673000000E-02	3.71662366723126000000E+00	Decreasing
3	1.346338229420500	4.91164314676729000000E-03	3.6348888804523000000E-01	Decreasing
4	1.350884693428240	3.65179139026006000000E-04	2.70252857328449000000E-02	Decreasing

5	1.351226847806690	2.30247605794709000000E-05	1.70396024058272000000E-03	Decreasing
6	1.351247447484770	2.42508250170026000000E-06	1.79469582268511000000E-04	Decreasing
7	1.351248481001510	1.39156575307275000000E-06	1.02983599208701000000E-04	Decreasing
8	1.351248525447020	1.34712025112727000000E-06	9.96943850635000000000E-05	Decreasing
9	1.351248527119440	1.34544782803836000000E-06	9.95706164606044000000E-05	Decreasing
10	1.351248527175380	1.34539188945126000000E-06	9.95664766942865000000E-05	Decreasing
11	1.351248527177060	1.34539020546498000000E-06	9.95663520699429000000E-05	Decreasing
12	1.351248527177110	1.34539015927970000000E-06	9.95663486519757000000E-05	Decreasing
<b>13</b>	<b>1.351248527177110</b>	<b>1.34539015816948000000E-06</b>	<b>9.95663485698130000000E-05</b>	<b>Decreasing</b>
14	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
15	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
16	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
17	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
18	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
19	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
20	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
21	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same

22	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
23	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
24	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
25	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
26	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
27	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
28	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
29	1.351248527177110	1.345390158169480000E-06	9.95663485698130000000E-05	Same
30	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
31	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
32	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
33	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
34	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
35	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
36	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
37	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
38	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same

39	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
40	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
41	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
42	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
43	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
44	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
45	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
46	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
47	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
48	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
49	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
50	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
51	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
52	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
53	1.351248527177110	1.345390158169480000E-06	9.95663485698130000000E-05	Same
54	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
55	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same

56	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
57	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
58	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
59	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
60	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
61	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
62	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
63	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
64	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
65	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
66	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
67	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
68	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
69	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
70	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
71	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
72	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same

73	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
74	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
75	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
76	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
77	1.351248527177110	1.345390158169480000E-06	9.95663485698130000000E-05	Same
78	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
79	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
80	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
81	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
82	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
83	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
84	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
85	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
86	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
87	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
88	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
89	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same

90	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
91	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
92	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
93	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
94	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
95	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
96	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
97	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
98	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
99	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
100	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
101	1.351248527177110	1.345390158169480000E-06	9.95663485698130000000E-05	Same
102	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
103	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
104	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
105	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
106	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same

107	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
108	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
109	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
110	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
111	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
112	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same
113	1.351248527177110	1.34539015816948000000E-06	9.95663485698130000000E-05	Same

*Table 18 Approximations and Error*

The bolded line is the **point of diminishing return**.

The value of Maclaurin series for X=0.301029995

Number of Terms	Approximated Answer Based on Terms	Absolute True Error (Et)	Relative True Error (et)%	Status
1	1.0000000000000000	3.51249872567267000000E-01	25.99444260445480400000000	---
2	1.301029995000000	5.02198775672673000000E-02	3.71655003170165000000E+00	Decreasing
3	1.346339523944850	4.91034862241735000000E-03	3.63393086808443000000E-01	Decreasing
4	1.350886033035420	3.63839531843935000000E-04	2.69261473566446000000E-02	Decreasing
5	1.351228191937620	2.16806296431393000000E-05	1.60448708142691000000E-03	Decreasing
6	1.351248791956150	1.08061111947499000000E-06	7.99712282245710000000E-05	Decreasing



7		4.70738739100085000000E-	Decreasing
	1.351249825493390	08	3.48372827747779000000E-06
8		2.62734367595385000000E-	Decreasing
	1.351249869939920	09	1.94438033208625000000E-07
9		9.54876400172111000000E-	Decreasing
	1.351249871612390	10	7.06661602385887000000E-08
10		8.98936036719533000000E-	Decreasing
	1.351249871668330	10	6.65262624603713000000E-08
11		8.97252050435782000000E-	Decreasing
	1.351249871670020	10	6.64016381167958000000E-08
12		8.97205865157957000000E-	Decreasing
	1.351249871670060	10	6.63982201495670000000E-08
<b>13</b>		<b>8.97204754934933000000E-</b>	<b>Decreasing</b>
	<b>1.351249871670060</b>	<b>10</b>	<b>6.63981379868932000000E-08</b>
14		8.97204754934933000000E-	Same
	1.351249871670060	10	6.63981379868932000000E-08
15		8.97204754934933000000E-	Same
	1.351249871670060	10	6.63981379868932000000E-08
16		8.97204754934933000000E-	Same
	1.351249871670060	10	6.63981379868932000000E-08
17		8.97204754934933000000E-	Same
	1.351249871670060	10	6.63981379868932000000E-08
18		8.97204754934933000000E-	Same
	1.351249871670060	10	6.63981379868932000000E-08
19		8.97204754934933000000E-	Same
	1.351249871670060	10	6.63981379868932000000E-08
20		8.97204754934933000000E-	Same
	1.351249871670060	10	6.63981379868932000000E-08
21		8.97204754934933000000E-	Same
	1.351249871670060	10	6.63981379868932000000E-08
22		8.97204754934933000000E-	Same
	1.351249871670060	10	6.63981379868932000000E-08
23		8.97204754934933000000E-	Same
	1.351249871670060	10	6.63981379868932000000E-08

24	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
25	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
26	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
27	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
28	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
29	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
30	1.351249871670060	8.9720475493493300000E-10	6.639813798689320000000E-08	Same
31	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
32	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
33	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
34	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
35	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
36	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
37	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
38	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
39	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
40	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same

41	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
42	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
43	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
44	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
45	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
46	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
47	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
48	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
49	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
50	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
51	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
52	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
53	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
54	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
55	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
56	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
57	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same

58	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
59	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
60	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
61	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
62	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
63	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
64	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
65	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
66	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
67	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
68	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
69	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
70	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
71	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
72	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
73	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
74	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same

75	1.351249871670060	8.97204754934933000000E-10	6.63981379868932000000E-08	Same
76	1.351249871670060	8.97204754934933000000E-10	6.63981379868932000000E-08	Same
77	1.351249871670060	8.972047549349330000E-10	6.63981379868932000000E-08	Same
78	1.351249871670060	8.97204754934933000000E-10	6.63981379868932000000E-08	Same
79	1.351249871670060	8.97204754934933000000E-10	6.63981379868932000000E-08	Same
80	1.351249871670060	8.97204754934933000000E-10	6.63981379868932000000E-08	Same
81	1.351249871670060	8.97204754934933000000E-10	6.63981379868932000000E-08	Same
82	1.351249871670060	8.97204754934933000000E-10	6.63981379868932000000E-08	Same
83	1.351249871670060	8.97204754934933000000E-10	6.63981379868932000000E-08	Same
84	1.351249871670060	8.97204754934933000000E-10	6.63981379868932000000E-08	Same
85	1.351249871670060	8.97204754934933000000E-10	6.63981379868932000000E-08	Same
86	1.351249871670060	8.97204754934933000000E-10	6.63981379868932000000E-08	Same
87	1.351249871670060	8.97204754934933000000E-10	6.63981379868932000000E-08	Same
88	1.351249871670060	8.97204754934933000000E-10	6.63981379868932000000E-08	Same
89	1.351249871670060	8.97204754934933000000E-10	6.63981379868932000000E-08	Same
90	1.351249871670060	8.97204754934933000000E-10	6.63981379868932000000E-08	Same
91	1.351249871670060	8.97204754934933000000E-10	6.63981379868932000000E-08	Same

92	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
93	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
94	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
95	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
96	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
97	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
98	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
99	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
100	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
101	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
102	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
103	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
104	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
105	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
106	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
107	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
108	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same

109	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
110	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
111	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
112	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same
113	1.351249871670060	8.972047549349330000000E-10	6.639813798689320000000E-08	Same

Table 19 Approximations and Errors

The bolded line is the **point of diminishing return**.

The value of Maclaurin series for  $X=0.301029995663$

Number of Terms	Approximated Answer Based on Terms	Absolute True Error (Et)	Relative True Error (et)%	Status
1	1.0000000000000000	3.512498725672670000000E-01	25.99444260445480400000000	---
2	1.301029995663000	5.021987690426720000000E-02	3.716549982635960000000E+00	Decreasing
3	1.346339524807430	4.910347759834230000000E-03	3.633930229724990000000E-01	Decreasing
4	1.350886033928050	3.638386392204040000000E-04	2.692608129754270000000E-02	Decreasing
5	1.351228192833260	2.167973400535320000000E-05	1.604420799253320000000E-03	Decreasing
6	1.351248792852010	1.0797152547592500000E-06	7.990492925693140000000E-05	Decreasing
7	1.351249826389270	4.617799564954340000000E-08	3.417428307453520000000E-06	Decreasing
8	1.351249870835800	1.731464749354930000000E-09	1.281380138867490000000E-07	Decreasing

9		5.89974735731857000000E-		Decreasing
	1.351249872508270	11	4.36614091671256000000E-09	
10		3.05711012060783000000E-		Decreasing
	1.351249872564210	12	2.26243138495145000000E-10	
11		1.37312383685639000000E-		Decreasing
	1.351249872565890	12	1.01618794919667000000E-10	
12		1.32693855903199000000E-		Decreasing
	1.351249872565940	12	9.82008276908037000000E-11	
13		1.32582833600736000000E-		Decreasing
	1.351249872565940	12	9.81186650170330000000E-11	
14		1.32582833600736000000E-		Same
	1.351249872565940	12	9.81186650170330000000E-11	
15		1.32582833600736000000E-		Same
	1.351249872565940	12	9.81186650170330000000E-11	
16		1.32582833600736000000E-		Same
	1.351249872565940	12	9.81186650170330000000E-11	
17		1.32582833600736000000E-		Same
	1.351249872565940	12	9.81186650170330000000E-11	
18		1.32582833600736000000E-		Same
	1.351249872565940	12	9.81186650170330000000E-11	
19		1.32582833600736000000E-		Same
	1.351249872565940	12	9.81186650170330000000E-11	
20		1.32582833600736000000E-		Same
	1.351249872565940	12	9.81186650170330000000E-11	
21		1.32582833600736000000E-		Same
	1.351249872565940	12	9.81186650170330000000E-11	
22		1.32582833600736000000E-		Same
	1.351249872565940	12	9.81186650170330000000E-11	
23		1.32582833600736000000E-		Same
	1.351249872565940	12	9.81186650170330000000E-11	
24		1.32582833600736000000E-		Same
	1.351249872565940	12	9.81186650170330000000E-11	
25		1.32582833600736000000E-		Same
	1.351249872565940	12	9.81186650170330000000E-11	



26	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same
27	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same
28	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same
29	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same
30	1.351249872565940	1.325828336007360000E-12	9.81186650170330000000E-11	Same
31	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same
32	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same
33	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same
34	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same
35	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same
36	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same
37	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same
38	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same
39	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same
40	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same
41	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same
42	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same

43	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same
44	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same
45	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same
46	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same
47	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same
48	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same
49	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same
50	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same
51	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same
52	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same
53	1.351249872565940	1.325828336007360000E-12	9.81186650170330000000E-11	Same
54	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same
55	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same
56	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same
57	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same
58	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same
59	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same

60	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same
61	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same
62	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same
63	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same
64	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same
65	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same
66	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same
67	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same
68	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same
69	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same
70	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same
71	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same
72	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same
73	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same
74	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same
75	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same
76	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same

77	1.351249872565940	1.3258283360073600000E-12	9.811866501703300000000E-11	Same
78	1.351249872565940	1.3258283360073600000E-12	9.811866501703300000000E-11	Same
79	1.351249872565940	1.325828336007360000000E-12	9.811866501703300000000E-11	Same
80	1.351249872565940	1.325828336007360000000E-12	9.811866501703300000000E-11	Same
81	1.351249872565940	1.325828336007360000000E-12	9.811866501703300000000E-11	Same
82	1.351249872565940	1.325828336007360000000E-12	9.811866501703300000000E-11	Same
83	1.351249872565940	1.325828336007360000000E-12	9.811866501703300000000E-11	Same
84	1.351249872565940	1.325828336007360000000E-12	9.811866501703300000000E-11	Same
85	1.351249872565940	1.325828336007360000000E-12	9.811866501703300000000E-11	Same
86	1.351249872565940	1.325828336007360000000E-12	9.811866501703300000000E-11	Same
87	1.351249872565940	1.325828336007360000000E-12	9.811866501703300000000E-11	Same
88	1.351249872565940	1.325828336007360000000E-12	9.811866501703300000000E-11	Same
89	1.351249872565940	1.325828336007360000000E-12	9.811866501703300000000E-11	Same
90	1.351249872565940	1.325828336007360000000E-12	9.811866501703300000000E-11	Same
91	1.351249872565940	1.325828336007360000000E-12	9.811866501703300000000E-11	Same
92	1.351249872565940	1.325828336007360000000E-12	9.811866501703300000000E-11	Same
93	1.351249872565940	1.325828336007360000000E-12	9.811866501703300000000E-11	Same

94	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same
95	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same
96	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same
97	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same
98	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same
99	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same
100	1.351249872565940	1.325828336007360000E-12	9.81186650170330000000E-11	Same
101	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same
102	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same
103	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same
104	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same
105	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same
106	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same
107	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same
108	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same
109	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same
110	1.351249872565940	1.32582833600736000000E-12	9.81186650170330000000E-11	Same

111	1.325828336007360000000E-			Same
	1.351249872565940	12	9.811866501703300000000E-11	
112	1.325828336007360000000E-			Same
	1.351249872565940	12	9.811866501703300000000E-11	
113	1.325828336007360000000E-			Same
	1.351249872565940	12	9.811866501703300000000E-11	

Table 20 Approximations and Errors

The bolded line is the **point of diminishing return**.

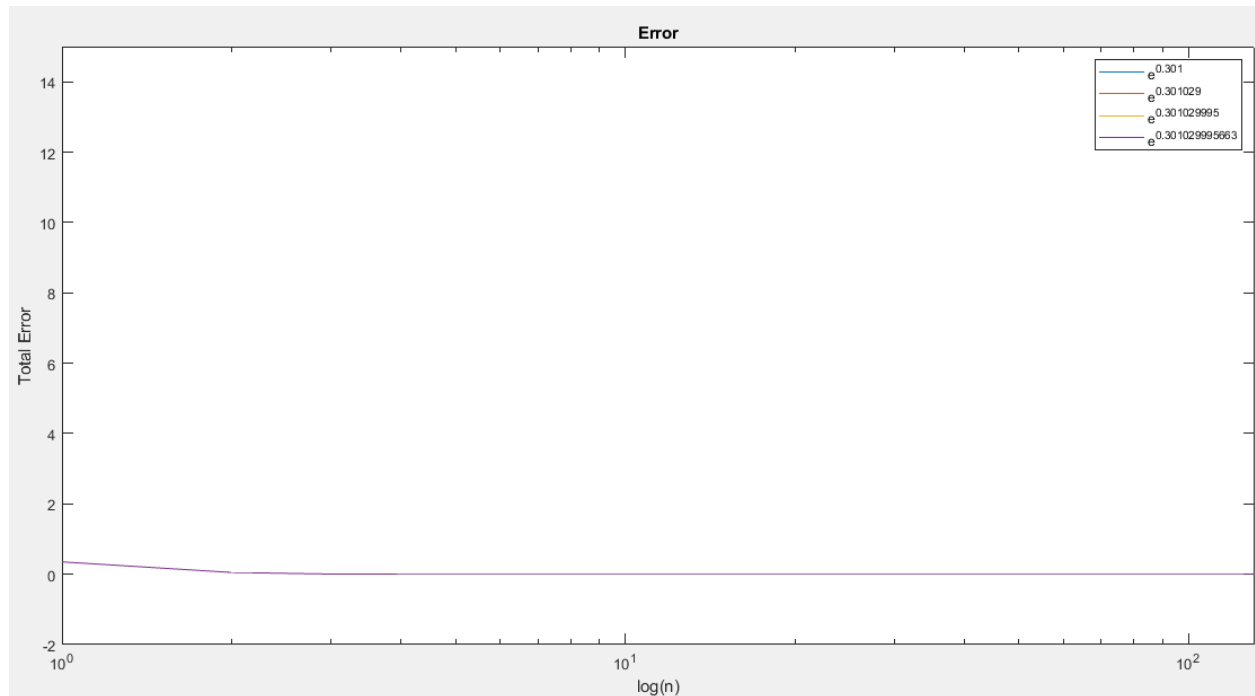


Figure 4 Total Error vs Number of Terms

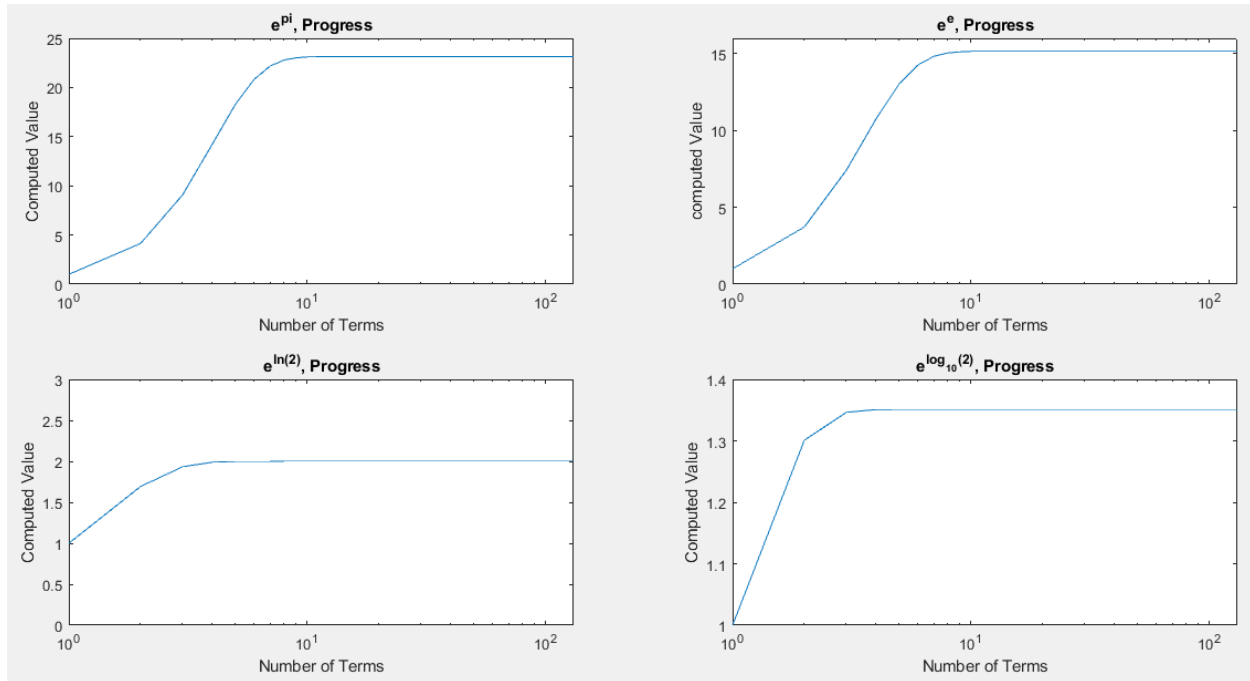


Figure 5 Value vs Number of Terms at Diminishing Point

### 1.1.5 Task 5:

- Problem Statement:

$$\sin(x) = x - \frac{x^3}{6} + \frac{x^5}{120} - \frac{x^7}{5040} + \dots \quad 1-2$$

At  $x = \pi$ .

- Solution:

$$X = \pi = 3.141592653589793.$$

$$X = \pi * \pi / 180.$$

$$\text{True Value Answer} = \sin(X) = 0.054803665148790.$$

# of significant Figures	Method	x approximate(Xa)
3	Chopping	3.14
6	Chopping	3.14159

9	Chopping	3.14159265
12	Chopping	3.14159265358

Table 21

The value of Maclaurin series for  $X=3.14$

Number of Terms	Approximated Answer Based on Terms	Absolute True Error (Et)	Relative True Error (et)%	Status
1	0.05477590985343360000	0.00002775529535590380	0.01268236453108160000	---
2	0.05474847707495140000	0.00005518807383810690	0.10070142879727800000	Decreasing
3	0.05474848119453990000	0.00005518395424965180	0.10069391180285100000	Decreasing
4	0.05474848119424530000	0.00005518395454424260	0.10069391234038900000	Decreasing
<b>5</b>	<b>0.05474848119424530000</b>	<b>0.00005518395454422870</b>	<b>0.10069391234036400000</b>	<b>Decreasing</b>
6	0.05474848119424530000	0.00005518395454422870	0.10069391234036400000	Same
7	0.05474848119424530000	0.00005518395454422870	0.10069391234036400000	Same
8	0.05474848119424530000	0.00005518395454422870	0.10069391234036400000	Same
9	0.05474848119424530000	0.00005518395454422870	0.10069391234036400000	Same
10	0.05474848119424530000	0.00005518395454422870	0.10069391234036400000	Same
11	0.05474848119424530000	0.00005518395454422870	0.10069391234036400000	Same
12	0.05474848119424530000	0.00005518395454422870	0.10069391234036400000	Same
13	0.05474848119424530000	0.00005518395454422870	0.10069391234036400000	Same
14	0.05474848119424530000	0.00005518395454422870	0.10069391234036400000	Same
15	0.05474848119424530000	0.00005518395454422870	0.10069391234036400000	Same
16	0.05474848119424530000	0.00005518395454422870	0.10069391234036400000	Same
17	0.05474848119424530000	0.00005518395454422870	0.10069391234036400000	Same
18	0.05474848119424530000	0.00005518395454422870	0.10069391234036400000	Same
19	0.05474848119424530000	0.00005518395454422870	0.10069391234036400000	Same



[illegible]

[illegible]

[illegible]

98	0.05474848119424530000	0.00005518395454422870	0.10069391234036400000	Same
99	0.05474848119424530000	0.00005518395454422870	0.10069391234036400000	Same
100	0.05474848119424530000	0.00005518395454422870	0.10069391234036400000	Same
101	0.05474848119424530000	0.00005518395454422870	0.10069391234036400000	Same
102	0.05474848119424530000	0.00005518395454422870	0.10069391234036400000	Same
103	0.05474848119424530000	0.00005518395454422870	0.10069391234036400000	Same
104	0.05474848119424530000	0.00005518395454422870	0.10069391234036400000	Same
105	0.05474848119424530000	0.00005518395454422870	0.10069391234036400000	Same

*Table 22 Approximations and Errors*

The Bolded line in the table is the **point of diminishing returns.**

The value of Maclaurin series for  $X = 3.14159$

Number of Terms	Approximated Answer Based on Terms	Absolute True Error (Et)	Relative True Error (et)%	Status
1	0.05480361890451340000	0.00000004624427613065	8.438172156022564e-05	---
2	0.05477614443156460000	0.00002752071722495610	0.05021692828433760000	Decreasing
3	0.05477614856159380000	0.00002751658719576250	0.05020939223874200000	Decreasing
4	0.05477614856129810000	0.00002751658749140100	0.05020939277819230000	Decreasing
<b>5</b>	<b>0.05477614856129810000</b>	<b>0.00002751658749138710</b>	<b>0.05020939277816700000</b>	<b>Decreasing</b>
6	0.05477614856129810000	0.00002751658749138710	0.05020939277816700000	Same
7	0.05477614856129810000	0.00002751658749138710	0.05020939277816700000	Same
8	0.05477614856129810000	0.00002751658749138710	0.05020939277816700000	Same
9	0.05477614856129810000	0.00002751658749138710	0.05020939277816700000	Same
10	0.05477614856129810000	0.00002751658749138710	0.05020939277816700000	Same
11	0.05477614856129810000	0.00002751658749138710	0.05020939277816700000	Same

[illegible]

[illegible]

[illegible]

90	0.05477614856129810000	0.00002751658749138710	0.05020939277816700000	Same
91	0.05477614856129810000	0.00002751658749138710	0.05020939277816700000	Same
92	0.05477614856129810000	0.00002751658749138710	0.05020939277816700000	Same
93	0.05477614856129810000	0.00002751658749138710	0.05020939277816700000	Same
94	0.05477614856129810000	0.00002751658749138710	0.05020939277816700000	Same
95	0.05477614856129810000	0.00002751658749138710	0.05020939277816700000	Same
96	0.05477614856129810000	0.00002751658749138710	0.05020939277816700000	Same
97	0.05477614856129810000	0.00002751658749138710	0.05020939277816700000	Same
98	0.05477614856129810000	0.00002751658749138710	0.05020939277816700000	Same
99	0.05477614856129810000	0.00002751658749138710	0.05020939277816700000	Same
100	0.05477614856129810000	0.00002751658749138710	0.05020939277816700000	Same
101	0.05477614856129810000	0.00002751658749138710	0.05020939277816700000	Same
102	0.05477614856129810000	0.00002751658749138710	0.05020939277816700000	Same
103	0.05477614856129810000	0.00002751658749138710	0.05020939277816700000	Same
104	0.05477614856129810000	0.00002751658749138710	0.05020939277816700000	Same
105	0.05477614856129810000	0.00002751658749138710	0.05020939277816700000	Same

Table 23 Approximations and Errors

The Bolded line in the table is the **point of diminishing returns.**

The value of Maclaurin series for  $X = 3.14159265$

Number of Terms	Approximated Answer Based on Terms	Absolute True Error (Et)	Relative True Error (et)%	Status
1	0.05480366508623000000	0.00000000006255954782	1.141521240416195e-07	---
2	0.05477619054375510000	0.00002747460503439020	0.05013278757871000000	Decreasing
3	0.05477619467380180000	0.00002747047498777990	0.05012525150133450000	Decreasing



4	0.05477619467350610000	0.00002747047528341840	0.05012525204078470000	Decreasing
5	<b>0.05477619467350610000</b>	<b>0.00002747047528340460</b>	<b>0.05012525204075940000</b>	<b>Decreasing</b>
6	0.05477619467350610000	0.00002747047528340460	0.05012525204075940000	Same
7	0.05477619467350610000	0.00002747047528340460	0.05012525204075940000	Same
8	0.05477619467350610000	0.00002747047528340460	0.05012525204075940000	Same
9	0.05477619467350610000	0.00002747047528340460	0.05012525204075940000	Same
10	0.05477619467350610000	0.00002747047528340460	0.05012525204075940000	Same
11	0.05477619467350610000	0.00002747047528340460	0.05012525204075940000	Same
12	0.05477619467350610000	0.00002747047528340460	0.05012525204075940000	Same
13	0.05477619467350610000	0.00002747047528340460	0.05012525204075940000	Same
14	0.05477619467350610000	0.00002747047528340460	0.05012525204075940000	Same
15	0.05477619467350610000	0.00002747047528340460	0.05012525204075940000	Same
16	0.05477619467350610000	0.00002747047528340460	0.05012525204075940000	Same
17	0.05477619467350610000	0.00002747047528340460	0.05012525204075940000	Same
18	0.05477619467350610000	0.00002747047528340460	0.05012525204075940000	Same
19	0.05477619467350610000	0.00002747047528340460	0.05012525204075940000	Same
20	0.05477619467350610000	0.00002747047528340460	0.05012525204075940000	Same
21	0.05477619467350610000	0.00002747047528340460	0.05012525204075940000	Same
22	0.05477619467350610000	0.00002747047528340460	0.05012525204075940000	Same
23	0.05477619467350610000	0.00002747047528340460	0.05012525204075940000	Same
24	0.05477619467350610000	0.00002747047528340460	0.05012525204075940000	Same
25	0.05477619467350610000	0.00002747047528340460	0.05012525204075940000	Same
26	0.05477619467350610000	0.00002747047528340460	0.05012525204075940000	Same
27	0.05477619467350610000	0.00002747047528340460	0.05012525204075940000	Same
28	0.05477619467350610000	0.00002747047528340460	0.05012525204075940000	Same
29	0.05477619467350610000	0.00002747047528340460	0.05012525204075940000	Same

[illegible]

[illegible]

82	0.05477619467350610000	0.00002747047528340460	0.05012525204075940000	Same
83	0.05477619467350610000	0.00002747047528340460	0.05012525204075940000	Same
84	0.05477619467350610000	0.00002747047528340460	0.05012525204075940000	Same
85	0.05477619467350610000	0.00002747047528340460	0.05012525204075940000	Same
86	0.05477619467350610000	0.00002747047528340460	0.05012525204075940000	Same
87	0.05477619467350610000	0.00002747047528340460	0.05012525204075940000	Same
88	0.05477619467350610000	0.00002747047528340460	0.05012525204075940000	Same
89	0.05477619467350610000	0.00002747047528340460	0.05012525204075940000	Same
90	0.05477619467350610000	0.00002747047528340460	0.05012525204075940000	Same
91	0.05477619467350610000	0.00002747047528340460	0.05012525204075940000	Same
92	0.05477619467350610000	0.00002747047528340460	0.05012525204075940000	Same
93	0.05477619467350610000	0.00002747047528340460	0.05012525204075940000	Same
94	0.05477619467350610000	0.00002747047528340460	0.05012525204075940000	Same
95	0.05477619467350610000	0.00002747047528340460	0.05012525204075940000	Same
96	0.05477619467350610000	0.00002747047528340460	0.05012525204075940000	Same
97	0.05477619467350610000	0.00002747047528340460	0.05012525204075940000	Same
98	0.05477619467350610000	0.00002747047528340460	0.05012525204075940000	Same
99	0.05477619467350610000	0.00002747047528340460	0.05012525204075940000	Same
100	0.05477619467350610000	0.00002747047528340460	0.05012525204075940000	Same
101	0.05477619467350610000	0.00002747047528340460	0.05012525204075940000	Same
102	0.05477619467350610000	0.00002747047528340460	0.05012525204075940000	Same
103	0.05477619467350610000	0.00002747047528340460	0.05012525204075940000	Same
104	0.05477619467350610000	0.00002747047528340460	0.05012525204075940000	Same
105	0.05477619467350610000	0.00002747047528340460	0.05012525204075940000	Same

Table 24 Approximations and Errors

The Bolded line in the table is the **point of diminishing returns.**

The value of Maclaurin series for  $X=3.14159265358$

Number of Terms	Approximated Answer Based on Terms	Absolute True Error (Et)	Relative True Error (et)%	Status
1	0.05480366514861890000	0.000000000000017066903	3.114190073540540e-10	---
2	0.05477619060605010000	0.00002747454273943630	0.05013267390938930000	Decreasing
3	0.05477619473609670000	0.00002747041269280520	0.05012513783197570000	Decreasing
4	0.05477619473580110000	0.00002747041298844370	0.05012513837142600000	Decreasing
5	<b>0.05477619473580110000</b>	<b>0.00002747041298842980</b>	<b>0.05012513837140070000</b>	<b>Decreasing</b>
6	0.05477619473580110000	0.00002747041298842980	0.05012513837140070000	Same
7	0.05477619473580110000	0.00002747041298842980	0.05012513837140070000	Same
8	0.05477619473580110000	0.00002747041298842980	0.05012513837140070000	Same
9	0.05477619473580110000	0.00002747041298842980	0.05012513837140070000	Same
10	0.05477619473580110000	0.00002747041298842980	0.05012513837140070000	Same
11	0.05477619473580110000	0.00002747041298842980	0.05012513837140070000	Same
12	0.05477619473580110000	0.00002747041298842980	0.05012513837140070000	Same
13	0.05477619473580110000	0.00002747041298842980	0.05012513837140070000	Same
14	0.05477619473580110000	0.00002747041298842980	0.05012513837140070000	Same
15	0.05477619473580110000	0.00002747041298842980	0.05012513837140070000	Same
16	0.05477619473580110000	0.00002747041298842980	0.05012513837140070000	Same
17	0.05477619473580110000	0.00002747041298842980	0.05012513837140070000	Same
18	0.05477619473580110000	0.00002747041298842980	0.05012513837140070000	Same
19	0.05477619473580110000	0.00002747041298842980	0.05012513837140070000	Same
20	0.05477619473580110000	0.00002747041298842980	0.05012513837140070000	Same
21	0.05477619473580110000	0.00002747041298842980	0.05012513837140070000	Same
22	0.05477619473580110000	0.00002747041298842980	0.05012513837140070000	Same

[illegible]

[illegible]

[illegible]



101	0.05477619473580110000	0.00002747041298842980	0.05012513837140070000	Same
102	0.05477619473580110000	0.00002747041298842980	0.05012513837140070000	Same
103	0.05477619473580110000	0.00002747041298842980	0.05012513837140070000	Same
104	0.05477619473580110000	0.00002747041298842980	0.05012513837140070000	Same
105	0.05477619473580110000	0.00002747041298842980	0.05012513837140070000	Same

Table 25 Approximations and Errors

The Bolded line in the table is the **point of diminishing returns**.

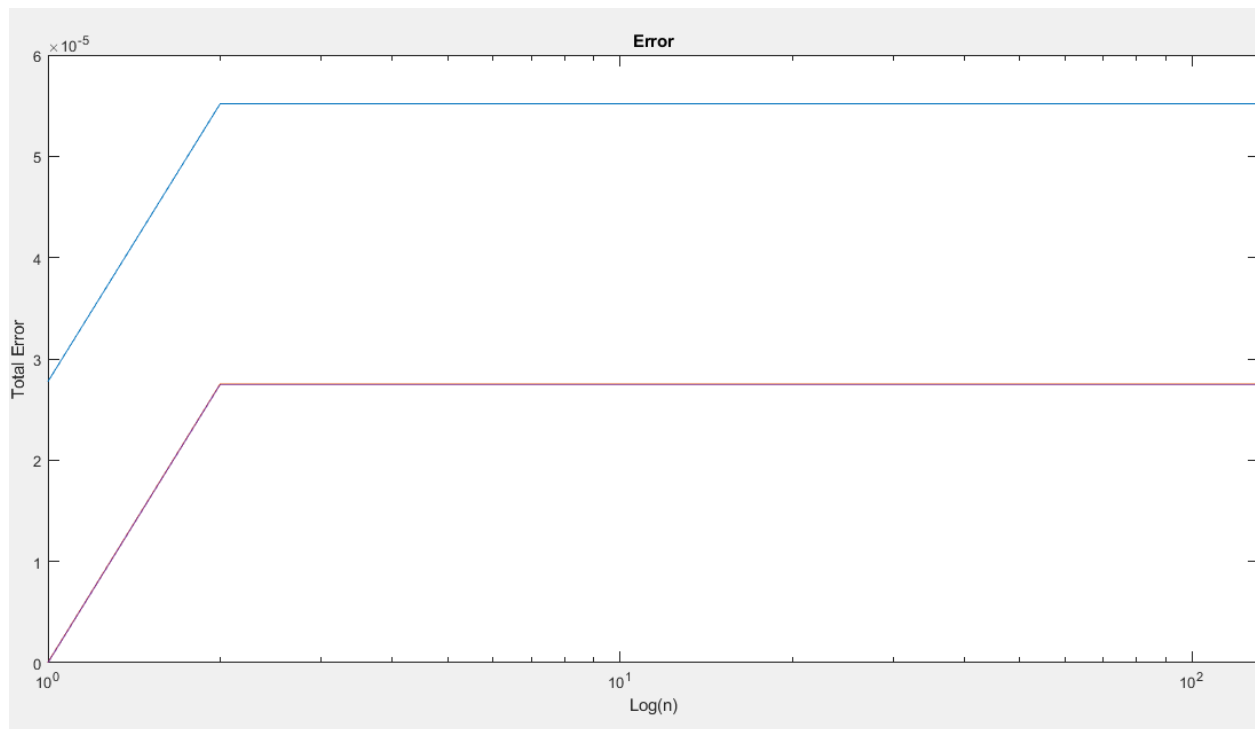


Figure 6 Total Error vs log(n)

### 1.1.6 Task 6:

- Problem Statement:

$$\sin(x) = x - \frac{x^3}{6} + \frac{x^5}{120} - \frac{x^7}{5040} + \dots$$

At  $x = 2\pi$ .

- Solution:  
 $X = 2\pi = 6.283185307179586$ .

$$X = 2 * \pi * \pi / 180.$$

$$\text{True Value Answer} = \sin(X) = 0.109442606906320.$$

# of significant Figures	Method	x approximate(Xa)
3	Chopping	6.28
6	Chopping	6.28318
9	Chopping	6.28318530
12	Chopping	6.28318530717

Table 26

The value of Maclaurin series for  $x = 6.28$

Number of Terms	Approximated Answer Based on Terms	Absolute True Error (Et)	Relative True Error (et)%	Status
1	0.109387346586516	0.000055260319804	0.012644188000474	---
2	0.109167884358658	0.000274722547662	0.251019740325700	Increasing
3	0.109168016185488	0.000274590720831	0.250899287392197	Increasing
4	0.109168016147781	0.000274590758539	0.250899321846396	Increasing
<b>5</b>	<b>0.109168016147787</b>	<b>0.000274590758533</b>	<b>0.250899321840651</b>	<b>Decreasing</b>
6	0.109168016147787	0.000274590758533	0.250899321840651	Same
7	0.109168016147787	0.000274590758533	0.250899321840651	Same
8	0.109168016147787	0.000274590758533	0.250899321840651	Same
9	0.109168016147787	0.000274590758533	0.250899321840651	Same
10	0.109168016147787	0.000274590758533	0.250899321840651	Same
11	0.109168016147787	0.000274590758533	0.250899321840651	Same
12	0.109168016147787	0.000274590758533	0.250899321840651	Same
13	0.109168016147787	0.000274590758533	0.250899321840651	Same

14	0.109168016147787	0.000274590758533	0.250899321840651	Same
15	0.109168016147787	0.000274590758533	0.250899321840651	Same
16	0.109168016147787	0.000274590758533	0.250899321840651	Same
17	0.109168016147787	0.000274590758533	0.250899321840651	Same
18	0.109168016147787	0.000274590758533	0.250899321840651	Same
19	0.109168016147787	0.000274590758533	0.250899321840651	Same
20	0.109168016147787	0.000274590758533	0.250899321840651	Same
21	0.109168016147787	0.000274590758533	0.250899321840651	Same
22	0.109168016147787	0.000274590758533	0.250899321840651	Same
23	0.109168016147787	0.000274590758533	0.250899321840651	Same
24	0.109168016147787	0.000274590758533	0.250899321840651	Same
25	0.109168016147787	0.000274590758533	0.250899321840651	Same
26	0.109168016147787	0.000274590758533	0.250899321840651	Same
27	0.109168016147787	0.000274590758533	0.250899321840651	Same
28	0.109168016147787	0.000274590758533	0.250899321840651	Same
29	0.109168016147787	0.000274590758533	0.250899321840651	Same
30	0.109168016147787	0.000274590758533	0.250899321840651	Same
31	0.109168016147787	0.000274590758533	0.250899321840651	Same
32	0.109168016147787	0.000274590758533	0.250899321840651	Same
33	0.109168016147787	0.000274590758533	0.250899321840651	Same
34	0.109168016147787	0.000274590758533	0.250899321840651	Same
35	0.109168016147787	0.000274590758533	0.250899321840651	Same
36	0.109168016147787	0.000274590758533	0.250899321840651	Same
37	0.109168016147787	0.000274590758533	0.250899321840651	Same
38	0.109168016147787	0.000274590758533	0.250899321840651	Same
39	0.109168016147787	0.000274590758533	0.250899321840651	Same

40	0.109168016147787	0.000274590758533	0.250899321840651	Same
41	0.109168016147787	0.000274590758533	0.250899321840651	Same
42	0.109168016147787	0.000274590758533	0.250899321840651	Same
43	0.109168016147787	0.000274590758533	0.250899321840651	Same
44	0.109168016147787	0.000274590758533	0.250899321840651	Same
45	0.109168016147787	0.000274590758533	0.250899321840651	Same
46	0.109168016147787	0.000274590758533	0.250899321840651	Same
47	0.109168016147787	0.000274590758533	0.250899321840651	Same
48	0.109168016147787	0.000274590758533	0.250899321840651	Same
49	0.109168016147787	0.000274590758533	0.250899321840651	Same
50	0.109168016147787	0.000274590758533	0.250899321840651	Same
51	0.109168016147787	0.000274590758533	0.250899321840651	Same
52	0.109168016147787	0.000274590758533	0.250899321840651	Same
53	0.109168016147787	0.000274590758533	0.250899321840651	Same
54	0.109168016147787	0.000274590758533	0.250899321840651	Same
55	0.109168016147787	0.000274590758533	0.250899321840651	Same
56	0.109168016147787	0.000274590758533	0.250899321840651	Same
57	0.109168016147787	0.000274590758533	0.250899321840651	Same
58	0.109168016147787	0.000274590758533	0.250899321840651	Same
59	0.109168016147787	0.000274590758533	0.250899321840651	Same
60	0.109168016147787	0.000274590758533	0.250899321840651	Same
61	0.109168016147787	0.000274590758533	0.250899321840651	Same
62	0.109168016147787	0.000274590758533	0.250899321840651	Same
63	0.109168016147787	0.000274590758533	0.250899321840651	Same
64	0.109168016147787	0.000274590758533	0.250899321840651	Same
65	0.109168016147787	0.000274590758533	0.250899321840651	Same

66	0.109168016147787	0.000274590758533	0.250899321840651	Same
67	0.109168016147787	0.000274590758533	0.250899321840651	Same
68	0.109168016147787	0.000274590758533	0.250899321840651	Same
69	0.109168016147787	0.000274590758533	0.250899321840651	Same
70	0.109168016147787	0.000274590758533	0.250899321840651	Same
71	0.109168016147787	0.000274590758533	0.250899321840651	Same
72	0.109168016147787	0.000274590758533	0.250899321840651	Same
73	0.109168016147787	0.000274590758533	0.250899321840651	Same
74	0.109168016147787	0.000274590758533	0.250899321840651	Same
75	0.109168016147787	0.000274590758533	0.250899321840651	Same
76	0.109168016147787	0.000274590758533	0.250899321840651	Same
77	0.109168016147787	0.000274590758533	0.250899321840651	Same
78	0.109168016147787	0.000274590758533	0.250899321840651	Same
79	0.109168016147787	0.000274590758533	0.250899321840651	Same
80	0.109168016147787	0.000274590758533	0.250899321840651	Same
81	0.109168016147787	0.000274590758533	0.250899321840651	Same
82	0.109168016147787	0.000274590758533	0.250899321840651	Same
83	0.109168016147787	0.000274590758533	0.250899321840651	Same
84	0.109168016147787	0.000274590758533	0.250899321840651	Same
85	0.109168016147787	0.000274590758533	0.250899321840651	Same
86	0.109168016147787	0.000274590758533	0.250899321840651	Same
87	0.109168016147787	0.000274590758533	0.250899321840651	Same
88	0.109168016147787	0.000274590758533	0.250899321840651	Same
89	0.109168016147787	0.000274590758533	0.250899321840651	Same
90	0.109168016147787	0.000274590758533	0.250899321840651	Same
91	0.109168016147787	0.000274590758533	0.250899321840651	Same

92	0.109168016147787	0.000274590758533	0.250899321840651	Same
93	0.109168016147787	0.000274590758533	0.250899321840651	Same
94	0.109168016147787	0.000274590758533	0.250899321840651	Same
95	0.109168016147787	0.000274590758533	0.250899321840651	Same
96	0.109168016147787	0.000274590758533	0.250899321840651	Same
97	0.109168016147787	0.000274590758533	0.250899321840651	Same
98	0.109168016147787	0.000274590758533	0.250899321840651	Same
99	0.109168016147787	0.000274590758533	0.250899321840651	Same
100	0.109168016147787	0.000274590758533	0.250899321840651	Same
101	0.109168016147787	0.000274590758533	0.250899321840651	Same
102	0.109168016147787	0.000274590758533	0.250899321840651	Same
103	0.109168016147787	0.000274590758533	0.250899321840651	Same
104	0.109168016147787	0.000274590758533	0.250899321840651	Same
105	0.109168016147787	0.000274590758533	0.250899321840651	Same

Table 27 Approximations and Errors

The bolded point is the **point of diminishing return.**

The value of Maclaurin series for  $x = 6.28318$

Number of Terms	Approximated Answer Based on Terms	Absolute True Error (Et)	Relative True Error (et)%	Status
1	0.109442514834966	0.000000092071354	8.412752272870365e-07	---
2	0.109222719051375	0.000219887854945	0.200916134182475	Increasing
3	0.109222851212309	0.000219755694011	0.200795375971541	Increasing
4	0.109222851174468	0.000219755731852	0.200795410548043	Increasing
5	<b>0.109222851174474</b>	<b>0.000219755731846</b>	<b>0.200795410542273</b>	<b>Decreasing</b>

6	0.109222851174474	0.000219755731846	0.200795410542273	Same
7	0.109222851174474	0.000219755731846	0.200795410542273	Same
8	0.109222851174474	0.000219755731846	0.200795410542273	Same
9	0.109222851174474	0.000219755731846	0.200795410542273	Same
10	0.109222851174474	0.000219755731846	0.200795410542273	Same
11	0.109222851174474	0.000219755731846	0.200795410542273	Same
12	0.109222851174474	0.000219755731846	0.200795410542273	Same
13	0.109222851174474	0.000219755731846	0.200795410542273	Same
14	0.109222851174474	0.000219755731846	0.200795410542273	Same
15	0.109222851174474	0.000219755731846	0.200795410542273	Same
16	0.109222851174474	0.000219755731846	0.200795410542273	Same
17	0.109222851174474	0.000219755731846	0.200795410542273	Same
18	0.109222851174474	0.000219755731846	0.200795410542273	Same
19	0.109222851174474	0.000219755731846	0.200795410542273	Same
20	0.109222851174474	0.000219755731846	0.200795410542273	Same
21	0.109222851174474	0.000219755731846	0.200795410542273	Same
22	0.109222851174474	0.000219755731846	0.200795410542273	Same
23	0.109222851174474	0.000219755731846	0.200795410542273	Same
24	0.109222851174474	0.000219755731846	0.200795410542273	Same
25	0.109222851174474	0.000219755731846	0.200795410542273	Same
26	0.109222851174474	0.000219755731846	0.200795410542273	Same
27	0.109222851174474	0.000219755731846	0.200795410542273	Same
28	0.109222851174474	0.000219755731846	0.200795410542273	Same
29	0.109222851174474	0.000219755731846	0.200795410542273	Same
30	0.109222851174474	0.000219755731846	0.200795410542273	Same
31	0.109222851174474	0.000219755731846	0.200795410542273	Same

32	0.109222851174474	0.000219755731846	0.200795410542273	Same
33	0.109222851174474	0.000219755731846	0.200795410542273	Same
34	0.109222851174474	0.000219755731846	0.200795410542273	Same
35	0.109222851174474	0.000219755731846	0.200795410542273	Same
36	0.109222851174474	0.000219755731846	0.200795410542273	Same
37	0.109222851174474	0.000219755731846	0.200795410542273	Same
38	0.109222851174474	0.000219755731846	0.200795410542273	Same
39	0.109222851174474	0.000219755731846	0.200795410542273	Same
40	0.109222851174474	0.000219755731846	0.200795410542273	Same
41	0.109222851174474	0.000219755731846	0.200795410542273	Same
42	0.109222851174474	0.000219755731846	0.200795410542273	Same
43	0.109222851174474	0.000219755731846	0.200795410542273	Same
44	0.109222851174474	0.000219755731846	0.200795410542273	Same
45	0.109222851174474	0.000219755731846	0.200795410542273	Same
46	0.109222851174474	0.000219755731846	0.200795410542273	Same
47	0.109222851174474	0.000219755731846	0.200795410542273	Same
48	0.109222851174474	0.000219755731846	0.200795410542273	Same
49	0.109222851174474	0.000219755731846	0.200795410542273	Same
50	0.109222851174474	0.000219755731846	0.200795410542273	Same
51	0.109222851174474	0.000219755731846	0.200795410542273	Same
52	0.109222851174474	0.000219755731846	0.200795410542273	Same
53	0.109222851174474	0.000219755731846	0.200795410542273	Same
54	0.109222851174474	0.000219755731846	0.200795410542273	Same
55	0.109222851174474	0.000219755731846	0.200795410542273	Same
56	0.109222851174474	0.000219755731846	0.200795410542273	Same
57	0.109222851174474	0.000219755731846	0.200795410542273	Same



58	0.109222851174474	0.000219755731846	0.200795410542273	Same
59	0.109222851174474	0.000219755731846	0.200795410542273	Same
60	0.109222851174474	0.000219755731846	0.200795410542273	Same
61	0.109222851174474	0.000219755731846	0.200795410542273	Same
62	0.109222851174474	0.000219755731846	0.200795410542273	Same
63	0.109222851174474	0.000219755731846	0.200795410542273	Same
64	0.109222851174474	0.000219755731846	0.200795410542273	Same
65	0.109222851174474	0.000219755731846	0.200795410542273	Same
66	0.109222851174474	0.000219755731846	0.200795410542273	Same
67	0.109222851174474	0.000219755731846	0.200795410542273	Same
68	0.109222851174474	0.000219755731846	0.200795410542273	Same
69	0.109222851174474	0.000219755731846	0.200795410542273	Same
70	0.109222851174474	0.000219755731846	0.200795410542273	Same
71	0.109222851174474	0.000219755731846	0.200795410542273	Same
72	0.109222851174474	0.000219755731846	0.200795410542273	Same
73	0.109222851174474	0.000219755731846	0.200795410542273	Same
74	0.109222851174474	0.000219755731846	0.200795410542273	Same
75	0.109222851174474	0.000219755731846	0.200795410542273	Same
76	0.109222851174474	0.000219755731846	0.200795410542273	Same
77	0.109222851174474	0.000219755731846	0.200795410542273	Same
78	0.109222851174474	0.000219755731846	0.200795410542273	Same
79	0.109222851174474	0.000219755731846	0.200795410542273	Same
80	0.109222851174474	0.000219755731846	0.200795410542273	Same
81	0.109222851174474	0.000219755731846	0.200795410542273	Same
82	0.109222851174474	0.000219755731846	0.200795410542273	Same
83	0.109222851174474	0.000219755731846	0.200795410542273	Same

84	0.109222851174474	0.000219755731846	0.200795410542273	Same
85	0.109222851174474	0.000219755731846	0.200795410542273	Same
86	0.109222851174474	0.000219755731846	0.200795410542273	Same
87	0.109222851174474	0.000219755731846	0.200795410542273	Same
88	0.109222851174474	0.000219755731846	0.200795410542273	Same
89	0.109222851174474	0.000219755731846	0.200795410542273	Same
90	0.109222851174474	0.000219755731846	0.200795410542273	Same
91	0.109222851174474	0.000219755731846	0.200795410542273	Same
92	0.109222851174474	0.000219755731846	0.200795410542273	Same
93	0.109222851174474	0.000219755731846	0.200795410542273	Same
94	0.109222851174474	0.000219755731846	0.200795410542273	Same
95	0.109222851174474	0.000219755731846	0.200795410542273	Same
96	0.109222851174474	0.000219755731846	0.200795410542273	Same
97	0.109222851174474	0.000219755731846	0.200795410542273	Same
98	0.109222851174474	0.000219755731846	0.200795410542273	Same
99	0.109222851174474	0.000219755731846	0.200795410542273	Same
100	0.109222851174474	0.000219755731846	0.200795410542273	Same
101	0.109222851174474	0.000219755731846	0.200795410542273	Same
102	0.109222851174474	0.000219755731846	0.200795410542273	Same
103	0.109222851174474	0.000219755731846	0.200795410542273	Same
104	0.109222851174474	0.000219755731846	0.200795410542273	Same
105	0.109222851174474	0.000219755731846	0.200795410542273	Same

Table 28 Approximations and Errors

The bolded point is the **point of diminishing return.**

The value of Maclaurin series for  $x = 6.28318530$

Number of Terms	Approximated Answer Based on Terms	Absolute True Error (Et)	Relative True Error (et)%	Status
1	0.109442606781765	0.000000000124555	1.138085097941938e-09	---
2	0.109222810441966	0.000219796464353	0.200832628686918	Increasing
3	0.109222942603458	0.000219664302862	0.200711869966675	Increasing
4	0.109222942565616	0.000219664340704	0.200711904543392	Increasing
5	<b>0.109222942565623</b>	<b>0.000219664340697</b>	<b>0.200711904537623</b>	<b>Decreasing</b>
6	0.109222942565623	0.000219664340697	0.200711904537623	Same
7	0.109222942565623	0.000219664340697	0.200711904537623	Same
8	0.109222942565623	0.000219664340697	0.200711904537623	Same
9	0.109222942565623	0.000219664340697	0.200711904537623	Same
10	0.109222942565623	0.000219664340697	0.200711904537623	Same
11	0.109222942565623	0.000219664340697	0.200711904537623	Same
12	0.109222942565623	0.000219664340697	0.200711904537623	Same
13	0.109222942565623	0.000219664340697	0.200711904537623	Same
14	0.109222942565623	0.000219664340697	0.200711904537623	Same
15	0.109222942565623	0.000219664340697	0.200711904537623	Same
16	0.109222942565623	0.000219664340697	0.200711904537623	Same
17	0.109222942565623	0.000219664340697	0.200711904537623	Same
18	0.109222942565623	0.000219664340697	0.200711904537623	Same
19	0.109222942565623	0.000219664340697	0.200711904537623	Same
20	0.109222942565623	0.000219664340697	0.200711904537623	Same
21	0.109222942565623	0.000219664340697	0.200711904537623	Same
22	0.109222942565623	0.000219664340697	0.200711904537623	Same

23	0.109222942565623	0.000219664340697	0.200711904537623	Same
24	0.109222942565623	0.000219664340697	0.200711904537623	Same
25	0.109222942565623	0.000219664340697	0.200711904537623	Same
<b>26</b>	0.109222942565623	0.000219664340697	0.200711904537623	Same
27	0.109222942565623	0.000219664340697	0.200711904537623	Same
28	0.109222942565623	0.000219664340697	0.200711904537623	Same
29	0.109222942565623	0.000219664340697	0.200711904537623	Same
30	0.109222942565623	0.000219664340697	0.200711904537623	Same
31	0.109222942565623	0.000219664340697	0.200711904537623	Same
32	0.109222942565623	0.000219664340697	0.200711904537623	Same
33	0.109222942565623	0.000219664340697	0.200711904537623	Same
34	0.109222942565623	0.000219664340697	0.200711904537623	Same
35	0.109222942565623	0.000219664340697	0.200711904537623	Same
36	0.109222942565623	0.000219664340697	0.200711904537623	Same
37	0.109222942565623	0.000219664340697	0.200711904537623	Same
38	0.109222942565623	0.000219664340697	0.200711904537623	Same
39	0.109222942565623	0.000219664340697	0.200711904537623	Same
40	0.109222942565623	0.000219664340697	0.200711904537623	Same
41	0.109222942565623	0.000219664340697	0.200711904537623	Same
42	0.109222942565623	0.000219664340697	0.200711904537623	Same
43	0.109222942565623	0.000219664340697	0.200711904537623	Same
44	0.109222942565623	0.000219664340697	0.200711904537623	Same
45	0.109222942565623	0.000219664340697	0.200711904537623	Same
46	0.109222942565623	0.000219664340697	0.200711904537623	Same
47	0.109222942565623	0.000219664340697	0.200711904537623	Same
48	0.109222942565623	0.000219664340697	0.200711904537623	Same

49	0.109222942565623	0.000219664340697	0.200711904537623	Same
50	0.109222942565623	0.000219664340697	0.200711904537623	Same
51	0.109222942565623	0.000219664340697	0.200711904537623	Same
52	0.109222942565623	0.000219664340697	0.200711904537623	Same
53	0.109222942565623	0.000219664340697	0.200711904537623	Same
54	0.109222942565623	0.000219664340697	0.200711904537623	Same
55	0.109222942565623	0.000219664340697	0.200711904537623	Same
56	0.109222942565623	0.000219664340697	0.200711904537623	Same
57	0.109222942565623	0.000219664340697	0.200711904537623	Same
58	0.109222942565623	0.000219664340697	0.200711904537623	Same
59	0.109222942565623	0.000219664340697	0.200711904537623	Same
60	0.109222942565623	0.000219664340697	0.200711904537623	Same
61	0.109222942565623	0.000219664340697	0.200711904537623	Same
62	0.109222942565623	0.000219664340697	0.200711904537623	Same
63	0.109222942565623	0.000219664340697	0.200711904537623	Same
64	0.109222942565623	0.000219664340697	0.200711904537623	Same
65	0.109222942565623	0.000219664340697	0.200711904537623	Same
66	0.109222942565623	0.000219664340697	0.200711904537623	Same
67	0.109222942565623	0.000219664340697	0.200711904537623	Same
68	0.109222942565623	0.000219664340697	0.200711904537623	Same
69	0.109222942565623	0.000219664340697	0.200711904537623	Same
70	0.109222942565623	0.000219664340697	0.200711904537623	Same
71	0.109222942565623	0.000219664340697	0.200711904537623	Same
72	0.109222942565623	0.000219664340697	0.200711904537623	Same
73	0.109222942565623	0.000219664340697	0.200711904537623	Same
74	0.109222942565623	0.000219664340697	0.200711904537623	Same

75	0.109222942565623	0.000219664340697	0.200711904537623	Same
76	0.109222942565623	0.000219664340697	0.200711904537623	Same
77	0.109222942565623	0.000219664340697	0.200711904537623	Same
78	0.109222942565623	0.000219664340697	0.200711904537623	Same
79	0.109222942565623	0.000219664340697	0.200711904537623	Same
80	0.109222942565623	0.000219664340697	0.200711904537623	Same
81	0.109222942565623	0.000219664340697	0.200711904537623	Same
82	0.109222942565623	0.000219664340697	0.200711904537623	Same
83	0.109222942565623	0.000219664340697	0.200711904537623	Same
84	0.109222942565623	0.000219664340697	0.200711904537623	Same
85	0.109222942565623	0.000219664340697	0.200711904537623	Same
86	0.109222942565623	0.000219664340697	0.200711904537623	Same
87	0.109222942565623	0.000219664340697	0.200711904537623	Same
88	0.109222942565623	0.000219664340697	0.200711904537623	Same
89	0.109222942565623	0.000219664340697	0.200711904537623	Same
90	0.109222942565623	0.000219664340697	0.200711904537623	Same
91	0.109222942565623	0.000219664340697	0.200711904537623	Same
92	0.109222942565623	0.000219664340697	0.200711904537623	Same
93	0.109222942565623	0.000219664340697	0.200711904537623	Same
94	0.109222942565623	0.000219664340697	0.200711904537623	Same
95	0.109222942565623	0.000219664340697	0.200711904537623	Same
96	0.109222942565623	0.000219664340697	0.200711904537623	Same
97	0.109222942565623	0.000219664340697	0.200711904537623	Same
98	0.109222942565623	0.000219664340697	0.200711904537623	Same
99	0.109222942565623	0.000219664340697	0.200711904537623	Same
100	0.109222942565623	0.000219664340697	0.200711904537623	Same

101	0.109222942565623	0.000219664340697	0.200711904537623	Same
102	0.109222942565623	0.000219664340697	0.200711904537623	Same
103	0.109222942565623	0.000219664340697	0.200711904537623	Same
104	0.109222942565623	0.000219664340697	0.200711904537623	Same
105	0.109222942565623	0.000219664340697	0.200711904537623	Same

Table 29 Approximations and Errors

The bolded point is the **point of diminishing return.**

The value of Maclaurin series for  $x = 6.28318530717$

Number of Terms	Approximated Answer Based on Terms	Absolute True Error (Et)	Relative True Error (et)%	Status
1	0.109442606906154	1.66297531301041e-13	1.516776735244363e-12	---
2	0.109222810565602	0.000219796340717	0.200832515718152	Increasing
3	0.109222942727095	0.000219664179225	0.200711756997224	Increasing
4	0.109222942689253	0.000219664217067	0.200711791573941	Increasing
<b>5</b>	<b>0.109222942689259</b>	<b>0.000219664217061</b>	<b>0.200711791568172</b>	<b>Decreasing</b>
6	0.109222942689259	0.000219664217061	0.200711791568172	Same
7	0.109222942689259	0.000219664217061	0.200711791568172	Same
8	0.109222942689259	0.000219664217061	0.200711791568172	Same
9	0.109222942689259	0.000219664217061	0.200711791568172	Same
10	0.109222942689259	0.000219664217061	0.200711791568172	Same
11	0.109222942689259	0.000219664217061	0.200711791568172	Same
12	0.109222942689259	0.000219664217061	0.200711791568172	Same
13	0.109222942689259	0.000219664217061	0.200711791568172	Same
14	0.109222942689259	0.000219664217061	0.200711791568172	Same

15	0.109222942689259	0.000219664217061	0.200711791568172	Same
16	0.109222942689259	0.000219664217061	0.200711791568172	Same
17	0.109222942689259	0.000219664217061	0.200711791568172	Same
18	0.109222942689259	0.000219664217061	0.200711791568172	Same
19	0.109222942689259	0.000219664217061	0.200711791568172	Same
20	0.109222942689259	0.000219664217061	0.200711791568172	Same
21	0.109222942689259	0.000219664217061	0.200711791568172	Same
22	0.109222942689259	0.000219664217061	0.200711791568172	Same
23	0.109222942689259	0.000219664217061	0.200711791568172	Same
24	0.109222942689259	0.000219664217061	0.200711791568172	Same
25	0.109222942689259	0.000219664217061	0.200711791568172	Same
26	0.109222942689259	0.000219664217061	0.200711791568172	Same
27	0.109222942689259	0.000219664217061	0.200711791568172	Same
28	0.109222942689259	0.000219664217061	0.200711791568172	Same
29	0.109222942689259	0.000219664217061	0.200711791568172	Same
30	0.109222942689259	0.000219664217061	0.200711791568172	Same
31	0.109222942689259	0.000219664217061	0.200711791568172	Same
32	0.109222942689259	0.000219664217061	0.200711791568172	Same
33	0.109222942689259	0.000219664217061	0.200711791568172	Same
34	0.109222942689259	0.000219664217061	0.200711791568172	Same
35	0.109222942689259	0.000219664217061	0.200711791568172	Same
36	0.109222942689259	0.000219664217061	0.200711791568172	Same
37	0.109222942689259	0.000219664217061	0.200711791568172	Same
38	0.109222942689259	0.000219664217061	0.200711791568172	Same
39	0.109222942689259	0.000219664217061	0.200711791568172	Same
40	0.109222942689259	0.000219664217061	0.200711791568172	Same



41	0.109222942689259	0.000219664217061	0.200711791568172	Same
42	0.109222942689259	0.000219664217061	0.200711791568172	Same
43	0.109222942689259	0.000219664217061	0.200711791568172	Same
44	0.109222942689259	0.000219664217061	0.200711791568172	Same
45	0.109222942689259	0.000219664217061	0.200711791568172	Same
46	0.109222942689259	0.000219664217061	0.200711791568172	Same
47	0.109222942689259	0.000219664217061	0.200711791568172	Same
48	0.109222942689259	0.000219664217061	0.200711791568172	Same
49	0.109222942689259	0.000219664217061	0.200711791568172	Same
50	0.109222942689259	0.000219664217061	0.200711791568172	Same
51	0.109222942689259	0.000219664217061	0.200711791568172	Same
52	0.109222942689259	0.000219664217061	0.200711791568172	Same
53	0.109222942689259	0.000219664217061	0.200711791568172	Same
54	0.109222942689259	0.000219664217061	0.200711791568172	Same
55	0.109222942689259	0.000219664217061	0.200711791568172	Same
56	0.109222942689259	0.000219664217061	0.200711791568172	Same
57	0.109222942689259	0.000219664217061	0.200711791568172	Same
58	0.109222942689259	0.000219664217061	0.200711791568172	Same
59	0.109222942689259	0.000219664217061	0.200711791568172	Same
60	0.109222942689259	0.000219664217061	0.200711791568172	Same
61	0.109222942689259	0.000219664217061	0.200711791568172	Same
62	0.109222942689259	0.000219664217061	0.200711791568172	Same
63	0.109222942689259	0.000219664217061	0.200711791568172	Same
64	0.109222942689259	0.000219664217061	0.200711791568172	Same
65	0.109222942689259	0.000219664217061	0.200711791568172	Same
66	0.109222942689259	0.000219664217061	0.200711791568172	Same

67	0.109222942689259	0.000219664217061	0.200711791568172	Same
68	0.109222942689259	0.000219664217061	0.200711791568172	Same
69	0.109222942689259	0.000219664217061	0.200711791568172	Same
70	0.109222942689259	0.000219664217061	0.200711791568172	Same
71	0.109222942689259	0.000219664217061	0.200711791568172	Same
72	0.109222942689259	0.000219664217061	0.200711791568172	Same
73	0.109222942689259	0.000219664217061	0.200711791568172	Same
74	0.109222942689259	0.000219664217061	0.200711791568172	Same
75	0.109222942689259	0.000219664217061	0.200711791568172	Same
76	0.109222942689259	0.000219664217061	0.200711791568172	Same
77	0.109222942689259	0.000219664217061	0.200711791568172	Same
78	0.109222942689259	0.000219664217061	0.200711791568172	Same
79	0.109222942689259	0.000219664217061	0.200711791568172	Same
80	0.109222942689259	0.000219664217061	0.200711791568172	Same
81	0.109222942689259	0.000219664217061	0.200711791568172	Same
82	0.109222942689259	0.000219664217061	0.200711791568172	Same
83	0.109222942689259	0.000219664217061	0.200711791568172	Same
84	0.109222942689259	0.000219664217061	0.200711791568172	Same
85	0.109222942689259	0.000219664217061	0.200711791568172	Same
86	0.109222942689259	0.000219664217061	0.200711791568172	Same
87	0.109222942689259	0.000219664217061	0.200711791568172	Same
88	0.109222942689259	0.000219664217061	0.200711791568172	Same
89	0.109222942689259	0.000219664217061	0.200711791568172	Same
90	0.109222942689259	0.000219664217061	0.200711791568172	Same
91	0.109222942689259	0.000219664217061	0.200711791568172	Same
92	0.109222942689259	0.000219664217061	0.200711791568172	Same

93	0.109222942689259	0.000219664217061	0.200711791568172	Same
94	0.109222942689259	0.000219664217061	0.200711791568172	Same
95	0.109222942689259	0.000219664217061	0.200711791568172	Same
96	0.109222942689259	0.000219664217061	0.200711791568172	Same
97	0.109442606906154	0.000000000000166	0.000000000000000	Same
98	0.109222810565602	0.000219796340717	0.200832515718152	Same
99	0.109222942727095	0.000219664179225	0.200711756997224	Same
100	0.109222942689253	0.000219664217067	0.200711791573941	Same
101	0.109222942689259	0.000219664217061	0.200711791568172	Same
102	0.109222942689259	0.000219664217061	0.200711791568172	Same
103	0.109222942689259	0.000219664217061	0.200711791568172	Same
104	0.109222942689259	0.000219664217061	0.200711791568172	Same
105	0.109222942689259	0.000219664217061	0.200711791568172	Same

*Table 30 Approximations and Errors*

The bolded point is the **point of diminishing return.**

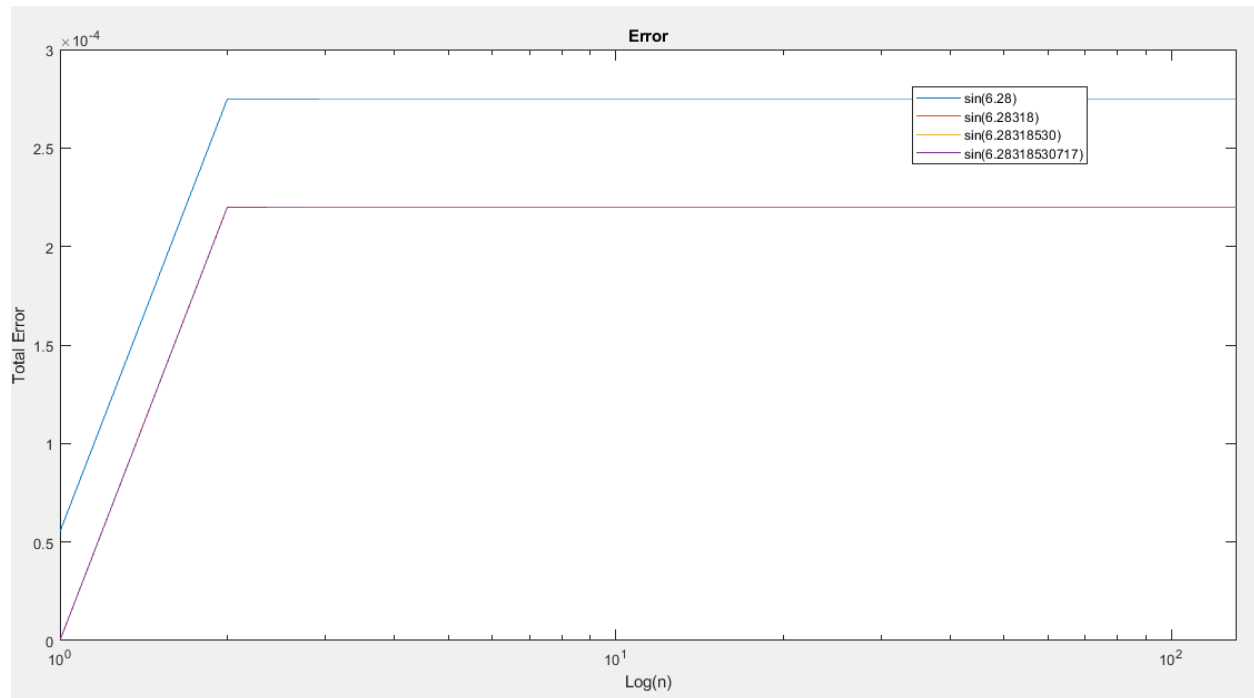


Figure 7 Total Error vs Number of Terms

### 1.1.7 Task 7:

- Problem Statement:

$$\sin(x) = x - \frac{x^3}{6} + \frac{x^5}{120} - \frac{x^7}{5040} + \dots$$

At  $x = \pi/2$ .

- Solution:  
 $X = \pi/2 = 1.570796326794897$ .  
 $X = \pi/2 * \pi/180$ .  
 True Value Answer =  $\sin(X) = 0.027412133592044$ .

# of significant Figures	Method	x approximate(Xa)
3	Chopping	1.57

6	Chopping	1.57079
9	Chopping	1.57079632
12	Chopping	1.57079632679

Table 31

The value of Maclaurin series for  $x = 1.57$

Number of Terms	Approximated Answer Based on Terms	Absolute True Error (Et)	Relative True Error (et)%	Status
1	0.02739824028773550000	1.38933043087631000000E-05	1.27715385623942000000E-02	---
2	0.02739481119042530000	1.73224016190368000000E-05	6.31924602325162000000E-02	Decreasing
3	0.02739481131916240000	1.73222728818978000000E-05	6.31919905969128000000E-02	Decreasing
4	<b>0.02739481131916010000</b>	<b>1.73222728841980000000E-05</b>	<b>6.31919906053041000000E-02</b>	<b>Decreasing</b>
5	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
6	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
7	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
8	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
9	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
10	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
11	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
12	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same

13	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
14	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
15	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
16	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
17	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
18	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
19	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
20	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
21	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
22	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
23	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
24	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
25	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
26	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
27	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
28	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
29	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same

30	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
31	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
32	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
33	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
34	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
35	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
36	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
37	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
38	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
39	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
40	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
41	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
42	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
43	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
44	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
45	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
46	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same

47	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
48	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
49	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
50	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
51	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
52	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
53	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
54	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
55	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
56	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
57	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
58	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
59	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
60	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
61	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
62	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
63	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same



64	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
65	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
66	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
67	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
68	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
69	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
70	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
71	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
72	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
73	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
74	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
75	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
76	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
77	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
78	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
79	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
80	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same

81	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
82	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
83	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
84	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
85	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
86	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
87	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
88	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
89	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
90	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
91	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
92	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
93	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
94	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
95	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
96	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
97	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same

98	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
99	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
100	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
101	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
102	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
103	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same
104	0.02739481131916010000	1.73222728841980000000E-05	6.31919906053041000000E-02	Same

Table 32 Approximations and Errors

The bolded point is the **point of diminishing return**.

The value of Maclaurin series for  $x = 1.57079$

Number of Terms	Approximated Answer Based on Terms	Absolute True Error (Et)	Relative True Error (et)%	Status
1	0.02741202321013730000	1.10381906968937000000E-07	0.00000000000000000000E+00	---
2	0.02740858893381390000	3.54465823041231000000E-06	1.29309826194669000000E-02	Decreasing
3	0.02740858906287520000	3.54452916905348000000E-06	1.29305118011033000000E-02	Decreasing
<b>4</b>	<b>0.02740858906287290000</b>	<b>3.54452917136414000000E-06</b>	<b>1.29305118095326000000E-02</b>	<b>Decreasing</b>
5	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
6	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same

7	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
8	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
9	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
10	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
11	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
12	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
13	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
14	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
15	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
16	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
17	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
18	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
19	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
20	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
21	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
22	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
23	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same

24	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
25	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
26	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
27	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
28	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
29	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
30	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
31	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
32	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
33	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
34	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
35	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
36	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
37	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
38	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
39	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
40	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same

41	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
42	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
43	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
44	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
45	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
46	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
47	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
48	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
49	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
50	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
51	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
52	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
53	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
54	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
55	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
56	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
57	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same

58	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
59	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
60	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
61	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
62	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
63	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
64	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
65	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
66	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
67	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
68	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
69	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
70	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
71	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
72	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
73	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
74	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same

75	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
76	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
77	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
78	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
79	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
80	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
81	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
82	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
83	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
84	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
85	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
86	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
87	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
88	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
89	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
90	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
91	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same



92	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
93	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
94	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
95	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
96	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
97	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
98	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
99	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
100	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
101	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
102	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
103	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same
104	0.02740858906287290000	3.54452917136414000000E-06	1.29305118095326000000E-02	Same

*Table 33 Approximations and Errors*

The bolded point is the **point of diminishing return.**

The value of Maclaurin series for  $x = 1.57079632$

Number of Terms	Approximated Answer Based on Terms	Absolute True Error (Et)	Relative True Error (et)%	Status
1	0.02741213347349550000	3.18548761085524000000E-10	0.000000000000000000E+00	---
2	0.02740869915571900000	3.43443632531970000000E-06	1.25288909518392000000E-02	Decreasing
3	0.02740869928478290000	3.43430726136573000000E-06	1.25284201240084000000E-02	Decreasing
4	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Decreasing
5	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
6	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
7	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
8	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
9	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
10	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
11	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
12	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
13	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
14	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
15	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same

16	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
17	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
18	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
19	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
20	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
21	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
22	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
23	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
24	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
25	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
26	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
27	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
28	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
29	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
30	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
31	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
32	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same

33	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
34	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
35	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
36	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
37	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
38	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
39	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
40	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
41	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
42	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
43	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
44	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
45	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
46	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
47	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
48	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
49	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same

50	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
51	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
52	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
53	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
54	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
55	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
56	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
57	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
58	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
59	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
60	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
61	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
62	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
63	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
64	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
65	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
66	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same

67	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
68	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
69	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
70	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
71	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
72	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
73	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
74	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
75	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
76	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
77	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
78	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
79	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
80	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
81	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
82	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
83	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same

84	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
85	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
86	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
87	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
88	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
89	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
90	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
91	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
92	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
93	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
94	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
95	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
96	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
97	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
98	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
99	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
100	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same

101	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
102	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
103	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same
104	0.02740869928478060000	3.43430726367638000000E-06	1.25284201324377000000E-02	Same

Table 34 Approximations and Errors

The bolded point is the **point of diminishing return.**

The value of Maclaurin series for  $x = 1.57079632679$

Number of Terms	Approximated Answer Based on Terms	Absolute True Error (Et)	Relative True Error (et)%	Status
1	0.02741213359195890000	8.54386006388097000000E-14	0.00000000000000000000E+00	---
2	0.02740869927413780000	3.43431790653451000000E-06	1.25284589577924000000E-02	Decreasing
3	0.02740869940320170000	3.43418884257707000000E-06	1.25279881299490000000E-02	Decreasing
4	<b>0.02740869940319940000</b>	<b>3.43418884488772000000E-06</b>	<b>1.25279881383783000000E-02</b>	<b>Decreasing</b>
5	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
6	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
7	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
8	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
9	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same



10	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
11	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
12	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
13	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
14	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
15	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
16	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
17	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
18	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
19	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
20	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
21	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
22	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
23	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
24	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
25	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
26	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same

27	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
28	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
29	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
30	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
31	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
32	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
33	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
34	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
35	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
36	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
37	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
38	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
39	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
40	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
41	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
42	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
43	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same

44	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
45	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
46	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
47	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
48	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
49	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
50	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
51	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
52	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
53	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
54	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
55	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
56	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
57	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
58	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
59	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
60	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same

61	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
62	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
63	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
64	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
65	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
66	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
67	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
68	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
69	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
70	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
71	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
72	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
73	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
74	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
75	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
76	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
77	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same

78	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
79	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
80	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
81	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
82	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
83	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
84	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
85	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
86	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
87	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
88	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
89	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
90	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
91	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
92	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
93	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
94	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same

95	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
96	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
97	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
98	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
99	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
100	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
101	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
102	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
103	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same
104	0.02740869940319940000	3.43418884488772000000E-06	1.25279881383783000000E-02	Same

*Table 35 Approximations and Errors*

The bolded point is the **point of diminishing return.**

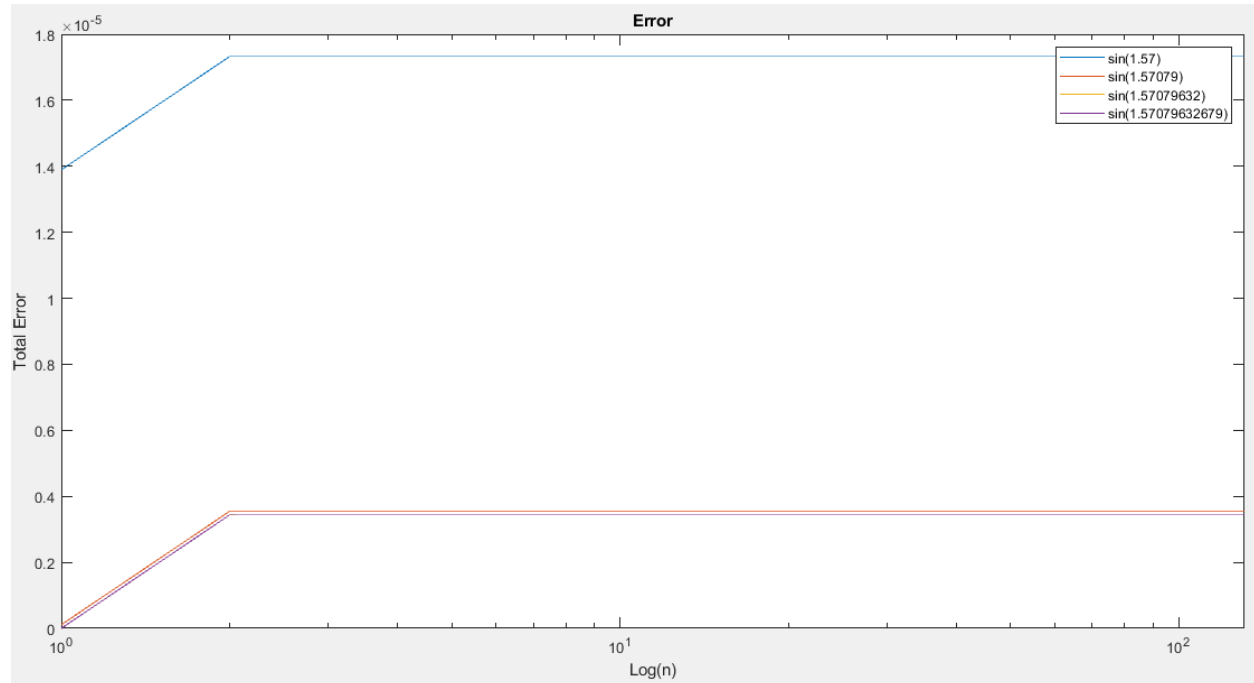


Figure 8 Total Error vs Number of Terms

### 1.1.8 Task 8:

- Problem Statement:

$$\sin(x) = x - \frac{x^3}{6} + \frac{x^5}{120} - \frac{x^7}{5040} + \dots \quad 1-2$$

At  $x = 3\pi/2$ .

- Solution:

$$X = 3\pi/2 = 4.712388980384690.$$

$$X = 3\pi/2 * \pi/180.$$

$$\text{True Value Answer} = \sin(X) = 0.082154008118732.$$

# of significant Figures	Method	x approximate(Xa)
3	Chopping	4.71
6	Chopping	4.71238
9	Chopping	4.71238898

Table 36

The value of Maclaurin series for  $x = 4.71$

Number of Terms	Approximated Answer Based on Terms	Absolute True Error (Et)	Relative True Error (et)%	Status
1	0.08211245341964740000	4.155469908426190000000E-05	1.269290271613850000000E-02	---
2	0.08201986779227000000	1.341403264616960000000E-04	1.632791016937750000000E-01	Decreasing
3	0.08201989907539480000	1.341090433368690000000E-04	1.632410230588510000000E-01	Decreasing
4	0.08201989907036150000	1.341090483702180000000E-04	1.632410291855740000000E-01	Decreasing
5	<b>0.08201989907036190000</b>	<b>1.341090483697460000000E-04</b>	<b>1.632410291850000000000E-01</b>	<b>Decreasing</b>
6	0.08201989907036190000	1.341090483697460000000E-04	1.632410291850000000000E-01	Same
7	0.08201989907036190000	1.341090483697460000000E-04	1.632410291850000000000E-01	Same
8	0.08201989907036190000	1.341090483697460000000E-04	1.632410291850000000000E-01	Same
9	0.08201989907036190000	1.341090483697460000000E-04	1.632410291850000000000E-01	Same
10	0.08201989907036190000	1.341090483697460000000E-04	1.632410291850000000000E-01	Same
11	0.08201989907036190000	1.341090483697460000000E-04	1.632410291850000000000E-01	Same
12	0.08201989907036190000	1.341090483697460000000E-04	1.632410291850000000000E-01	Same
13	0.08201989907036190000	1.341090483697460000000E-04	1.632410291850000000000E-01	Same



14	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
15	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
16	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
17	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
18	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
19	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
20	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
21	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
22	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
23	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
24	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
25	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
26	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
27	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
28	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
29	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
30	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same

31	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
32	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
33	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
34	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
35	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
36	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
37	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
38	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
39	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
40	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
41	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
42	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
43	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
44	0.08201989907036190000	1.341090483697460000E-04	1.63241029185000000000E-01	Same
45	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
46	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
47	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same

48	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
49	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
50	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
51	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
52	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
53	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
54	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
55	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
56	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
57	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
58	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
59	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
60	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
61	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
62	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
63	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
64	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same

65	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
66	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
67	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
68	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
69	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
70	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
71	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
72	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
73	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
74	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
75	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
76	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
77	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
78	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
79	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
80	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
81	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same

82	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
83	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
84	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
85	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
86	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
87	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
88	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
89	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
90	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
91	0.08201989907036190000	1.341090483697460000E-04	1.63241029185000000000E-01	Same
92	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
93	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
94	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
95	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
96	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
97	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
98	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same

99	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
100	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
101	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
102	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
103	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
104	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same
105	0.08201989907036190000	1.34109048369746000000E-04	1.63241029185000000000E-01	Same

*Table 37 Approximations and Errors*

The bolded point is the **point of diminishing return.**

The value of Maclaurin series for  $x = 4.71238$

Number of Terms	Approximated Answer Based on Terms	Absolute True Error (Et)	Relative True Error (et)%	Status
1	0.08215385191127720000	1.56207454457546000000E-07	1.901397850629384e-06	---
2	0.08206112586023200000	9.28822584996686000000E-05	1.13058705992083000000E-01	Decreasing
3	0.08206115722247480000	9.285089625687970000E-05	1.13020531052713000000E-01	Decreasing
4	0.08206115721742360000	9.28509013080614000000E-05	1.13020537201143000000E-01	Decreasing
5	<b>0.08206115721742410000</b>	<b>9.28509013075896000000E-05</b>	<b>1.13020537200569000000E-01</b>	<b>Decreasing</b>

6	0.08206115721742410000	9.285090130758960000000E-05	1.130205372005690000000E-01	Same
7	0.08206115721742410000	9.285090130758960000000E-05	1.130205372005690000000E-01	Same
8	0.08206115721742410000	9.285090130758960000000E-05	1.130205372005690000000E-01	Same
9	0.08206115721742410000	9.285090130758960000000E-05	1.130205372005690000000E-01	Same
10	0.08206115721742410000	9.285090130758960000000E-05	1.130205372005690000000E-01	Same
11	0.08206115721742410000	9.285090130758960000000E-05	1.130205372005690000000E-01	Same
12	0.08206115721742410000	9.285090130758960000000E-05	1.130205372005690000000E-01	Same
13	0.08206115721742410000	9.285090130758960000000E-05	1.130205372005690000000E-01	Same
14	0.08206115721742410000	9.285090130758960000000E-05	1.130205372005690000000E-01	Same
15	0.08206115721742410000	9.285090130758960000000E-05	1.130205372005690000000E-01	Same
16	0.08206115721742410000	9.285090130758960000000E-05	1.130205372005690000000E-01	Same
17	0.08206115721742410000	9.285090130758960000000E-05	1.130205372005690000000E-01	Same
18	0.08206115721742410000	9.285090130758960000000E-05	1.130205372005690000000E-01	Same
19	0.08206115721742410000	9.285090130758960000000E-05	1.130205372005690000000E-01	Same
20	0.08206115721742410000	9.285090130758960000000E-05	1.130205372005690000000E-01	Same
21	0.08206115721742410000	9.285090130758960000000E-05	1.130205372005690000000E-01	Same
22	0.08206115721742410000	9.285090130758960000000E-05	1.130205372005690000000E-01	Same

23	0.08206115721742410000	9.28509013075896000000E-05	1.13020537200569000000E-01	Same
24	0.08206115721742410000	9.28509013075896000000E-05	1.13020537200569000000E-01	Same
25	0.08206115721742410000	9.28509013075896000000E-05	1.13020537200569000000E-01	Same
26	0.08206115721742410000	9.28509013075896000000E-05	1.13020537200569000000E-01	Same
27	0.08206115721742410000	9.28509013075896000000E-05	1.13020537200569000000E-01	Same
28	0.08206115721742410000	9.28509013075896000000E-05	1.13020537200569000000E-01	Same
29	0.08206115721742410000	9.28509013075896000000E-05	1.13020537200569000000E-01	Same
30	0.08206115721742410000	9.28509013075896000000E-05	1.13020537200569000000E-01	Same
31	0.08206115721742410000	9.28509013075896000000E-05	1.13020537200569000000E-01	Same
32	0.08206115721742410000	9.28509013075896000000E-05	1.13020537200569000000E-01	Same
33	0.08206115721742410000	9.28509013075896000000E-05	1.13020537200569000000E-01	Same
34	0.08206115721742410000	9.28509013075896000000E-05	1.13020537200569000000E-01	Same
35	0.08206115721742410000	9.28509013075896000000E-05	1.13020537200569000000E-01	Same
36	0.08206115721742410000	9.28509013075896000000E-05	1.13020537200569000000E-01	Same
37	0.08206115721742410000	9.28509013075896000000E-05	1.13020537200569000000E-01	Same
38	0.08206115721742410000	9.28509013075896000000E-05	1.13020537200569000000E-01	Same
39	0.08206115721742410000	9.28509013075896000000E-05	1.13020537200569000000E-01	Same



40	0.08206115721742410000	9.285090130758960000000E-05	1.130205372005690000000E-01	Same
41	0.08206115721742410000	9.285090130758960000000E-05	1.130205372005690000000E-01	Same
42	0.08206115721742410000	9.285090130758960000000E-05	1.130205372005690000000E-01	Same
43	0.08206115721742410000	9.285090130758960000000E-05	1.130205372005690000000E-01	Same
44	0.08206115721742410000	9.285090130758960000000E-05	1.130205372005690000000E-01	Same
45	0.08206115721742410000	9.285090130758960000000E-05	1.130205372005690000000E-01	Same
46	0.08206115721742410000	9.285090130758960000000E-05	1.130205372005690000000E-01	Same
47	0.08206115721742410000	9.285090130758960000000E-05	1.130205372005690000000E-01	Same
48	0.08206115721742410000	9.285090130758960000000E-05	1.130205372005690000000E-01	Same
49	0.08206115721742410000	9.285090130758960000000E-05	1.130205372005690000000E-01	Same
50	0.08206115721742410000	9.2850901307589600000E-05	1.130205372005690000000E-01	Same
51	0.08206115721742410000	9.285090130758960000000E-05	1.130205372005690000000E-01	Same
52	0.08206115721742410000	9.285090130758960000000E-05	1.130205372005690000000E-01	Same
53	0.08206115721742410000	9.285090130758960000000E-05	1.130205372005690000000E-01	Same
54	0.08206115721742410000	9.285090130758960000000E-05	1.130205372005690000000E-01	Same
55	0.08206115721742410000	9.285090130758960000000E-05	1.130205372005690000000E-01	Same
56	0.08206115721742410000	9.285090130758960000000E-05	1.130205372005690000000E-01	Same

57	0.08206115721742410000	9.28509013075896000000E-05	1.13020537200569000000E-01	Same
58	0.08206115721742410000	9.28509013075896000000E-05	1.13020537200569000000E-01	Same
59	0.08206115721742410000	9.28509013075896000000E-05	1.13020537200569000000E-01	Same
60	0.08206115721742410000	9.28509013075896000000E-05	1.13020537200569000000E-01	Same
61	0.08206115721742410000	9.28509013075896000000E-05	1.13020537200569000000E-01	Same
62	0.08206115721742410000	9.28509013075896000000E-05	1.13020537200569000000E-01	Same
63	0.08206115721742410000	9.28509013075896000000E-05	1.13020537200569000000E-01	Same
64	0.08206115721742410000	9.28509013075896000000E-05	1.13020537200569000000E-01	Same
65	0.08206115721742410000	9.28509013075896000000E-05	1.13020537200569000000E-01	Same
66	0.08206115721742410000	9.28509013075896000000E-05	1.13020537200569000000E-01	Same
67	0.08206115721742410000	9.28509013075896000000E-05	1.13020537200569000000E-01	Same
68	0.08206115721742410000	9.28509013075896000000E-05	1.13020537200569000000E-01	Same
69	0.08206115721742410000	9.28509013075896000000E-05	1.13020537200569000000E-01	Same
70	0.08206115721742410000	9.28509013075896000000E-05	1.13020537200569000000E-01	Same
71	0.08206115721742410000	9.28509013075896000000E-05	1.13020537200569000000E-01	Same
72	0.08206115721742410000	9.28509013075896000000E-05	1.13020537200569000000E-01	Same
73	0.08206115721742410000	9.28509013075896000000E-05	1.13020537200569000000E-01	Same

74	0.08206115721742410000	9.285090130758960000000E-05	1.130205372005690000000E-01	Same
75	0.08206115721742410000	9.285090130758960000000E-05	1.130205372005690000000E-01	Same
76	0.08206115721742410000	9.285090130758960000000E-05	1.130205372005690000000E-01	Same
77	0.08206115721742410000	9.285090130758960000000E-05	1.130205372005690000000E-01	Same
78	0.08206115721742410000	9.285090130758960000000E-05	1.130205372005690000000E-01	Same
79	0.08206115721742410000	9.285090130758960000000E-05	1.130205372005690000000E-01	Same
80	0.08206115721742410000	9.285090130758960000000E-05	1.130205372005690000000E-01	Same
81	0.08206115721742410000	9.285090130758960000000E-05	1.130205372005690000000E-01	Same
82	0.08206115721742410000	9.285090130758960000000E-05	1.130205372005690000000E-01	Same
83	0.08206115721742410000	9.285090130758960000000E-05	1.130205372005690000000E-01	Same
84	0.08206115721742410000	9.285090130758960000000E-05	1.130205372005690000000E-01	Same
85	0.08206115721742410000	9.285090130758960000000E-05	1.130205372005690000000E-01	Same
86	0.08206115721742410000	9.285090130758960000000E-05	1.130205372005690000000E-01	Same
87	0.08206115721742410000	9.285090130758960000000E-05	1.130205372005690000000E-01	Same
88	0.08206115721742410000	9.285090130758960000000E-05	1.130205372005690000000E-01	Same
89	0.08206115721742410000	9.285090130758960000000E-05	1.130205372005690000000E-01	Same
90	0.08206115721742410000	9.285090130758960000000E-05	1.130205372005690000000E-01	Same

91	0.08206115721742410000	9.285090130758960000000E-05	1.130205372005690000000E-01	Same
92	0.08206115721742410000	9.285090130758960000000E-05	1.130205372005690000000E-01	Same
93	0.08206115721742410000	9.285090130758960000000E-05	1.130205372005690000000E-01	Same
94	0.08206115721742410000	9.285090130758960000000E-05	1.130205372005690000000E-01	Same
95	0.08206115721742410000	9.285090130758960000000E-05	1.130205372005690000000E-01	Same
96	0.08206115721742410000	9.285090130758960000000E-05	1.130205372005690000000E-01	Same
97	0.08206115721742410000	9.2850901307589600000E-05	1.130205372005690000000E-01	Same
98	0.08206115721742410000	9.285090130758960000000E-05	1.130205372005690000000E-01	Same
99	0.08206115721742410000	9.285090130758960000000E-05	1.130205372005690000000E-01	Same
100	0.08206115721742410000	9.285090130758960000000E-05	1.130205372005690000000E-01	Same
101	0.08206115721742410000	9.285090130758960000000E-05	1.130205372005690000000E-01	Same
102	0.08206115721742410000	9.285090130758960000000E-05	1.130205372005690000000E-01	Same
103	0.08206115721742410000	9.285090130758960000000E-05	1.130205372005690000000E-01	Same
104	0.08206115721742410000	9.285090130758960000000E-05	1.130205372005690000000E-01	Same
105	0.08206115721742410000	9.285090130758960000000E-05	1.130205372005690000000E-01	Same

*Table 38 Approximations and Errors*

The bolded point is the **point of diminishing return.**

The value of Maclaurin series for  $x = 4.71238898$

Number of Terms	Approximated Answer Based on Terms	Absolute True Error (Et)	Relative True Error (et)%	Status
1	0.08215400811204030000	6.69139743614267000000E-12	8.144943368401474e-11	---
2	0.08206128153089260000	9.27265878391398000000E-05	1.12869219606581000000E-01	Decreasing
3	0.08206131289343420000	9.26952252975344000000E-05	1.12831044303484000000E-01	Decreasing
4	0.08206131288838290000	9.26952303487855000000E-05	1.12831050451999000000E-01	Decreasing
5	<b>0.08206131288838340000</b>	<b>9.26952303483136000000E-05</b>	<b>1.12831050451425000000E-01</b>	<b>Decreasing</b>
6	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
7	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
8	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
9	0.08206131288838340000	9.269523034831360000E-05	1.12831050451425000000E-01	Same
10	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
11	0.08206131288838340000	9.269523034831360000E-05	1.12831050451425000000E-01	Same
12	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
13	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
14	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
15	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same

16	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
17	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
18	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
19	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
20	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
21	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
22	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
23	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
24	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
25	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
26	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
27	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
28	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
29	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
30	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
31	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
32	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same

33	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
34	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
35	0.08206131288838340000	9.269523034831360000E-05	1.12831050451425000000E-01	Same
36	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
37	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
38	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
39	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
40	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
41	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
42	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
43	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
44	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
45	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
46	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
47	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
48	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
49	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same

50	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
51	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
52	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
53	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
54	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
55	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
56	0.08206131288838340000	9.269523034831360000E-05	1.12831050451425000000E-01	Same
57	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
58	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
59	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
60	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
61	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
62	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
63	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
64	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
65	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
66	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same



67	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
68	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
69	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
70	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
71	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
72	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
73	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
74	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
75	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
76	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
77	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
78	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
79	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
80	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
81	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
82	0.08206131288838340000	9.269523034831360000E-05	1.12831050451425000000E-01	Same
83	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same

84	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
85	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
86	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
87	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
88	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
89	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
90	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
91	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
92	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
93	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
94	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
95	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
96	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
97	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
98	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
99	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
100	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same

101	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
102	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
103	0.08206131288838340000	9.269523034831360000E-05	1.12831050451425000000E-01	Same
104	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same
105	0.08206131288838340000	9.26952303483136000000E-05	1.12831050451425000000E-01	Same

Table 39 Approximations and Errors

The bolded point is the **point of diminishing return.**

The value of Maclaurin series for  $x = 4.71238898038$

Number of Terms	Approximated Answer Based on Terms	Absolute True Error (Et)	Relative True Error (et)%	Status
1	0.08215400811865010000	8.15597589465256000000E-14	2.97531597358756300000e-10	---
2	0.08206128153747990000	9.27265812517425000000E-05	1.12869211588229000000E-01	Decreasing
3	0.08206131290002160000	9.26952187101232000000E-05	1.12831036285116000000E-01	Decreasing
4	0.08206131289497030000	9.26952237613743000000E-05	1.12831042433630000000E-01	Decreasing
5	<b>0.08206131289497080000</b>	<b>9.26952237609024000000E-05</b>	<b>1.12831042433056000000E-01</b>	<b>Decreasing</b>
6	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
7	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
8	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same

9	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
10	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
11	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
12	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
13	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
14	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
15	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
16	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
17	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
18	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
19	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
20	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
21	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
22	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
23	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
24	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
25	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same

26	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
27	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
28	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
29	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
30	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
31	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
32	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
33	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
34	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
35	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
36	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
37	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
38	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
39	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
40	0.08206131289497080000	9.269522376090240000E-05	1.12831042433056000000E-01	Same
41	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
42	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same

43	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
44	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
45	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
46	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
47	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
48	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
49	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
50	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
51	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
52	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
53	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
54	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
55	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
56	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
57	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
58	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
59	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same

60	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
61	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
62	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
63	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
64	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
65	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
66	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
67	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
68	0.08206131289497080000	9.269522376090240000E-05	1.12831042433056000000E-01	Same
69	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
70	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
71	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
72	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
73	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
74	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
75	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
76	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same

77	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
78	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
79	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
80	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
81	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
82	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
83	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
84	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
85	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
86	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
87	0.08206131289497080000	9.269522376090240000E-05	1.12831042433056000000E-01	Same
88	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
89	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
90	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
91	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
92	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
93	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same



94	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
95	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
96	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
97	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
98	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
99	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
100	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
101	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
102	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
103	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
104	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same
105	0.08206131289497080000	9.26952237609024000000E-05	1.12831042433056000000E-01	Same

*Table 40 Approximations and Errors*

The bolded point is the **point of diminishing return.**

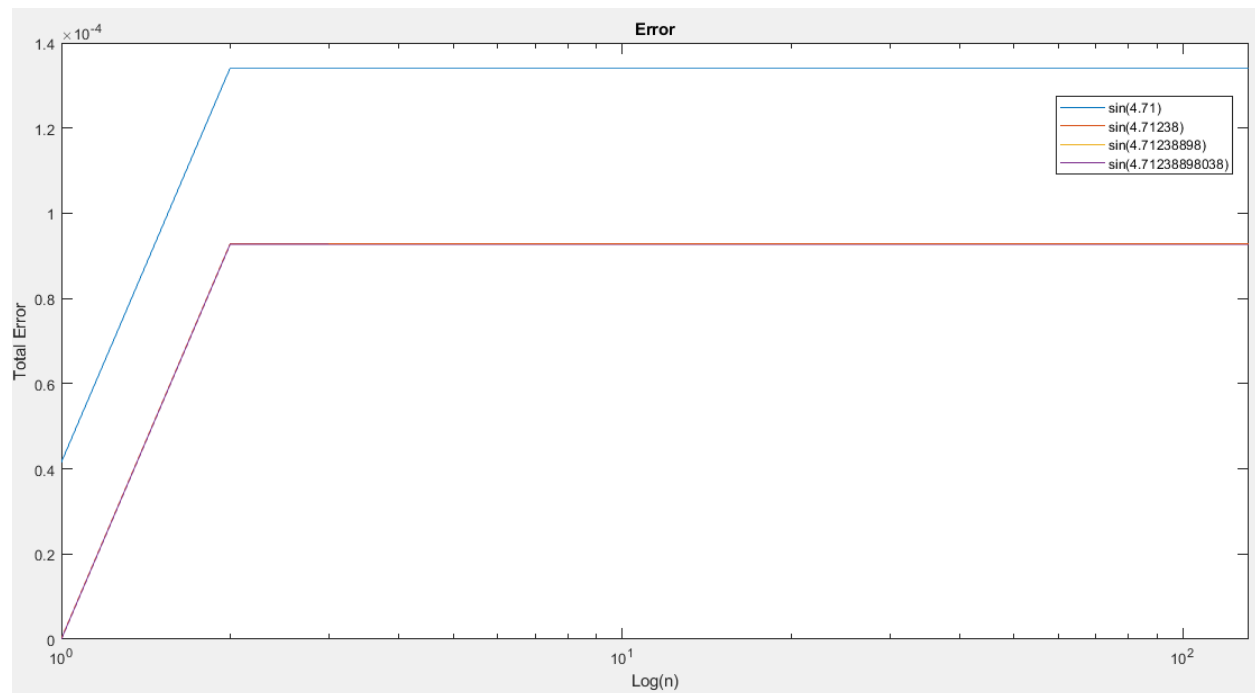


Figure 9 Total Error vs Number of Terms

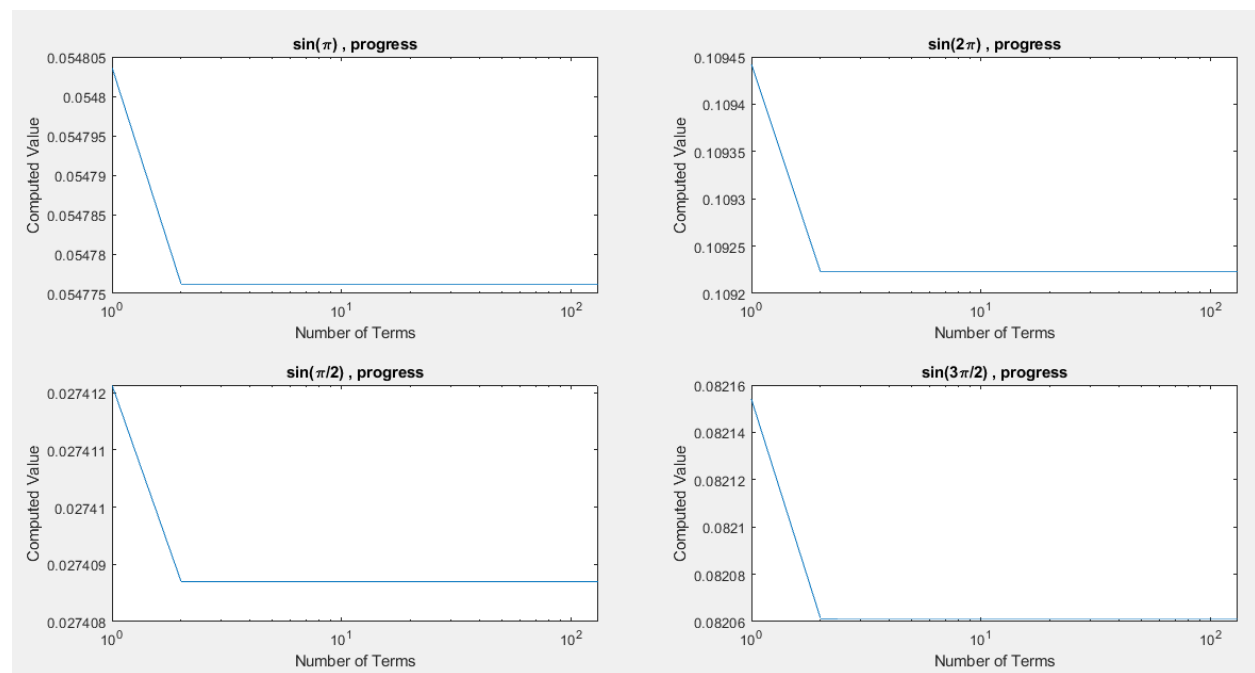


Figure 10 Value vs Number of Terms at Diminishing Point

## 4. Chapter 4: Curve Fitting:

### 4.1 Regression:

#### 4.1.1 Task1:

- Problem Statement:

i	$X_i$	$Y_i$
1	1	39.7063
2	2	50.7066
3	3	55.8900
4	4	54.0228
5	5	44.9760
6	6	29.7674
7	7	10.4099
8	8	-10.4099
9	9	-29.7674
10	10	-44.9760
11	11	-54.0228
$\Sigma$	66	146.3029
ave	6	13.3003

Table 41 Set of Data Points

- Solution:

#### **Step 1**

Make a table with all your x and y values. When you plug these values into a graphing calculator, they should form a parabola.

#### **Step 2**

Create 5 additional columns for [quadratic regression: x, xy and y values and calculate. You'll want to use Microsoft Excel or a calculator for this step.

#### **Step 3**

At the bottom of each column, calculate the sums.

#### **Step 4**

Below is the matrix equation for determining the parabolic curve.  $\Sigma$  represents the summation, meaning that you will plug the relevant sum into the equation. For example,  $\Sigma x_i^4$  would be the sum of column  $x^4$ . Using the matrix equation, fill in all the sums.

i	$X_i$	$Y_i$	$X_i^2$	$X_i^3$	$X_i^4$	$X_i Y_i$	$X_i^2 Y_i$
1	1	39.7063	1	1	1	39.7063	1.0e+03 *0.0397

2	2	50.7066	4	8	16	101.4131	1.0e+03 *0.2028
3	3	55.8900	9	27	81	167.6701	1.0e+03 *0.5030
4	4	54.0228	16	64	256	216.0913	1.0e+03 *0.8644
5	5	44.9760	25	125	625	224.8798	1.0e+03 *1.1244
6	6	29.7674	36	216	1296	178.6042	1.0e+03 *1.0716
7	7	10.4099	49	343	2401	72.8693	1.0e+03 *0.5101
8	8	-10.4099	64	512	4096	-83.2792	1.0e+03 *- 0.6662
9	9	-29.7674	81	729	6561	-267.9063	1.0e+03 *- 2.4112
10	10	-44.9760	100	1000	10000	-449.7595	1.0e+03 *- 4.4976
11	11	-54.0228	121	1331	14641	-594.2512	1.0e+03 *- 6.5368
$\Sigma$	66	146.3029	506	4356	39974	-393.9621	-9.7957e+03
ave	6	13.3003					

Table 42 Calculations(1)

$$m=2, \Sigma x_i=66, \Sigma x_i^4=39974$$

$$n=11, \Sigma y_i=146.3029, \Sigma x_i y_i=-393.9621$$

$$\text{ave}X=6, \Sigma x_i^2=506, \Sigma x_i^2 y_i=-9.7957e+03$$

$$\text{ave}Y=13.3003, \Sigma x_i^3=4356$$

### Set of normal equations:

$$na_0 + (\Sigma x_i)a_1 + (\Sigma x_i^2)a_2 = \Sigma y_i \dots\dots\dots 1$$

$$(\Sigma x_i)a_0 + (\Sigma x_i^2)a_1 + (\Sigma x_i^3)a_2 = \Sigma x_i y_i \dots\dots\dots 2$$

$$(\Sigma x_i^2)a_0 + (\Sigma x_i^3)a_1 + (\Sigma x_i^4)a_2 = \Sigma x_i^2 y_i \dots\dots\dots 3$$

$$11a_0 + 66a_1 + 506a_2 = 146.3029 \dots\dots\dots 1$$

$$66a_0 + 506a_1 + 4356a_2 = -393.9621 \dots\dots\dots 2$$

$$506a_0 + 4356a_1 + 39974a_2 = -9.7957e+03 \dots\dots\dots 3$$

### model coefficients:

$$a_0 = -1.4736$$

$$a_1 = 6.1210$$

$$a_2 = 44.3576$$

$$y = a_0 + a_1x + a_2x^2$$

$$y = -1.4736 + 6.1210x + 44.3576x^2$$

find the values of  $S_t$  and  $S_r$

i	$X_i$	$Y_i$	$(Y_i - Y_{ave})^2$	$S_t$	$(Y_i - a_0 - a_1X_i - a_2X_i^2)^2$ $S_r$	$S_d = (S_t / (n - 1))^{1/2}$	$S_{y/x}$
1	1	39.7063	1.0e+03 * 0.6973		86.4673		
2	2	50.7066	1.0e+03 *1.3992		0.0000		
3	3	55.8900	1.0e+03 *1.8139		41.3619		
4	4	54.0228	1.0e+03 *1.6583		76.7020		
5	5	44.9760	1.0e+03 *1.0033		46.9506		
6	6	29.7674	1.0e+03 *0.2712		2.9983		
7	7	10.4099	1.0e+03 *0.0084		21.0748		
8	8	-10.4099	1.0e+03 *0.5622		88.8916		
9	9	-29.7674	1.0e+03 *1.8548		97.1466		
10	10	-44.9760	1.0e+03 *3.3961		10.1656		
11	11	-54.0228	1.0e+03 *4.5324		158.4678		
$\Sigma$	66	146.3029	1.7197e+04		630.2265	41.4693	8.8757
ave	6	13.3003					

Table 43 Calculations(2)

$$S_t = \Sigma(Y_i - Y_{ave})^2 = 1.7197e+04$$

$$S_r = (Y_i - a_0 - a_1X_i - a_2X_i^2)^2 = 630.2265$$

find the values of  $S_d$  and  $S_{y/x}$ :

$$S_d = S_y$$

$$S_d = (S_t / (n-1))^{1/2} = 41.4693$$

$$S_{y/x} = (S_r / n - (m+1))^{1/2} = 8.8757$$

**the coefficients of determination ( $r^2$ ):**

$$r^2 = (S_t - S_r) / S_t = ((1.7197e+04 - 630.2265) / 1.7197e+04) = 0.9634 = 96.3\%$$

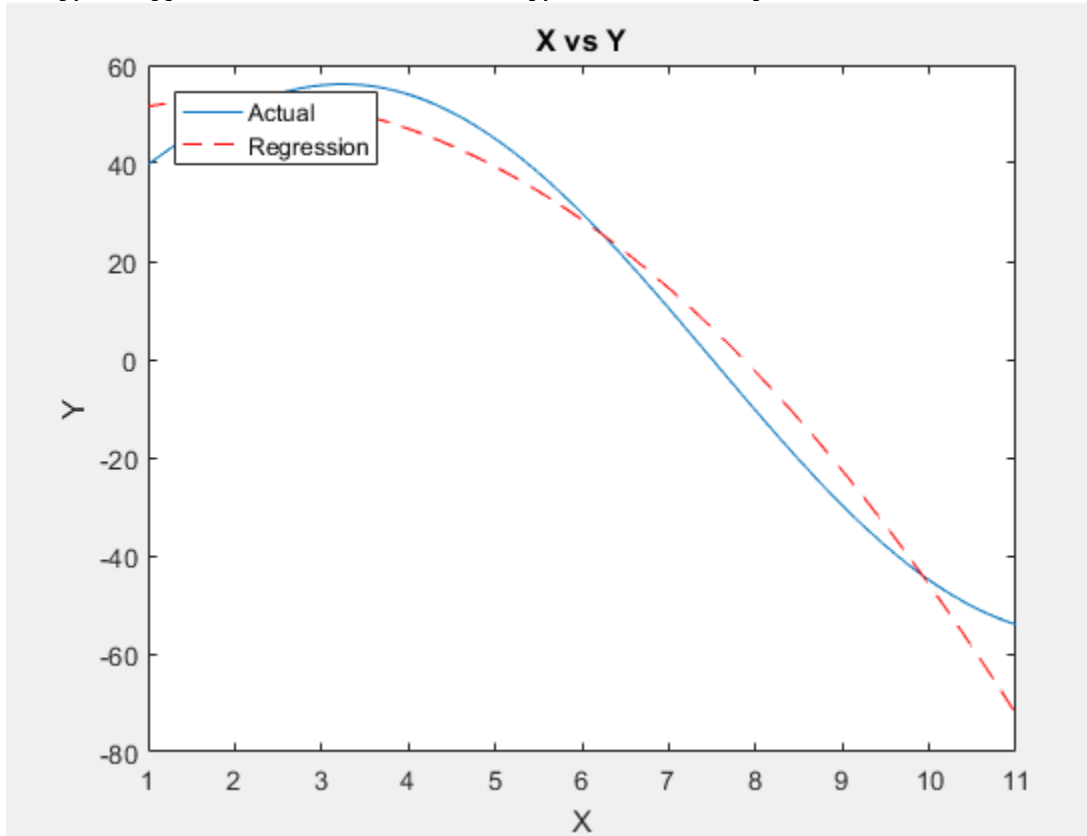


Figure 11 Actual vs Regression

## 4.2 Interpolation:

### 4.2.1 Task 1:

- Problem Statement:  $F(x) = \ln(x)$ , True value at  $x = 5$

i	$X_i$	$F(x_i)$
0	2	0.6931471
1	6	1.791759
2	3	1.098612
3	5	1.609437

4                      4                      1.386294

Table 44 Set of Data Points

• Solution:

First finite derivative difference:

$$F[x_1, x_0] = (1.791759 - 0.6931471) / (6 - 2) = 0.2746529$$

$$F[x_2, x_1] = (1.098612 - 1.791759) / (3 - 6) = 0.231049$$

$$F[x_3, x_2] = (1.609437 - 1.098612) / (5 - 3) = 0.2554125$$

$$F[x_4, x_3] = (1.386294 - 1.609437) / (4 - 5) = 0.223143$$

Second finite derivative difference:

$$F[x_2, x_1, x_0] = (0.231049 - 0.2746529) / (3 - 2) = -0.0436039$$

$$F[x_3, x_2, x_1] = (0.2554125 - 0.231049) / (5 - 6) = -0.0243635$$

$$F[x_4, x_3, x_2] = (0.223143 - 0.2554125) / (4 - 3) = -0.0322695$$

Third finite derivative difference:

$$F[x_3, x_2, x_1, x_0] = (-0.0243635 - (-0.0436039)) / (5 - 2) = 0.0064134667$$

$$F[x_4, x_3, x_2, x_1] = (-0.0322695 - (-0.0243635)) / (4 - 6) = 0.003953$$

Fourth finite derivative difference:

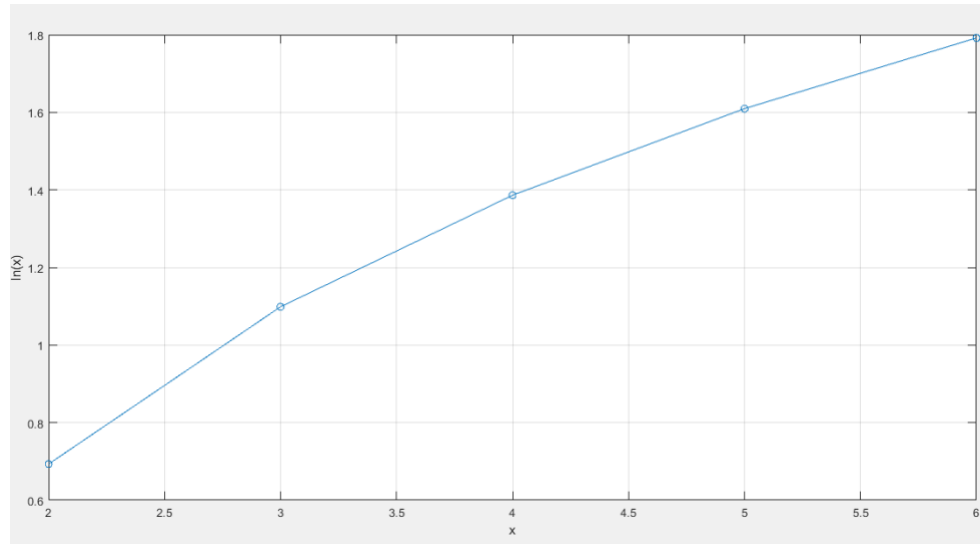
$$F[x_4, x_3, x_2, x_1, x_0] = (0.003953 - 0.0064134667) / (4 - 2) = -0.00123023$$

$$F4(x) = 0.6931472 + 0.2746529(x-2) - 0.00436039(x-2)(x-6) + 0.006413467(x-2)(x-6)(x-3) - 0.00123023(x-2)(x-6)(x-3)(x-5).$$

$$\text{True Value} = \ln(5) = 1.609437912.$$

$$F4(5) = 1.608624631.$$

$$\text{Relative True Error\%} = ((1.609437912 - 1.608624631) / 1.609437912) * 100 = 0.05\%$$



*Figure 12 Output after Interpolation*



## Conclusion:

In this project, we learned how to approximate values using Maclaurin series expansion.

## Appendix:

MATLAB Codes for chapter 1.

### Exponential code:

```
clc;clear;close all

x=[pi;exp(1);log(2);log10(2)];
xx=[pi;exp(1);log(2);log10(2)];

y=exp(xx);
f=[1 1 1 1];
E=abs(f-y');
et=(abs(E/y'))*100;

for j=1:length(x)
    xj=x(j);
    for n=1:130
        f(n+1,j)=f(n,j)+xj^n/factorial(n);
        E(n+1,j)=abs(f(n+1,j)-y(j));
        et(n+1,j)=(abs(E(n+1,j)/y(j)))*100;
    end
end

figure()
subplot(2,2,1)
semilogx(f(:,1))
title('e^{pi}, Progress')
xlabel('Number of Terms')
ylabel('Computed Value')
subplot(2,2,2)
semilogx(f(:,2))
title('e^e, Progress')
xlabel('Number of Terms')
ylabel('computed Value')
ylim([0 16])
subplot(2,2,3)
semilogx(f(:,3))
title('e^{ln(2)}, Progress')
xlabel('Number of Terms')
ylabel('Computed Value')
```

```

ylim([0 3])
subplot(2,2,4)
semilogx(f(:,4))
title('e^{log_{10}(2)}, Progress')
xlabel('Number of Terms')
ylabel('Computed Value')

figure()
semilogx(E)
legend('e^pi', 'e^e', 'e^{ln(2)}', 'e^{log_{10}(2)}')
xlabel('log(n)')
ylabel('Total Error')
title('Error')
ylim([-2 15])

%%
for i=1:4
    fprintf('X(i)=%.4f , y(i)=%.4f\n',x(i),y(i))
    table(f(:,i),E(:,i),et(:,i))
end
%%
y_final=f(130,:);
y_final=y_final';
E_final=E(130,:);

for i=1:4
    fprintf('X=%.4f , exp(X)=%d,\nMaclurian Series after 130= %.4f
, |E|=%.4e\n',x(i),y(i),y_final(i),E_final(i))
end

```

### Sine code:

```

clc;clear;close all

x=(pi/180)*pi*[1,2,0.5,3/2];
xx=(pi/180)*[pi/2;pi/2;pi/2;pi/2];
y=sin(xx);
f=sin(x');
E=abs(f-y');
et=(abs(E/y'))*100;

for j=1:length(x)
    xj=x(j);
    for n=1:130
        k1=(-1)^n;
        k2=(xj^((2*n)+1))/factorial((2*n)+1);
        f(n+1,j)=f(n,j)+(k1*k2);
        E(n+1,j)=abs(f(n+1,j)-y(j));
        et(n+1,j)=(abs(E(n+1,j)/y(j)))*100;
    end
end

```

```

figure()
subplot(2,2,1)
semilogx(f(:,1))
title('sin(\pi) , progress')
xlabel('Number of Terms')
ylabel('Computed Value')
subplot(2,2,2)
semilogx(f(:,2))
title('sin(2\pi) , progress')
xlabel('Number of Terms')
ylabel('Computed Value')
subplot(2,2,3)
semilogx(f(:,3))
title('sin(\pi/2) , progress')
xlabel('Number of Terms')
ylabel('Computed Value')
subplot(2,2,4)
semilogx(f(:,4))
title('sin(3\pi/2) , progress')
xlabel('Number of Terms')
ylabel('Computed Value')

figure()
semilogx(E)
legend('sin(\pi)', 'sin(2\pi)', 'sin(\pi/2)', 'sin(3\pi/2)')
xlabel('Log(n)')
ylabel('Total Error')
title('Error')
%%
for i=1:4
    fprintf('X(i)=%.4f , y(i)=%.4f\n',x(i),y(i))
    table(f(:,i),E(:,i),et(:,i))
end
%%
y_final=f(130,:);
y_final=y_final';
E_final=E(130,:);

for i=1:4
    fprintf('X=%.4f , sin(X)=%d,\nMaclurian Series after 130= %.4f
, |E|=%.4e\n',x(i),y(i),y_final(i),E_final(i))
end

```

## MATLAB Codes for chapter 4:

### Regression:

```

x=(1:1:11);
n=10;
a1=25;
b1=a1*1.5;
y1=a1.*cos(x.*pi/15)+b1*sin(x.*pi/7.5);
averx =mean(x);
avery1=mean(y1);

```

```

xi1=sum(x);
xi2=sum(x.^2);
xi3=sum(x.^3);
xi4=sum(x.^4);

M=[xi4 xi3 xi2 xi3 xi2 xi1 xi2 xi1 n];
K=inv(M).*V;
a2=K(1);
b2=K(2);
c2=K(3);
disp('X,Y table')
table(x,y1)
disp('-----')
disp('x x^2 x^3 x^4')
x2=x.^2;x3=x.^3;x4=x.^4;
table(x,x2,x3,x4)
disp('-----')
disp('x^2*y x*y y')
y=y1;x2y=x.^2.*y;xy=x.*y;
table(x2y,xy,y)
disp('-----')
disp('SSE Vector , SST Vector')
sse_v=(y1-y2).^2;
sst_v=(y1-mean(y1)).^2;
table(sse_v,sst_v)

```

## Interpolation:

```

x=2:1:6;
y=log(x);
plot(x,y,'-o')
grid
xlabel('x')
ylabel('ln(x)')

```

