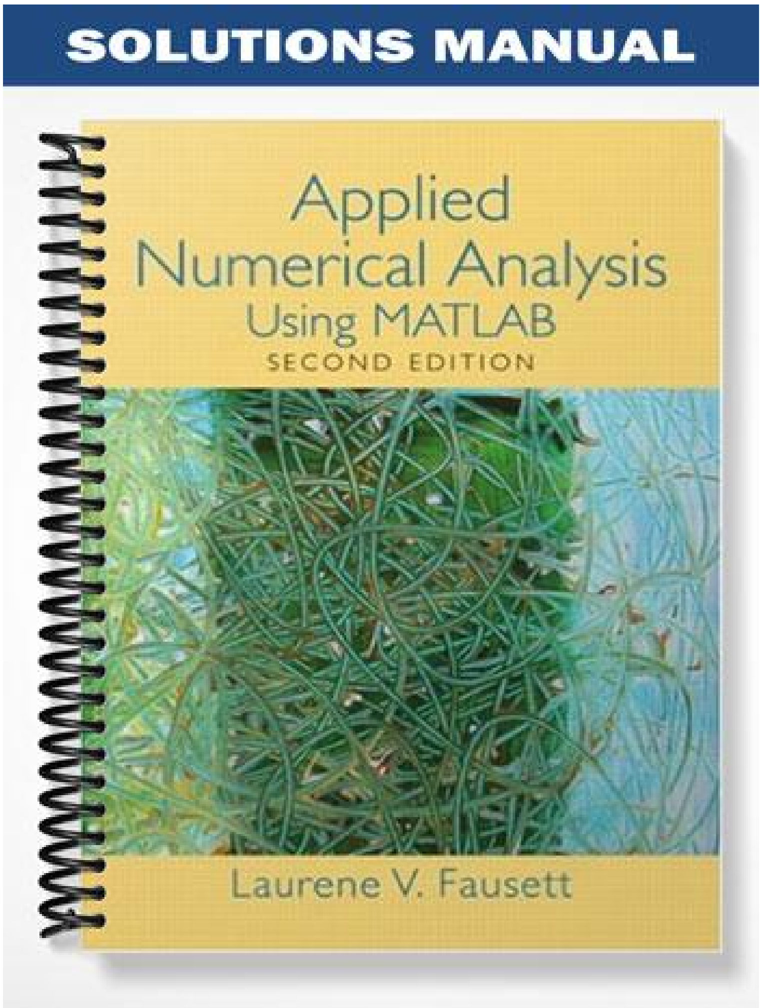
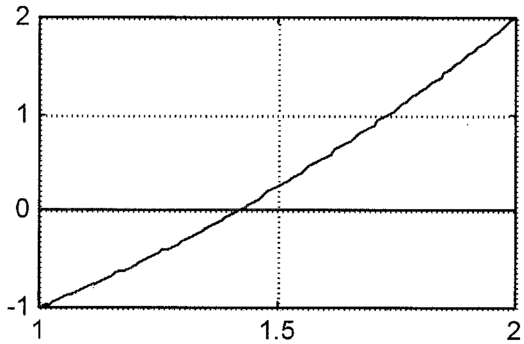

SOLUTIONS MANUAL
Applied
Numerical Analysis
Using MATLAB
SECOND EDITION
Laurene V. Fausett

Chapter 2 Functions of One Variable

Find the positive real zero of the given functions.
Answers shown are actual values, to 4 decimal places

P2.1

f(x) = x^2 - 2



ans: x = 1.4142

bisect:

step	a	b	m	ym	bound
1.0000	1.0000	2.0000	1.5000	0.2500	0.5000
2.0000	1.0000	1.5000	1.2500	-0.4375	0.2500
3.0000	1.2500	1.5000	1.3750	-0.1094	0.1250
4.0000	1.3750	1.5000	1.4375	0.0664	0.0625
5.0000	1.3750	1.4375	1.4063	-0.0225	0.0313
6.0000	1.4063	1.4375	1.4219	0.0217	0.0156

```
f = inline('x.^2 - 2'); a = 1; b = 2; kmax = 6; tol = 0.000001;
```

```
[s, y] =  Falsi(f, a, b, tol, kmax);
```

step	a	b	s	y
1.0000	1.0000	2.0000	1.3333	-0.2222
2.0000	1.3333	2.0000	1.4000	-0.0400
3.0000	1.4000	2.0000	1.4118	-0.0069
4.0000	1.4118	2.0000	1.4138	-0.0012
5.0000	1.4138	2.0000	1.4141	-0.0002
6.0000	1.4141	2.0000	1.4142	-0.0000

```
[xx, yy] =  Secant(f, a, b, tol, kmax);
```

step	x(k-1)	x(k)	x(k+1)	y(k+1)	Dx(k+1)
1.0000	1.0000	2.0000	1.3333	-0.2222	-0.6667
2.0000	2.0000	1.3333	1.4000	-0.0400	0.0667
3.0000	1.3333	1.4000	1.4146	0.0012	0.0146
4.0000	1.4000	1.4146	1.4142	-0.0000	-0.0004
5.0000	1.4146	1.4142	1.4142	-0.0000	0.0000

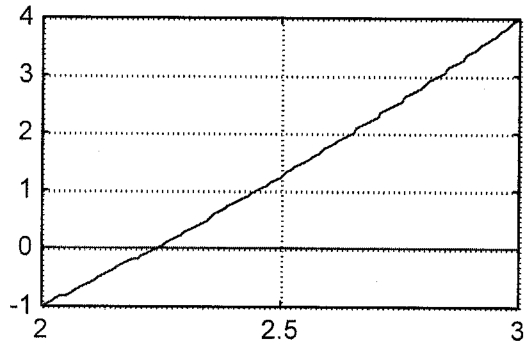
```
[x, y] = Newton(f, inline('2*x'),1.5, tol, kmax);
```

step	x	y
1.0000	1.5000	0.2500
2.0000	1.4167	0.0069
3.0000	1.4142	0.0000
4.0000	1.4142	0.0000
5.0000	1.4142	0.0000

```
[x, y] = Muller(f, a, b, tol, kmax)
x =    1.0000    2.0000    1.5000    1.4142    1.4142
y =   -1.0000    2.0000    0.2500    0.0000   -0.0000
```

P2.2

f(x) = x^2 - 5



ans: x = 2.2361

bisect:

step	a	b	m	ym	bound
1.0000	2.0000	3.0000	2.5000	1.2500	0.5000
2.0000	2.0000	2.5000	2.2500	0.0625	0.2500
3.0000	2.0000	2.2500	2.1250	-0.4844	0.1250
4.0000	2.1250	2.2500	2.1875	-0.2148	0.0625
5.0000	2.1875	2.2500	2.2188	-0.0771	0.0313
6.0000	2.2188	2.2500	2.2344	-0.0076	0.0156

```
f = inline('x.^2 - 5'); a = 2; b = 3; kmax = 6; tol = 0.000001;
```

```
[s, y] =  Falsi(f, a, b, tol, kmax)
```

step	a	b	s	y
1	2.0000	3.0000	2.2000	-0.1600
2	2.2000	3.0000	2.2308	-0.0237
3	2.2308	3.0000	2.2353	-0.0035
4	2.2353	3.0000	2.2360	-0.0005
5	2.2360	3.0000	2.2361	-0.0001
6	2.2361	3.0000	2.2361	-0.0000

```
[xx, yy] =  Secant(f, a, b, tol, kmax)
```

step	x(k-1)	x(k)	x(k+1)	y(k+1)	Dx(k+1)
1.0000	2.0000	3.0000	2.2000	-0.1600	-0.8000
2.0000	3.0000	2.2000	2.2308	-0.0237	0.0308
3.0000	2.2000	2.2308	2.2361	0.0002	0.0053
4.0000	2.2308	2.2361	2.2361	-0.0000	-0.0000

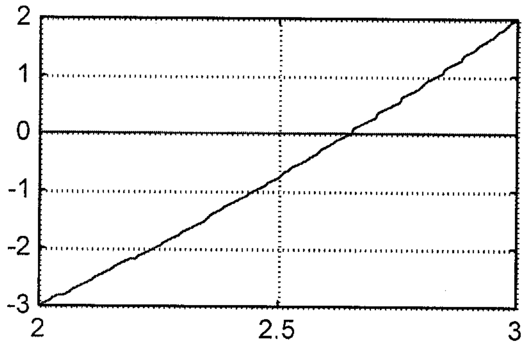
```
[x, y] = Newton(f, inline('2*x'),1.5, tol, kmax)
```

step	x	y
1.0000	1.5000	-2.7500
2.0000	2.4167	0.8403
3.0000	2.2428	0.0302
4.0000	2.2361	0.0000
5.0000	2.2361	0.0000
6.0000	2.2361	0.0000

```
[x, y] = Muller(f, a, b, tol, kmax)
x =    2.0000     3.0000     2.5000     2.2361     2.2361
y =   -1.0000     4.0000     1.2500     0.0000     0.0000
```

P2.3

f(x) = x^2 - 7



ans: x = 2.6458

bisect:

step	a	b	m	ym	bound
1.0000	2.0000	3.0000	2.5000	-0.7500	0.5000
2.0000	2.5000	3.0000	2.7500	0.5625	0.2500
3.0000	2.5000	2.7500	2.6250	-0.1094	0.1250
4.0000	2.6250	2.7500	2.6875	0.2227	0.0625
5.0000	2.6250	2.6875	2.6563	0.0557	0.0313
6.0000	2.6250	2.6563	2.6406	-0.0271	0.0156

```
f = inline('x.^2 - 7'); a = 2; b = 3; kmax = 6; tol = 0.000001;
```

```
[s, y] =  Falsi(f, a, b, tol, kmax);
```

step	a	b	s	y
1.0000	2.0000	3.0000	2.6000	-0.2400
2.0000	2.6000	3.0000	2.6429	-0.0153
3.0000	2.6429	3.0000	2.6456	-0.0010
4.0000	2.6456	3.0000	2.6457	-0.0001
5.0000	2.6457	3.0000	2.6458	-0.0000
6.0000	2.6458	3.0000	2.6458	-0.0000

```
[xx, yy] =  Secant(f, a, b, tol, kmax);
```

step	x(k-1)	x(k)	x(k+1)	y(k+1)	Dx(k+1)
1.0000	2.0000	3.0000	2.6000	-0.2400	-0.4000
2.0000	3.0000	2.6000	2.6429	-0.0153	0.0429
3.0000	2.6000	2.6429	2.6458	0.0001	0.0029
4.0000	2.6429	2.6458	2.6458	-0.0000	-0.0000

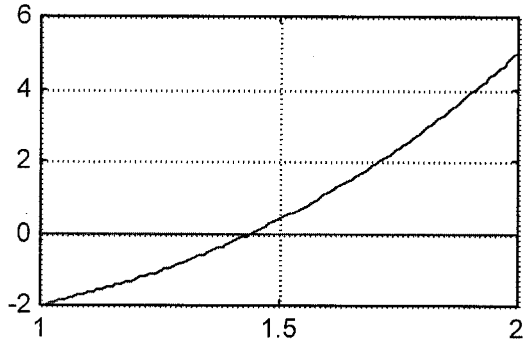
```
[x, y] = Newton(f, inline('2*x'),1.5, tol, kmax);
```

step	x	y
1.0000	1.5000	-4.7500
2.0000	3.0833	2.5069
3.0000	2.6768	0.1653
4.0000	2.6459	0.0010
5.0000	2.6458	0.0000
6.0000	2.6458	0.0000

```
[x, y] = Muller(f, a, b, tol, kmax)
x =     2.0000     3.0000     2.5000     2.6458     2.6458
y =    -3.0000     2.0000    -0.7500     0.0000     0.0000
```

P2.4

f(x) = x^3 - 3



ans: x = 1.4422

bisect:

step	a	b	m	ym	bound
1.0000	1.0000	2.0000	1.5000	0.3750	0.5000
2.0000	1.0000	1.5000	1.2500	-1.0469	0.2500
3.0000	1.2500	1.5000	1.3750	-0.4004	0.1250
4.0000	1.3750	1.5000	1.4375	-0.0295	0.0625
5.0000	1.4375	1.5000	1.4688	0.1684	0.0313
6.0000	1.4375	1.4688	1.4531	0.0684	0.0156

```
f = inline('x.^3-3'); a = 1; b = 2; kmax = 6; tol = 0.00001;
```

```
[s, y] =  Falsi(f, a, b, tol, kmax)
```

step	a	b	s	y
1.0000	1.0000	2.0000	1.2857	-0.8746
2.0000	1.2857	2.0000	1.3921	-0.3024
3.0000	1.3921	2.0000	1.4267	-0.0958
4.0000	1.4267	2.0000	1.4375	-0.0295
5.0000	1.4375	2.0000	1.4408	-0.0090
6.0000	1.4408	2.0000	1.4418	-0.0027

```
[xx, yy] =  Secant(f, a, b, tol, kmax)
```

step	x(k-1)	x(k)	x(k+1)	y(k+1)	Dx(k+1)
1.0000	1.0000	2.0000	1.2857	-0.8746	-0.7143
2.0000	2.0000	1.2857	1.3921	-0.3024	0.1063
3.0000	1.2857	1.3921	1.4483	0.0377	0.0562
4.0000	1.3921	1.4483	1.4420	-0.0013	-0.0062
5.0000	1.4483	1.4420	1.4422	-0.0000	0.0002

```
[x, y] = Newton(f, inline('3*x.^2'),1.5, tol, kmax)
```

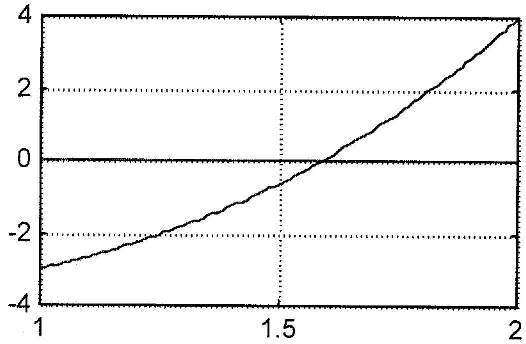
step	x	y
1.0000	1.5000	0.3750
2.0000	1.4444	0.0137
3.0000	1.4423	0.0000
4.0000	1.4422	0.0000

```
[x, y] = Muller(f, a, b, tol, kmax)
```

x =	1.00	2.00	1.5000	1.4444	1.4422	1.4422
y =	-2.00	5.00	0.3750	0.0137	-0.0001	0.0000

P2.5

f(x) = x^3 - 4



ans: x = 1.5874

bisect:

i	x	y
1	1.5	-0.625
2	1.75	1.3594
3	1.625	0.29102
4	1.5625	-0.1853
5	1.5938	0.048187
6	1.5781	-0.069714

```
f = inline('x.^3-4'); a = 1; b = 2; kmax = 6; tol = 0.00001;

[s, y] =  Falsi(f, a, b, tol, kmax)
```

step	a	b	s	y
1.0000	1.0000	2.0000	1.4286	-1.0845
2.0000	1.4286	2.0000	1.5505	-0.2728
3.0000	1.5505	2.0000	1.5792	-0.0620
4.0000	1.5792	2.0000	1.5856	-0.0137
5.0000	1.5856	2.0000	1.5870	-0.0030
6.0000	1.5870	2.0000	1.5873	-0.0007

```
[xx, yy] =  Secant(f, a, b, tol, kmax)
```

step	x(k-1)	x(k)	x(k+1)	y(k+1)	Dx(k+1)
1.0000	1.0000	2.0000	1.4286	-1.0845	-0.5714
2.0000	2.0000	1.4286	1.5505	-0.2728	0.1219
3.0000	1.4286	1.5505	1.5914	0.0305	0.0410
4.0000	1.5505	1.5914	1.5873	-0.0007	-0.0041
5.0000	1.5914	1.5873	1.5874	-0.0000	0.0001

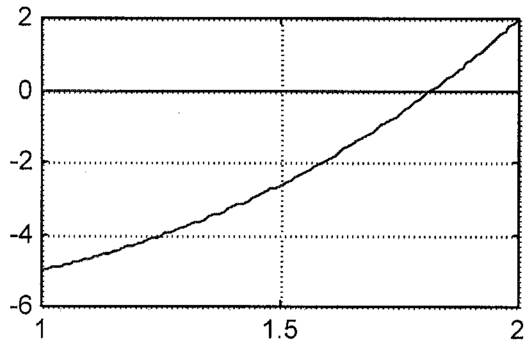
```
[x, y] = Newton(f, inline('3*x.^2'),1.5, tol, kmax)
```

step	x	y
1.0000	1.5000	-0.6250
2.0000	1.5926	0.0394
3.0000	1.5874	0.0001
4.0000	1.5874	0.0000
5.0000	1.5874	0.0000

```
[x, y] = Muller(f, a, b, tol, kmax)
x =    1.0000    2.0000    1.5000    1.5847    1.5874    1.5874
y =   -3.0000    4.0000   -0.6250   -0.0206   -0.0001    0.0000
```

P2.6

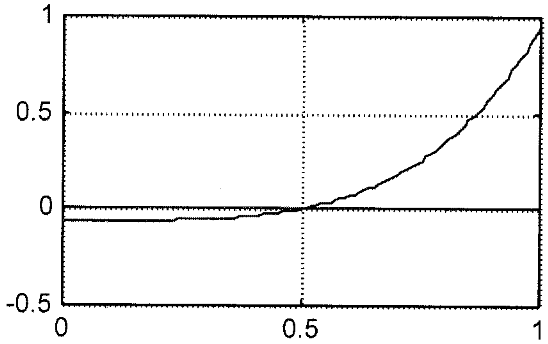
f(x) = x^3 - 6




```
ans:   x =    1.8171

bisect:
  i         x            y
  1        1.5          -2.625
  2        1.75         -0.64062
  3        1.875         0.5918
  4        1.8125       -0.045654
  5        1.8438        0.26767
  6        1.8281        0.10967

f = inline('x.^3-6'); a = 1; b = 2; kmax = 6; tol = 0.00001;
[s, y] =  Falsi(f, a, b, tol, kmax)
    step         a          b          s          y
    1.0000     1.0000     2.0000     1.7143    -0.9621
    2.0000     1.7143     2.0000     1.8071    -0.0988
    3.0000     1.8071     2.0000     1.8162    -0.0094
    4.0000     1.8162     2.0000     1.8170    -0.0009
    5.0000     1.8170     2.0000     1.8171    -0.0001
    6.0000     1.8171     2.0000     1.8171    -0.0000

[xx, yy] =  Secant(f, a, b, tol, kmax);
    step       x(k-1)      x(k)       x(k+1)     y(k+1)     Dx(k+1)
    1.0000     1.0000     2.0000     1.7143    -0.9621    -0.2857
    2.0000     2.0000     1.7143     1.8071    -0.0988     0.0928
    3.0000     1.7143     1.8071     1.8177     0.0059     0.0106
    4.0000     1.8071     1.8177     1.8171    -0.0000    -0.0006
    5.0000     1.8177     1.8171     1.8171    -0.0000     0.0000

[x, y] = Newton(f, inline('3*x.^2'),1.5, tol, kmax)
    step       x          y
    1.0000     1.5000    -2.6250
    2.0000     1.8889     0.7394
    3.0000     1.8198     0.0267
    4.0000     1.8171     0.0000
    5.0000     1.8171     0.0000

[x, y] = Muller(f, a, b, tol, kmax)
x =  1.0000     2.0000     1.5000     1.8123     1.8171     1.8171
y = -5.0000     2.0000    -2.6250    -0.0476    -0.0003     0.0000
```

P2.7

```
f(x) = x^4 - 0.06
ans:   x =   0.4949
```



a. Results from bisection method

i	x	y
1	0.5	0.0025
2	0.25	-0.056094
3	0.375	-0.040225
4	0.4375	-0.023364
5	0.46875	-0.01172
6	0.48438	-0.0049539
7	0.49219	-0.0013156
8	0.49609	0.00056964

b. Results from regula falsi

i	x	y
1	0.06	-0.059987
2	0.11639	-0.059816
3	0.16925	-0.059179
4	0.21846	-0.057723
5	0.26367	-0.055167
6	0.30449	-0.051404
7	0.34055	-0.04655
8	0.37167	-0.040918

c. Results from secant method

i	x	y
1	0.06	-0.059987
2	0.11639	-0.059816
3	19.894	1.5664e+05
4	0.1164	-0.059816

d. Results from Newton's method

i	x	y
1	0.5	0.0025
2	0.495	3.7251e-05
3	0.49492	8.6663e-09
4	0.49492	4.7184e-16

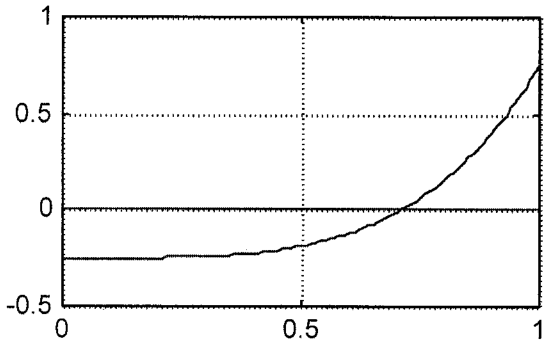
e. Results from Muller's method

1	0	-0.06
2	1	0.94
3	0.5	0.0025
4	0.49749	0.0012539
5	0.49489	-1.6732e-05
6	0.49492	8.9334e-10
7	0.49492	3.1225e-16

P2.8

f(x) = x^4 - 0.25

ans: x = 0.7071



a. Results from bisection method

i	x	y
1	0.5	-0.1875
2	0.75	0.066406
3	0.625	-0.097412
4	0.6875	-0.026596
5	0.71875	0.016877
6	0.70312	-0.0055837
7	0.71094	0.0054616

b. Results from regula falsi

1	0.25	-0.24609
2	0.43529	-0.2141
3	0.5607	-0.15116
4	0.63439	-0.088036
5	0.6728	-0.045105
6	0.69136	-0.02154
7	0.69997	-0.0099358

c. Results from secant method

1	0.25	-0.24609
2	0.43529	-0.2141
3	1.6751	7.6241
4	0.46916	-0.20155
5	0.50022	-0.18739
6	0.91123	0.43945
7	0.62309	-0.099271

d. Results from Newton's method

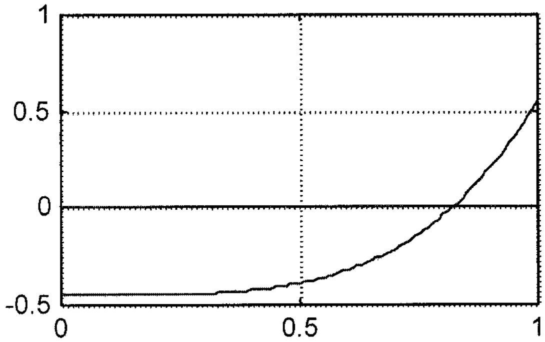
1	0.5	-0.1875
2	0.875	0.33618
3	0.74954	0.065638
4	0.71058	0.0049435
5	0.70713	3.5831e-05
6	0.70711	1.9255e-09

e. Results from Muller's method (starting with x = 0, 1, 0.5)

4	0.64877	-0.072842
5	0.70073	-0.0088948
6	0.70725	0.00020198
7	0.70711	-1.4687e-07
8	0.70711	-2.6684e-13

P2.9

```
f(x) = x^4 - 0.45
ans:    x =    0.8190
```



a. Results from bisection method

1	0.5	-0.3875
2	0.75	-0.13359
3	0.875	0.13618
4	0.8125	-0.014194
5	0.84375	0.056822
6	0.82812	0.020309
7	0.82031	0.0028114

b. Results from regula falsi

1	0.45	-0.40899
2	0.68457	-0.23039
3	0.77769	-0.084218
4	0.80721	-0.025435
5	0.81573	-0.0072207
6	0.81812	-0.0020134
7	0.81878	-0.0005586

c. Results from secant method

1	0.45	-0.40899
2	0.68457	-0.23039
3	0.98713	0.49951
4	0.78007	-0.079721
5	0.80857	-0.022572
6	0.81982	0.0017307
7	0.81902	-3.3465e-05

d. Results from Newton's method

1	0.5	-0.3875
2	1.275	2.1927
3	1.0105	0.59278
4	0.86692	0.11482
5	0.82286	0.0084599
6	0.81906	5.8362e-05
7	0.81904	2.838e-09

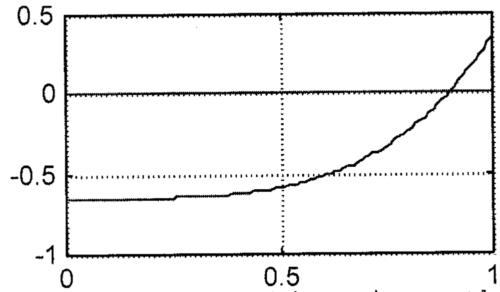
e. Results from Muller's method (starting with x = 0, 1, 0.5)

4	0.7648	-0.10788
5	0.81491	-0.0089961
6	0.81913	0.00021218
7	0.81904	-6.9512e-08

P2.10

f(x) = x^4 - 0.65

ans: x = 0.8979



a. Results from bisection method

i	x	y
1	0.5	-0.5875
2	0.75	-0.33359
3	0.875	-0.063818
4	0.9375	0.12248
5	0.90625	0.024516
6	0.89062	-0.020813
7	0.89844	0.0015556

b. Results from regula falsi

1	0.65	-0.47149
2	0.85088	-0.12583
3	0.89031	-0.021693
4	0.89672	-0.0034263
5	0.89772	-0.00053353
6	0.89787	-8.2894e-05
7	0.8979	-1.2875e-05

c. Results from secant method

1	0.65	-0.47149
2	0.85088	-0.12583
3	0.924	0.078944
4	0.89581	-0.0060247
5	0.89781	-0.00025778
6	0.8979	9.0108e-07
7	0.8979	-1.3404e-10

d. Results from Newton's method

1	0.5	-0.5875
2	1.675	7.2215
3	1.2908	2.1264
4	1.0437	0.53648
5	0.9257	0.084303
6	0.89913	0.0035605
7	0.8979	7.2675e-06

e. Results from Muller's method (starting with x = 0, 1, 0.5)

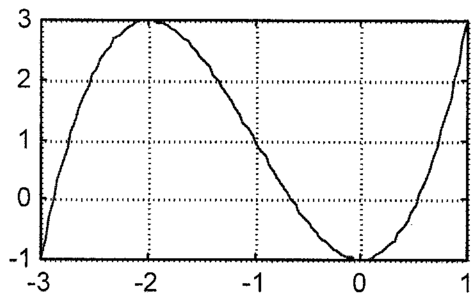
4	0.86031	-0.1022
5	0.89623	-0.0048102
6	0.89793	7.9965e-05
7	0.8979	-6.1432e-09
8	0.8979	-4.4409e-16

Find all real zeros of the functions that follow.

P2.11

f(x) = x^3 + 3x^2 -1

ans: x = -2.8794, -0.6527, 0.5321



a. Results from bisection

step	a	b	x	y
1	-3	-2	-2.5	2.125
2	-3	-2.5	-2.75	0.89062
3	-3	-2.75	-2.875	0.033203
4	-3	-2.875	-2.9375	-0.46069
5	-2.9375	-2.875	-2.9062	-0.20816
6	-2.9062	-2.875	-2.8906	-0.086094

step	a	b	x	y
1	-2	0	-1	1
2	-1	0	-0.5	-0.375
3	-1	-0.5	-0.75	0.26562
4	-0.75	-0.5	-0.625	-0.072266
5	-0.75	-0.625	-0.6875	0.093018
6	-0.6875	-0.625	-0.65625	0.0093689

step	a	b	x	y
1	0	1	0.5	-0.125
2	0.5	1	0.75	1.1094
3	0.5	0.75	0.625	0.41602
4	0.5	0.625	0.5625	0.1272
5	0.5	0.5625	0.53125	-0.0033875
6	0.53125	0.5625	0.54688	0.060772

b. Results from regula falsi

step	a	b	x	y
1	-3	-2	-2.75	0.89062
2	-3	-2.75	-2.8678	0.087484
3	-3	-2.8678	-2.8784	0.0074324
4	-3	-2.8784	-2.8793	0.00062341

step	a	b	x	y
1	-2	0	-0.5	-0.375
2	-2	-0.5	-0.66667	0.037037
3	-0.66667	-0.5	-0.65169	-0.0026852
4	-0.66667	-0.65169	-0.6527	-1.4556e-05
5	-0.66667	-0.6527	-0.6527	-7.8764e-08

step	a	b	x	y
1	0	1	0.25	-0.79688
2	0.25	1	0.40741	-0.43444
3	0.40741	1	0.48237	-0.18973
4	0.48237	1	0.51316	-0.074882
5	0.51316	1	0.52501	-0.028372
6	0.52501	1	0.52946	-0.010584

c. Results from secant method

step	x	y
1	-3	-1
2	-2	3
3	-2.75	0.89062
4	-3.0667	-1.627
5	-2.862	0.13018
6	-2.8772	0.016679

step	x	y
1	-2	3
2	0	-1
3	-0.5	-0.375
4	-0.8	0.408
5	-0.64368	-0.023725
6	-0.65227	-0.0011473

step	x	y
1	0	-1
2	1	3
3	0.25	-0.79688
4	0.40741	-0.43444
5	0.59608	0.27774
6	0.5225	-0.03833

d. Results from Newton's method

step	x	y
1	-2.5	2.125
2	-3.0667	-1.627
3	-2.9009	-0.16586
4	-2.8797	-0.0025428
5	-2.8794	-6.3123e-07

step	x	y
1	-1	1
2	-0.66667	0.037037
3	-0.65278	0.00019558
4	-0.6527	5.7248e-09

step	x	y
1	0.5	-0.125
2	0.53333	0.005037
3	0.53209	7.1018e-06
4	0.53209	1.419e-11

e. Results from Muller's method

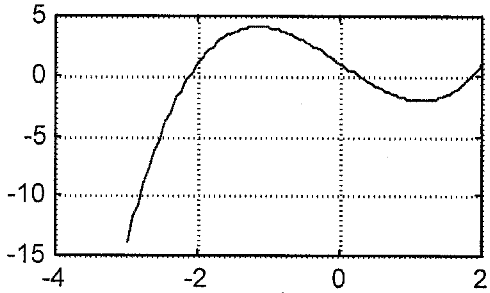
step	x	y
1	-3	-1
2	-2	3
3	-2.5	2.125
4	-2.8739	0.041197
5	-2.8796	-0.001902

step	x	y
1	-2	3
2	0	-1
3	-1	1
4	-0.5	-0.375
5	-0.66667	0.037037
6	-0.65242	-0.00075489

step	x	y
1	0	-1
2	1	3
3	0.5	-0.125
4	0.53022	-0.007528
5	0.53208	-2.7915e-05
6	0.53209	4.1365e-10

P2.12

f(x) = x^3 -4x +1   ans: x = -2.1149, 1.8608, 0.2541



a. Results from bisection method

step	a	b	x	y
1	-3	-2	-2.5	-4.625
2	-2.5	-2	-2.25	-1.3906
3	-2.25	-2	-2.125	-0.095703
4	-2.125	-2	-2.0625	0.47632
5	-2.125	-2.0625	-2.0938	0.19644
6	-2.125	-2.0938	-2.1094	0.051914

step	a	b	x	y
1	0	1	0.5	-0.875
2	0	0.5	0.25	0.015625
3	0.25	0.5	0.375	-0.44727
4	0.25	0.375	0.3125	-0.21948
5	0.25	0.3125	0.28125	-0.10275
6	0.25	0.28125	0.26562	-0.043758

step	a	b	x	y
1	1	2	1.5	-1.625
2	1.5	2	1.75	-0.64062
3	1.75	2	1.875	0.091797
4	1.75	1.875	1.8125	-0.29565
5	1.8125	1.875	1.8438	-0.10733
6	1.8438	1.875	1.8594	-0.0091286

b. Results from regula falsi method

step	a	b	x	y
1	-3	-2	-2.0667	0.4397
2	-3	-2.0667	-2.0951	0.18419
3	-3	-2.0951	-2.1068	0.075587
4	-3	-2.1068	-2.1116	0.030757
5	-3	-2.1116	-2.1136	0.012472
6	-3	-2.1136	-2.1144	0.0050505

step	a	b	x	y
1	0	1	0.33333	-0.2963
2	0	0.33333	0.25714	-0.011569
3	0	0.25714	0.2542	-0.00038225
4	0	0.2542	0.2541	-1.2546e-05

step	a	b	x	y
1	1	2	1.6667	-1.037
2	1.6667	2	1.8364	-0.15281
3	1.8364	2	1.8581	-0.017533
4	1.8581	2	1.8605	-0.0019511
5	1.8605	2	1.8608	-0.00021638

c. Results from secant method

1	-3	-14
2	-2	1
3	-2.0667	0.4397
4	-2.119	-0.038506
5	-2.1148	0.0012768
6	-2.1149	3.5e-06

step	x	y
1	0	1
2	1	-2
3	0.33333	-0.2963
4	0.21739	0.14071
5	0.25472	-0.0023637
6	0.25411	-1.6445e-05

step	x	y
1	1	-2
2	2	1
3	1.6667	-1.037
4	1.8364	-0.15281
5	1.8657	0.031336
6	1.8607	-0.0006756
7	1.8608	-2.8748e-06

d. Results from Newton's method

step	x	y
1	-2.5	-4.625
2	-2.1864	-0.70657
3	-2.1181	-0.0303
4	-2.1149	-6.5167e-05
5	-2.1149	-3.0374e-10

step	x	y
1	0.5	-0.875
2	0.23077	0.089213
3	0.254	0.00038616
4	0.2541	7.8435e-09

step	x	y
1	1.5	-1.625
2	2.0909	1.7776
3	1.8959	0.23112
4	1.8618	0.0065631
5	1.8608	5.874e-06
6	1.8608	4.7198e-12

e. Results from Muller's method

step	x	y
1	-3	-14
2	-2	1
3	-2.5	-4.625
4	-2.1191	-0.039969
5	-2.1149	-0.0001864
6	-2.1149	3.2255e-08

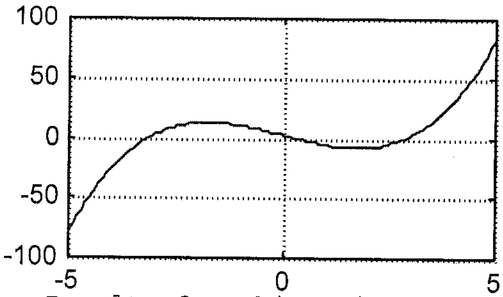
step	x	y
1	0	1
2	1	-2
3	0.5	-0.875
4	0.24169	0.047342
5	0.25353	0.0021775
6	0.2541	-1.7467e-06

step	x	y
1	1	-2
2	2	1
3	1.5	-1.625
4	1.8539	-0.044157
5	1.8608	-0.00034665
6	1.8608	1.3624e-07

P2.13

f(x) = x^3 -9x +2

ans: x = -3.1055, 2.8820, 0.2235



a. Results from bisection method

step	a	b	x	y
1	-4	-2	-3	2
2	-4	-3	-3.5	-9.375
3	-3.5	-3	-3.25	-3.0781
4	-3.25	-3	-3.125	-0.39258
5	-3.125	-3	-3.0625	0.8396
6	-3.125	-3.0625	-3.0938	0.23257
7	-3.125	-3.0938	-3.1094	-0.077724

step	a	b	x	y
1	0	1	0.5	-2.375
2	0	0.5	0.25	-0.23438
3	0	0.25	0.125	0.87695
4	0.125	0.25	0.1875	0.31909
5	0.1875	0.25	0.21875	0.041718
6	0.21875	0.25	0.23438	-0.0965
7	0.21875	0.23438	0.22656	-0.027433

step	a	b	x	y
1	2	3	2.5	-4.875
2	2.5	3	2.75	-1.9531
3	2.75	3	2.875	-0.11133
4	2.875	3	2.9375	0.90991
5	2.875	2.9375	2.9062	0.39078
6	2.875	2.9062	2.8906	0.13761
7	2.875	2.8906	2.8828	0.012612

b. Results from regula falsi

step	a	b	x	y
1	-4	-2	-2.6316	7.46
2	-4	-2.6316	-2.9367	3.1041
3	-4	-2.9367	-3.0501	1.0759
4	-4	-3.0501	-3.0878	0.34905
5	-4	-3.0878	-3.0999	0.11081
6	-4	-3.0999	-3.1037	0.034932
7	-4	-3.1037	-3.1049	0.010988
8	-4	-3.1049	-3.1053	0.0034542

step	a	b	x	y
1	0	1	0.25	-0.23438
2	0	0.25	0.22378	-0.0027802
3	0	0.22378	0.22347	-3.1047e-05

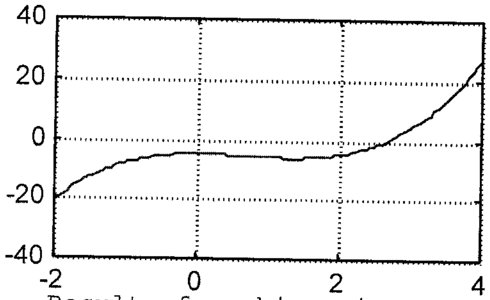
step	a	b	x	y
1	2	3	2.8	-1.248
2	2.8	3	2.8768	-0.082117
3	2.8768	3	2.8817	-0.0050324
4	2.8817	3	2.882	-0.00030703

```
c.  Results from secant method
 1       -4        -26
 2       -2         12
 3       -2.6316     7.46
 4       -3.6694   -14.381
 5       -2.986      2.2494
 6       -3.0785     0.53161
 7       -3.1071    -0.03175
 8       -3.1055     0.00040424
 9       -3.1055     3.0058e-07
step       x           y
 1       0             2
 2       1            -6
 3       0.25         -0.23438
 4       0.21951       0.034968
 5       0.22347      -7.2768e-05
 6       0.22346      -2.1638e-08
step       x           y
 1       2           -8
 2       3            2
 3       2.8         -1.248
 4       2.8768      -0.082117
 5       2.8823       0.0038109
 6       2.882       -1.0729e-05
d.  Results from Newton's method
1           -3       2
 2       -3.1111    -0.11248
 3       -3.1055    -0.00029396
 4       -3.1055    -2.0263e-09
step       x          y
 1       0.5        -2.375
 2       0.21212     0.10045
 3       0.22345     8.3165e-05
 4       0.22346     5.9196e-11
step       x          y
 1        2.5       -4.875
 2        3          2
 3        2.8889     0.10974
 4        2.882      0.0004055
 5        2.882      5.6103e-09
e.  Results from Muller's method
 1       -4        -26
 2       -2         12
 3       -3          2
 4       -3.1005     0.099466
 5       -3.1055    -0.00058689
 6       -3.1055     1.5536e-08
step       x          y
 1       0           2
 2       1          -6
 3       0.5        -2.375
 4       0.21803     0.048074
 5       0.22333     0.0011391
 6       0.22346    -1.9329e-07
step       x          y
 1        2         -8
 2        3          2
 3        2.5       -4.875
 4        2.8795    -0.040221
 5        2.882     -0.00011372
 6        2.882      6.906e-09
```

P2.14

f(x) = x^3 -2x^2 -5

ans: x = 2.6906



a. Results from bisection method

step	a	b	x	y
1	2	4	3	4
2	2	3	2.5	-1.875
3	2.5	3	2.75	0.67188
4	2.5	2.75	2.625	-0.69336
5	2.625	2.75	2.6875	-0.034424
6	2.6875	2.75	2.7188	0.31271
7	2.6875	2.7188	2.7031	0.13765
8	2.6875	2.7031	2.6953	0.051243

b. Results from regula falsi

step	a	b	x	y
1	2	4	2.3125	-3.3289
2	2.3125	4	2.4977	-1.8949
3	2.4977	4	2.5962	-0.98109
4	2.5962	4	2.6455	-0.4828
5	2.6455	4	2.6693	-0.23163
6	2.6693	4	2.6806	-0.10977
7	2.6806	4	2.6859	-0.051716
8	2.6859	4	2.6884	-0.024298

c. Results from secant method

step	x	y
1	2	-5
2	4	27
3	2.3125	-3.3289
4	2.4977	-1.8949
5	2.7425	0.5844
6	2.6848	-0.063949
7	2.6905	-0.0018104
8	2.6906	5.8896e-06

d. Results from Newton's method

step	x	y
1	3	4
2	2.7333	0.47881
3	2.6916	0.010713
4	2.6906	5.7947e-06

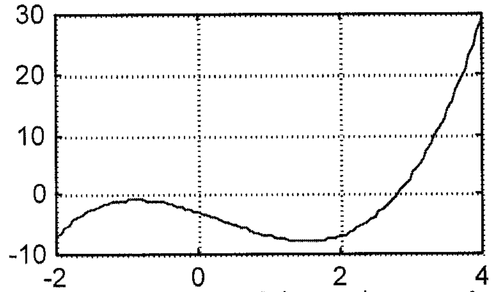
e. Results from Muller's method

step	x	y
1	2	-5
2	4	27
3	3	4
4	2.7143	0.26239
5	2.6897	-0.0099801
6	2.6906	6.6687e-06

P2.15

f(x) = x^3 -x^2 -4x -3

ans: x = 2.8063



a. Results from bisection method

step	a	b	x	y
1	2	4	3	3
2	2	3	2.5	-3.625
3	2.5	3	2.75	-0.76562
4	2.75	3	2.875	0.99805
5	2.75	2.875	2.8125	0.087158
6	2.75	2.8125	2.7812	-0.34641
7	2.7812	2.8125	2.7969	-0.13143
8	2.7969	2.8125	2.8047	-0.022587
9	2.8047	2.8125	2.8086	0.032172
10	2.8047	2.8086	2.8066	0.0047641

b. Results from regula falsi method

step	a	b	x	y
1	2	4	2.3889	-4.6295
2	2.3889	4	2.6107	-2.4649
3	2.6107	4	2.7195	-1.1609
4	2.7195	4	2.7688	-0.5151
5	2.7688	4	2.7903	-0.22248
6	2.7903	4	2.7995	-0.094972
7	2.7995	4	2.8034	-0.040339
8	2.8034	4	2.8051	-0.017098
9	2.8051	4	2.8058	-0.0072402

c. Results from secant method

step	x	y
1	2	-7
2	4	29
3	2.3889	-4.6295
4	2.6107	-2.4649
5	2.8632	0.82222
6	2.8001	-0.087033
7	2.8061	-0.0025804
8	2.8063	8.5349e-06

d. Results from Newton's method

step	x	y
1	3	3
2	2.8235	0.24364
3	2.8065	0.0021728
4	2.8063	1.783e-07

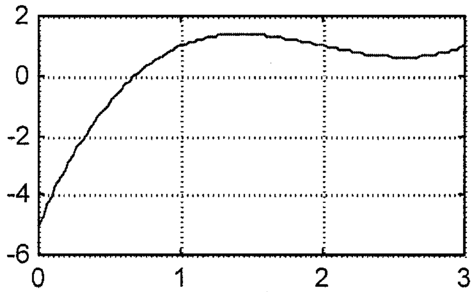
e. Results from Muller's method

step	x	y
1	2	-7
2	4	29
3	3	3
4	2.8187	0.17531
5	2.8061	-0.0029257
6	2.8063	5.0275e-07

P2.16

f(x) = x^3 -6x^2 +11x -5

ans: x = 0.6753



a. Results from bisection method

step	a	b	x	y
1	0	1	0.5	-0.875
2	0.5	1	0.75	0.29688
3	0.5	0.75	0.625	-0.22461
4	0.625	0.75	0.6875	0.051514
5	0.625	0.6875	0.65625	-0.082611
6	0.65625	0.6875	0.67188	-0.014576
7	0.67188	0.6875	0.67969	0.018711
8	0.67188	0.67969	0.67578	0.0021279
9	0.67188	0.67578	0.67383	-0.0062088
10	0.67383	0.67578	0.6748	-0.0020367

b. Results from regula falsi method

step	a	b	x	y
1	0	1	0.83333	0.5787
2	0	0.83333	0.74689	0.28536
3	0	0.74689	0.70656	0.12954
4	0	0.70656	0.68872	0.056588
5	0	0.68872	0.68101	0.024304
6	0	0.68101	0.67772	0.010362
7	0	0.67772	0.67632	0.0044039
8	0	0.67632	0.67572	0.0018693

c. Results from secant method

step	x	y
1	0	-5
2	1	1
3	0.83333	0.5787
4	0.6044	-0.32263
5	0.68634	0.046687
6	0.67598	0.0029911
7	0.67527	-3.1101e-05

d. Results from Newton's method

step	x	y
1	0.5	-0.875
2	0.65217	-0.10068
3	0.6748	-0.0020584
4	0.67528	-9.2438e-07

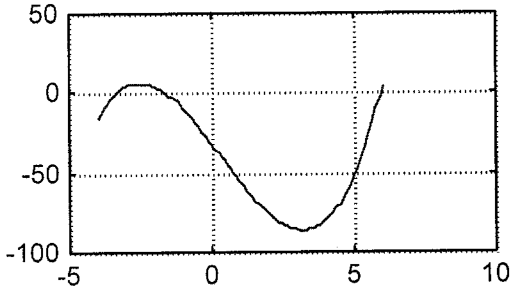
e. Results from Muller's method

step	x	y
1	0	-5
2	1	1
3	0.5	-0.875
4	0.66667	-0.037037
5	0.67517	-0.00048376
6	0.67528	1.7135e-07

P2.17

f(x) = x^3 -x^2 -24x -32

ans: x = 5.9437, -3.3240, -1.6197



a. Results from bisection method

step	a	b	x	y
1	-4	-3	-3.5	-3.125
2	-3.5	-3	-3.25	1.1094
3	-3.5	-3.25	-3.375	-0.83398
4	-3.375	-3.25	-3.3125	0.18042
5	-3.375	-3.3125	-3.3438	-0.31601
6	-3.3438	-3.3125	-3.3281	-0.065113
7	-3.3281	-3.3125	-3.3203	0.058322
8	-3.3281	-3.3203	-3.3242	-0.0032279

step	a	b	x	y
1	-2	-1	-1.5	-1.625
2	-2	-1.5	-1.75	1.5781
3	-1.75	-1.5	-1.625	0.068359
4	-1.625	-1.5	-1.5625	-0.7561
5	-1.625	-1.5625	-1.5938	-0.33823
6	-1.625	-1.5938	-1.6094	-0.13351
7	-1.625	-1.6094	-1.6172	-0.032218
8	-1.625	-1.6172	-1.6211	0.01816

step	a	b	x	y
1	5	6	5.5	-27.875
2	5.5	6	5.75	-12.953
3	5.75	6	5.875	-4.7363
4	5.875	6	5.9375	-0.43384
5	5.9375	6	5.9688	1.7666
6	5.9375	5.9688	5.9531	0.66225
7	5.9375	5.9531	5.9453	0.11318
8	5.9375	5.9453	5.9414	-0.16059

b. Results from regula falsi method

1	-4	-3	-3.2	1.792
2	-4	-3.2	-3.2806	0.66551
3	-4	-3.2806	-3.3093	0.22998
4	-4	-3.3093	-3.3191	0.077493
5	-4	-3.3191	-3.3224	0.02589
6	-4	-3.3224	-3.3235	0.008625
7	-4	-3.3235	-3.3238	0.0028706

step	a	b	x	y
1	-2	-1	-1.7143	1.1662
2	-1.7143	-1	-1.6397	0.25549
3	-1.6397	-1	-1.6238	0.05232
4	-1.6238	-1	-1.6205	0.010564
5	-1.6205	-1	-1.6198	0.002127

step	a	b	x	y
1	5	6	5.9286	-1.0565
2	5.9286	6	5.9435	-0.014228
3	5.9435	6	5.9437	-0.00019042

c. Results from secant method

step	x	y
1	-4	-16
2	-3	4
3	-3.2	1.792
4	-3.3623	-0.62118
5	-3.3205	0.05481
6	-3.3239	0.0014317
7	-3.324	-3.467e-06

step	x	y
1	-2	4
2	-1	-10
3	-1.7143	1.1662
4	-1.6397	0.25549
5	-1.6188	-0.011941
6	-1.6197	0.00010983

step	x	y
1	5	-52
2	6	4
3	5.9286	-1.0565
4	5.9435	-0.014228
5	5.9437	5.1825e-05

d. Results from Newton's method

step	x	y
1	-3.5	-3.125
2	-3.3418	-0.28395
3	-3.3242	-0.0033878
4	-3.324	-5.0447e-07

step	x	y
1	-1.5	-1.625
2	-1.614	-0.073005
3	-1.6197	-0.00018566
4	-1.6197	-1.2153e-09

step	x	y
1	5.5	-27.875
2	6	4
3	5.9444	0.052298
4	5.9437	9.3633e-06

e. Results from Muller's method

step	x	y
1	-4	-16
2	-3	4
3	-3.5	-3.125
4	-3.3264	-0.038164
5	-3.324	-0.00013705
6	-3.324	3.6832e-09

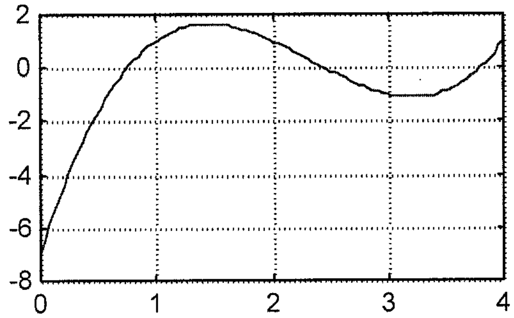
step	x	y
1	-2	4
2	-1	-10
3	-1.5	-1.625
4	-1.6219	0.028666
5	-1.6197	0.00016417
6	-1.6197	-3.3932e-09

step	x	y
1	5	-52
2	6	4
3	5.5	-27.875
4	5.9434	-0.023689
5	5.9437	-8.4402e-06

P2.18

f(x) = x^3 -7x^2 +14 x -7

ans: x = 3.8019, 2.4450, 0.7530



a. Results from bisection method (7 steps)

step	a	b	x	y
1	0	1	0.5	-1.625
2	0.5	1	0.75	-0.015625
3	0.75	1	0.875	0.56055
4	0.75	0.875	0.8125	0.29028
5	0.75	0.8125	0.78125	0.14188
6	0.75	0.78125	0.76562	0.064274
7	0.75	0.76562	0.75781	0.024613

step	a	b	x	y
1	2	3	2.5	-0.125
2	2	2.5	2.25	0.45312
3	2.25	2.5	2.375	0.16211
4	2.375	2.5	2.4375	0.017334
5	2.4375	2.5	2.4688	-0.05423
6	2.4375	2.4688	2.4531	-0.018536
7	2.4375	2.4531	2.4453	-0.00062132

step	a	b	x	y
1	3	4	3.5	-0.875
2	3.5	4	3.75	-0.20312
3	3.75	4	3.875	0.32617
4	3.75	3.875	3.8125	0.044189
5	3.75	3.8125	3.7812	-0.08371
6	3.7812	3.8125	3.7969	-0.020832
7	3.7969	3.8125	3.8047	0.011409

b. Results from regula falsi method

step	a	b	x	y
1	0	1	0.875	0.56055
2	0	0.875	0.81013	0.27933
3	0	0.81013	0.77904	0.13104
4	0	0.77904	0.76472	0.059731
5	0	0.76472	0.75825	0.026871
6	0	0.75825	0.75535	0.012016
7	0	0.75535	0.75406	0.0053592
8	0	0.75406	0.75348	0.0023874

step	a	b	x	y
1	2	3	2.5	-0.125
2	2	2.5	2.4444	0.0013717
3	2.4444	2.5	2.445	-1.2907e-05

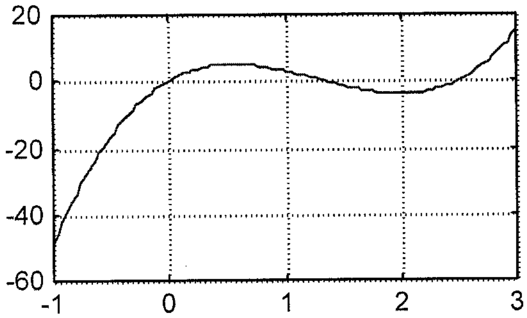
step	a	b	x	y
1	3	4	3.5	-0.875
2	3.5	4	3.7333	-0.26341
3	3.7333	4	3.7889	-0.053068
4	3.7889	4	3.7996	-0.0097823
5	3.7996	4	3.8015	-0.0017733
6	3.8015	4	3.8019	-0.00032048

```
c.  Results from secant method
 1       0           -7
 2       1            1
 3       0.875        0.56055
 4       0.71556     -0.19998
 5       0.75748      0.022921
 6       0.75317      0.00077414
 7       0.75302     -3.1847e-06
step     x            y
 1       2            1
 2       3           -1
 3       2.5         -0.125
 4       2.4286       0.037901
 5       2.4452      -0.00034045
 6       2.445       -7.7688e-07
step     x            y
 1       3           -1
 2       4            1
 3       3.5         -0.875
 4       3.7333      -0.26341
 5       3.8338       0.13644
 6       3.7995      -0.0099134
 7       3.8019      -0.00032935
 8       3.8019       8.4446e-07
d.  Results from Newton's method
 1       0.5         -1.625
 2       0.70968     -0.23259
 3       0.75139     -0.0084041
 4       0.75302     -1.2516e-05
 5       0.75302     -2.7905e-11
step     x            y
 1       2.5         -0.125
 2       2.4444       0.0013717
 3       2.445        1.1916e-07
step     x            y
 1       3.5         -0.875
 2       4            1
 3       3.8333       0.13426
 4       3.8029       0.0041302
 5       3.8019       4.3745e-06
e.  Results from Muller's method
 1       0         -7
 2       1          1
 3       0.5       -1.625
 4       0.74408   -0.046479
 5       0.75291   -0.00055175
 6       0.75302    2.419e-07
step     x          y
 1       2          1
 2       3         -1
 3       2.5       -0.125
 4       2.4384     0.015155
 5       2.445      0.00019884
 6       2.445     -3.1393e-08
step     x          y
 1       3         -1
 2       4          1
 3       3.5       -0.875
 4       3.7902    -0.048111
 5       3.8018    -0.00069442
 6       3.8019     5.9748e-07
```

P2.19

f(x) = 6x^3 -23x^2 +20x

ans: x = 0, 2.5000, 1.3333



a. Results from bisection method

step	a	b	x	y
1	-1	1	0	0

exact zero found

step	a	b	x	y
1	1	2	1.5	-1.5
2	1	1.5	1.25	0.78125
3	1.25	1.5	1.375	-0.38672
4	1.25	1.375	1.3125	0.19482
5	1.3125	1.375	1.3438	-0.097107
6	1.3125	1.3438	1.3281	0.048637
7	1.3281	1.3438	1.3359	-0.024299
8	1.3281	1.3359	1.332	0.012154
9	1.332	1.3359	1.334	-0.006076
10	1.332	1.334	1.333	0.0030383

step	a	b	x	y
1	2	3	2.5	0

exact zero found

b. Results from regula falsi method

step	a	b	x	y
1	-1	1	0.88462	3.8473
2	-1	0.88462	0.74742	4.605
3	-1	0.74742	0.5973	5.0189
4	-1	0.5973	0.4489	4.886
5	-1	0.4489	0.31752	4.2236
6	-1	0.31752	0.21297	3.2741
7	-1	0.21297	0.13699	2.3237
8	-1	0.13699	0.085517	1.5459
9	-1	0.085517	0.052318	0.98426
10	-1	0.052318	0.031596	0.60915

step	a	b	x	y
1	1	2	1.4286	-0.87464
2	1	1.4286	1.3318	0.014048
3	1.3318	1.4286	1.3334	-0.00022752
4	1.3318	1.3334	1.3333	-3.6353e-08

step	a	b	x	y
1	2	3	2.2105	-3.3678
2	2.2105	3	2.3553	-2.09
3	2.3553	3	2.4341	-1.059
4	2.4341	3	2.4714	-0.48194
5	2.4714	3	2.4879	-0.20859
6	2.4879	3	2.4949	-0.088322
7	2.4949	3	2.4979	-0.03705
8	2.4979	3	2.4991	-0.015481
9	2.4991	3	2.4996	-0.006458

c. Results from secant method

step	x	y
1	-1	-49
2	1	3
3	0.88462	3.8473
4	1.4085	-0.69373
5	1.3285	0.045123
6	1.3334	-0.0005226
7	1.3333	-2.6269e-07

(note that secant method has converged to root between 1 and 2, not root between -1 and 1.)

step	x	y
1	1	3
2	2	-4
3	1.4286	-0.87464
4	1.2687	0.60621
5	1.3341	-0.0073461
6	1.3333	-3.1263e-05

step	x	y
1	2	-4
2	3	15
3	2.2105	-3.3678
4	2.3553	-2.09
5	2.592	1.8018
6	2.4824	-0.30074
7	2.4981	-0.033042
8	2.5	0.00074596
9	2.5	-1.778e-06

d. Results from Newton's method

step	x	y
1	0	0
2	0	0

step	x	y
1	1.5	-1.5
2	1.3235	0.091594
3	1.3333	8.4647e-05
4	1.3333	8.2238e-11

step	x	y
1	2.5	0
2	2.5	0

e. Results from Muller's method

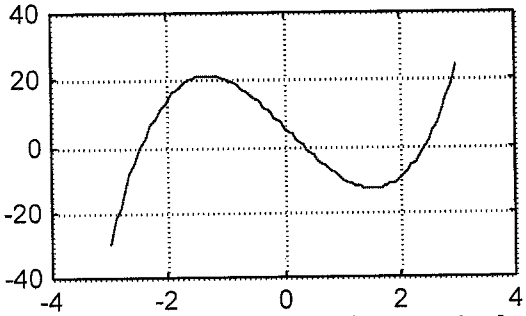
step	x	y
1	-1	-49
2	1	3
3	0	0
4	0	0

step	x	y
1	1	3
2	2	-4
3	1.5	-1.5
4	1.307	0.24637
5	1.3316	0.01659
6	1.3333	-4.6939e-05
7	1.3333	-1.4121e-09

step	x	y
1	2	-4
2	3	15
3	2.5	0
4	2.5	0

P2.20

```
f(x) = 3x^3 -x^2 -18x +6
ans:    x =      2.4495    -2.4495      0.3333
```



a. Results from bisection method

step	a	b	x	y
1	-3	-2	-2.5	-2.125
2	-2.5	-2	-2.25	7.2656
3	-2.5	-2.25	-2.375	2.9199
4	-2.5	-2.375	-2.4375	0.48706
5	-2.5	-2.4375	-2.4688	-0.7963
6	-2.4688	-2.4375	-2.4531	-0.14898
7	-2.4531	-2.4375	-2.4453	0.17044
8	-2.4531	-2.4453	-2.4492	0.011082

step	a	b	x	y
1	0	1	0.5	-2.875
2	0	0.5	0.25	1.4844
3	0.25	0.5	0.375	-0.73242
4	0.25	0.375	0.3125	0.3689
5	0.3125	0.375	0.34375	-0.18381
6	0.3125	0.34375	0.32812	0.092068
7	0.32812	0.34375	0.33594	-0.045993
8	0.32812	0.33594	0.33203	0.023007

step	a	b	x	y
1	2	3	2.5	1.625
2	2	2.5	2.25	-5.3906
3	2.25	2.5	2.375	-2.2012
4	2.375	2.5	2.4375	-0.36987
5	2.4375	2.5	2.4688	0.60684
6	2.4375	2.4688	2.4531	0.11334
7	2.4375	2.4531	2.4453	-0.12955
8	2.4453	2.4531	2.4492	-0.0084266

b. Results from regula falsi method

step	a	b	x	y
1	-3	-2	-2.3182	4.9798
2	-3	-2.3182	-2.4152	1.3736
3	-3	-2.4152	-2.4408	0.3517
4	-3	-2.4408	-2.4473	0.088319
5	-3	-2.4473	-2.4489	0.022071

step	a	b	x	y
1	0	1	0.375	-0.73242
2	0	0.375	0.3342	-0.015374
3	0	0.3342	0.33335	-0.00028549

step	a	b	x	y
1	2	3	2.2941	-4.3354
2	2.2941	3	2.4021	-1.4263
3	2.4021	3	2.4357	-0.42612
4	2.4357	3	2.4455	-0.12361
5	2.4455	3	2.4483	-0.035551
6	2.4483	3	2.4492	-0.010199

```
c.  Results from secant method
 1      -3          -30
 2      -2           14
 3      -2.3182       4.9798
 4      -2.4938      -1.8595
 5      -2.4461       0.13912
 6      -2.4494       0.0034223
 7      -2.4495      -6.5822e-06
step        x          y
 1      0            6
 2      1          -10
 3      0.375        -0.73242
 4      0.32561       0.13664
 5      0.33337      -0.00067951
 6      0.33333      -5.8708e-07
step        x          y
 1       2         -10
 2       3          24
 3       2.2941      -4.3354
 4       2.4021      -1.4263
 5       2.4551       0.17433
 6       2.4493      -0.005693
 7       2.4495      -2.1453e-05
d.  Results from Newton's method
step        x          y
 1      -2.5         -2.125
 2      -2.4509      -0.056374
 3      -2.4495      -4.3665e-05
 4      -2.4495      -2.6269e-11
step        x          y
 1      0.5          -2.875
 2      0.32836       0.087943
 3      0.33333       4.8711e-05
 4      0.33333       1.5204e-11
step        x          y
 1       2.5          1.625
 2       2.4511       0.051002
 3       2.4495       5.6372e-05
 4       2.4495       6.9129e-11
e.  Results from Muller's method
step      x          y
 1     -3          -30
 2     -2           14
 3     -2.5         -2.125
 4     -2.4504      -0.036841
 5     -2.4495      -6.1219e-05
step      x          y
 1      0           6
 2      1          -10
 3      0.5         -2.875
 4      0.32687      0.11428
 5      0.33321      0.0021166
 6      0.33333     -3.8729e-07
step       x         y
 1       2         -10
 2       3          24
 3       2.5         1.625
 4       2.4507      0.03664
 5       2.4495     -9.8468e-05
 6       2.4495      5.6475e-10
```

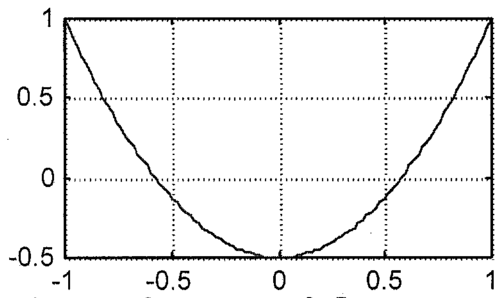
P2.21

For each of the following equations, use Newton's method with the specified starting value to find a root; discuss the source of the difficulty if Newton's method fails.

```
f(x) = -5 x^4 +11x^2 -2;          x_0 = 1
ans:
[x,y]=Newton(inline('-5*x^4+11*x^2-2'), inline('-20*x^3 +22*x'),1,0.0001,5)
  step     x     y
     1     1     4
     2    -1     4
     3     1     4
     4    -1     4
     5     1     4
estimated roots oscillate.
f(x) = x^3 -4x+1;                  x_0 = 0
ans:
[x, y] = Newton(inline('x^3 -4*x  +1'), inline('3*x^2  -4'), 0, 0.0001, 5)
Newton method has converged
step          x          y
    1.0000    0          1.0000
    2.0000    0.2500     0.0156
    3.0000    0.2541     0.0000
    4.0000    0.2541     0.0000

f(x) = 5 x^4 -11x^2 +2;            x_0 = 1;
ans:
[x, y] = Newton(inline('5*x^4-11*x^2 +2'), inline('20*x^3-22*x'),1,0.0001, 5)
   step    x     y
     1     1    -4
     2    -1    -4
     3     1    -4
     4    -1    -4
     5     1    -4
estimated roots oscillate.

f(x) = 5 x^4 -11x^2 +2;            x_0 = 1/2;
ans:
[x,y]=Newton(inline('5*x^4-11*x^2 +2'), inline('20*x^3-22*x'), 1/2,0.0001, 5)
Newton method has converged
x =      0.4472

f(x) = 5 x^4 -11x^2 +2;            x_0 = 0
ans:
[x, y]=Newton(inline('5*x^4-11*x^2+2'), inline('20*x^3 -22*x'), 0, 0.0001, 5)
  step    x     y
     1     0     2
     2  -Inf   NaN
     3   NaN   NaN
     4   NaN   NaN
     5   NaN   NaN
f' is zero at x = 0

f(x) = x^5 -0.5;                   x_0 = 1
ans:
[x, y] = Newton(inline('x^5 -0.5'), inline('5*x^4'), 1, 0.0001, 5)
Newton method has converged
x=     0.8706
```

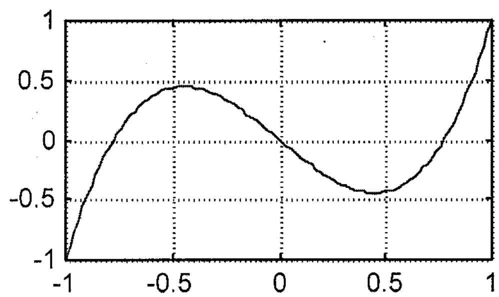
P2.22

```
Find the zeros of the following Legendre polynomials:
P_2(x) = (3 x^2-1)/2        ans:    x =     0.5774,    -0.5774
Results from secant method
a.     y = 1.5*x.^2 -0.5;
```



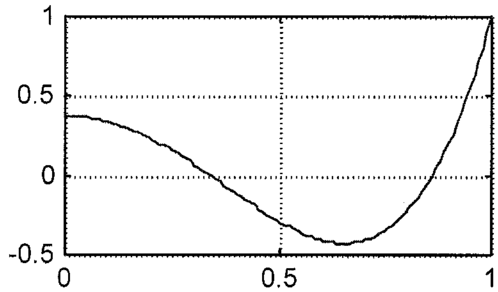
```
  1       0         -0.5
  2       1          1
  3       0.33333   -0.33333
  4       0.5       -0.125
  5       0.6        0.04
  6       0.57576   -0.0027548
  7       0.57732   -5.3141e-05
 step      x          y
  1      -1          1
  2       0         -0.5
  3      -0.33333   -0.33333
  4      -1          1
  5      -0.5       -0.125
  6      -0.55556   -0.037037
```

```
P_3(x) = (5 x^3-3 x)/2       ans:    x =  0,     0.7746,    -0.7746
b.     y = 2.5*x.^3 - 1.5*x;
```



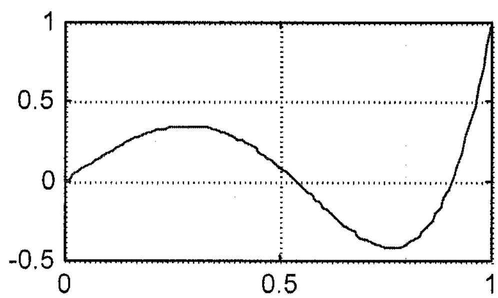
```
  1      -1          -1
  2      -0.5         0.4375
  3      -0.65217     0.28479
  4      -0.93595    -0.64584
  5      -0.73902     0.0995
  6      -0.76531     0.027371
step      x          y
  1       0.5        -0.4375
  2       1           1
  3       0.65217    -0.28479
  4       0.72927    -0.12427
  5       0.78896     0.044302
  6       0.77328    -0.0039542
step      x          y
  1      -0.5         0.4375
  2       0.5        -0.4375
  3       0           0
  4       0           0
```

```
P_4(x) = (35 x^4-30 x^2+3 )/8;
ans: x =  0.8611,  -0.8611,  0.3400,  -0.3400
c.    y = (35*x.^4 - 30*x.^2 + 3)/8;
```




```
step      x          y
 1       0          0.375
 2       0.5       -0.28906
 3       0.28235    0.10384
 4       0.33988    0.00019438
 5       0.33998   -6.4953e-06
step      x          y
 1       0.6       -0.408
 2       1          1
 3       0.71591   -0.39773
 4       0.79675   -0.24249
 5       0.92301    0.35566
 6       0.84794   -0.059557
Note: function is even, so the other two roots can be found by symmetry.
```

```
P_5(x) = (63 x^5-70 x^3+15 x )/8
     ans:    x =  0     0.9062,   -0.9062,     0.5385,    -0.5385
d.    y = (63*x.^5 - 70*x.^3 + 15*x)/8;
```

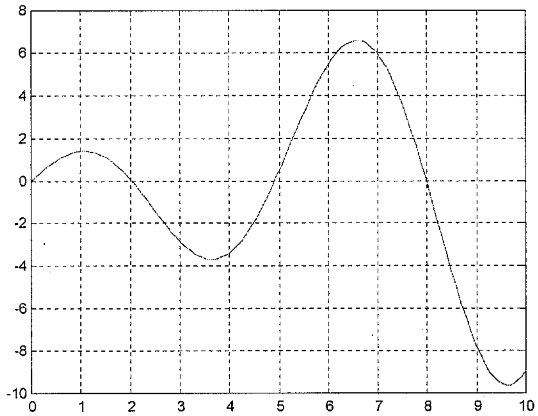



```
step      x          y
 1       0.5        0.089844
 2       0.7       -0.3652
 3       0.53949   -0.0024733
 4       0.53839    0.00018366
 5       0.53847    1.4077e-07
step      x          y
 1       0.8       -0.39952
 2       1          1
 3       0.85709   -0.25977
 4       0.88656   -0.1218
 5       0.91258    0.045391
 6       0.90551   -0.0045576
Note: function is odd, so the other roots are 0, -0.53847, -0.90616.
```

P2.23

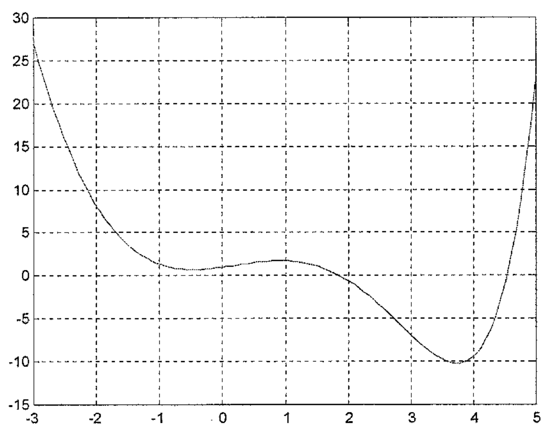
Find the first three positive zeros of y = x*cos(x) + sin(x)
ans:
Graph suggests a zero between 1 and 3, another between 4 and 6, and another between 7 and 9
The secant method finds these zeros to be
x = 2.0288,   x = 4.9132,   x = 7.9787
The plot is generated by the following commands

```
     x = linspace(0, 10);  y = x.*cos(x) + sin(x); plot(x,y), grid on
```



P2.24

Find the intersection(s) of y = e^x and y = x^3;
i.e. find the zeros of f(x) = e^x - x^3.

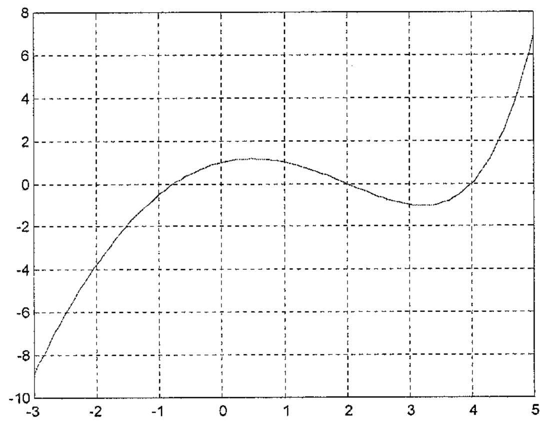


The graph suggests zeros between 1 and 2, and also between 4 and 5.

```
[x, y] = Secant(inline('exp(x) - x.^3'), 1,2, 0.0001, 10)
x = 1.8572
[x, y] = Secant(inline('exp(x) - x.^3'), 4,5, 0.0001, 10)
x = 4.5364
```

P2.25
Find the intersection(s) of y = e^x and y = x^2 .
```
[x, y] = Secant(inline('exp(x) - x.^2'), -1, 0, 0.0001, 10)
x = -0.7035
```

P2.26
Find all intersections of y = 2^x and y = x^2.




```
[x, y] = Secant(inline('2.^x - x.^2'), -1, 0, 0.0001, 10)
x = -0.7667
```
by inspection of the graph, and simple substitution, we see that the other zeros are x = 2 and x = 4.

P2.27
Find the point(s) of intersection of x^c and c^x for c=3 and c=2.7
(It is interesting to note that for c = e, x^c <= c^x for all x.)
ans:
```
[x, y] = Secant(inline('3.^x - x.^3'), 2, 4, 0.0001, 10)
   x = 2.4781 (and by inspection and substitution, x = 3)
[x, y] = Secant(inline('2.7 .^x - x.^2.7'), 2.65, 2.75, 0.0001, 10)
   x = 2.7368 (and by inspection and substitution, x = 2.7)
```

P2.28
Find the intersection(s) of y =-a +e^x and y = b +log(x).
ans:
for a = 5, b = 1
```
[x, y] = Secant(inline('-5 +exp(x) - (1 +log(x))'), 1, 3, 0.0001, 10)
     x = 1.8928
```
for a = 3, b = 2
```
[x, y] = Secant(inline('-3 +exp(x) - (2 +log(x))'), 1, 2, 0.0001, 10)
     x = 1.7115
```
for a = 1, b = 5
```
[x, y] = Secant(inline('-1 +exp(x) - (5 +log(x))'), 1, 2, 0.0001, 10)
     x = 1.8928
```

P2.29
Find the zeros of y = f(x) = log(x+0.1) + 1.5.
ans:
```
[x, y] = Secant(inline('log(x+0.1) + 1.5'), 0, 0.5, 0.0001, 10)
x = 0.1231
```