Homework 2

Problem 1 (1)

```
clear; clc;

syms x

f(x) = sqrt(x) - cos(x);

a_1 = 0;
b_1 = 1;
p_1 = (a_1 + b_1)/2
```

```
p_1 = 0.5000
```

```
vpa(f(a_1), 4)
```

```
ans = −1.0
```

```
vpa(f(b_1), 4)
```

```
ans = 0.4597
```

```
vpa(f(p_1), 4)
```

```
ans = −0.1705
```

```
a_2 = p_1;
b_2 = b_1;
p_2 = (a_2 + b_2)/2
```

```
p_2 = 0.7500
```

```
vpa(f(a_2), 4)
```

```
ans = −0.1705
```

```
vpa(f(b_2), 4)
```

```
ans = 0.4597
```

```
vpa(f(p_2), 4)
```

```
ans = 0.1343
```

```
a_3 = a_2;
b_3 = p_2;
```

```
p_3 = (a_3 + b_3)/2
```

```
p_3 = 0.6250
```

Problem 2 (14)

```
clear; clc;

syms n x

TOL = 10^-4
```

```
TOL = 1.0000e-04
```

```
f(x) = x^2 - 3;

n = log2(1/TOL)
```

```
n = 13.2877
```

```
bisectionMethod(f, 1, 2, TOL)
```

```
n             a             b             p             f(p)
1             1             2             1.5           -0.75
2             1.5           2             1.75          0.0625
3             1.5           1.75          1.625         -0.35938
4             1.625         1.75          1.6875        -0.15234
5             1.6875        1.75          1.7188        -0.045898
6             1.7188        1.75          1.7344        0.0080566
7             1.7188        1.7344        1.7266        -0.018982
8             1.7266        1.7344        1.7305        -0.0054779
9             1.7305        1.7344        1.7324        0.0012856
10            1.7305        1.7324        1.7314        -0.0020971
11            1.7314        1.7324        1.7319        -0.00040603
12            1.7319        1.7324        1.7322        0.0004397
13            1.7319        1.7322        1.7321        1.6823e-05
ans = 1.7321
```

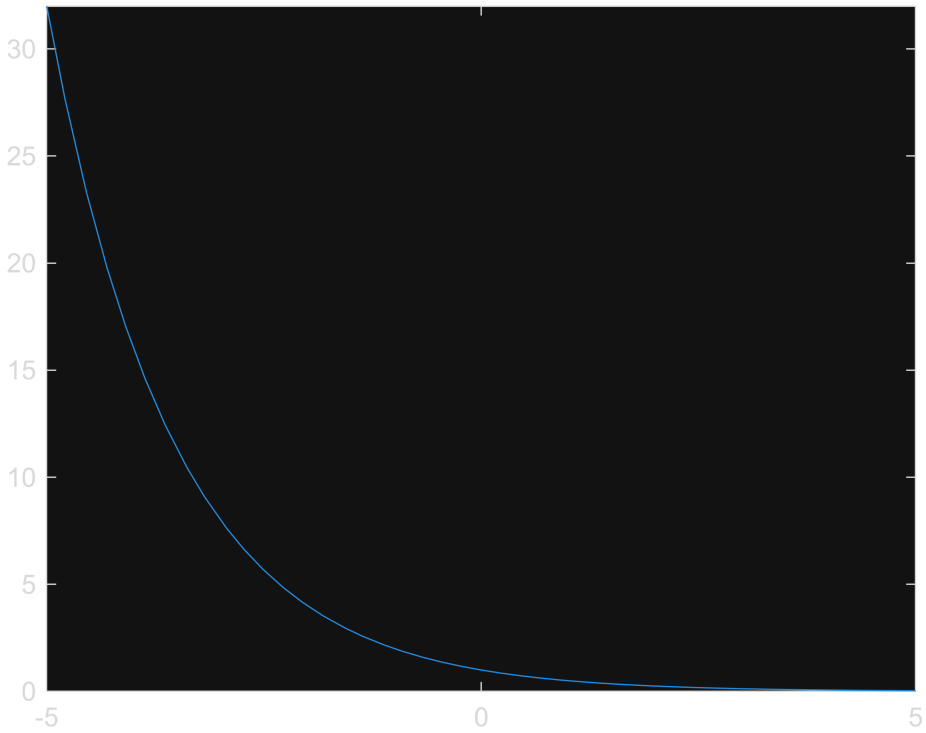
Problem 3 (10)

```
clear; clc;

syms x n

g(x) = 2^(-x)
```

```
g(x) =
```

$$\frac{1}{2^x}$$

```
fplot(g)
```




```
vpa(g(1/3), 4)
```

```
ans = 0.7937
```

```
vpa(g(1), 4)
```

```
ans = 0.5
```

```
vpa(subs(diff(g, x), x, 1/3), 4)
```

```
ans(x) = −0.5502
```

```
n_sol = vpasolve(0.551^n*(2/3)==10^-4, n)
```

```
n_sol = 14.772773267990065312154981867054
```

```
fixedPoint(g, 2/3, 10^-4);
```

```
n               p_n             |p_n-p_{n-1}|
1               0.62996         0.036706
2               0.64619         0.016234
3               0.63896         0.0072304
4               0.64217         0.0032103
5               0.64075         0.0014274
```

```
6              0.64138        0.00063427
7              0.6411         0.00028192
8              0.64122        0.00012529
9              0.64117        5.5684e-05
```

Problem 4 (1)

```
clear; clc;

syms x

p_0 = 1;

f(x) = x^2 - 6
```

f(x) = $x^2 - 6$

```
f_prime(x) = diff(f, x)
```

f_prime(x) = $2\,x$

```


p_1 = p_0 - f(p_0)/f_prime(p_0)
```

p_1 =

$$\frac{7}{2}$$

```
p_2 = p_1 - f(p_1)/f_prime(p_1)
```

p_2 =

$$\frac{73}{28}$$

Problem 5 (12a)

```
clear; clc;

syms x

f(x) = x^2 - 4*x + 4 - log(x)
```

f(x) = $x^2 - \log(x) - 4\,x + 4$

```
g = @(x) x^2 - 4*x + 4 - log(x)
```

```
g = function_handle with value:
    @(x)x^2-4*x+4-log(x)
```

```


NewtonMethod(f, 1.5, 10^-7);
```

```
n             p_n           |p_n-p_{n-1}|
1             1.406721      0.09327906
2             1.41237       0.005649022
3             1.412391      2.121447e-05
4             1.412391      2.988791e-10
```

```
secantMethod(g, 1, 2, 10^-7);
```

```
n             p_n           |p_n-p_{n-1}|
2             1.590616      0.4093839
3             1.284548      0.3060683
4             1.427966      0.1434183
5             1.413635      0.01433147
6             1.412378      0.001256454
7             1.412391      1.299672e-05
8             1.412391      1.073098e-08
```

```
NewtonMethod(f, 3, 10^-7);
```

```
n             p_n           |p_n-p_{n-1}|
1             3.059167      0.05916737
2             3.057106      0.002061319
3             3.057104      2.504693e-06
4             3.057104      3.698235e-12
```

```
secantMethod(g, 2, 4, 10^-7);
```

```
n             p_n           |p_n-p_{n-1}|
2             2.419219      1.580781
3             2.75604       0.3368211
4             3.317023      0.5609828
5             3.009769      0.3072535
6             3.050671      0.04090175
7             3.057289      0.006618332
8             3.057103      0.0001861977
9             3.057104      7.059887e-07
10            3.057104      7.719825e-11
```

Problem 6 (4b)

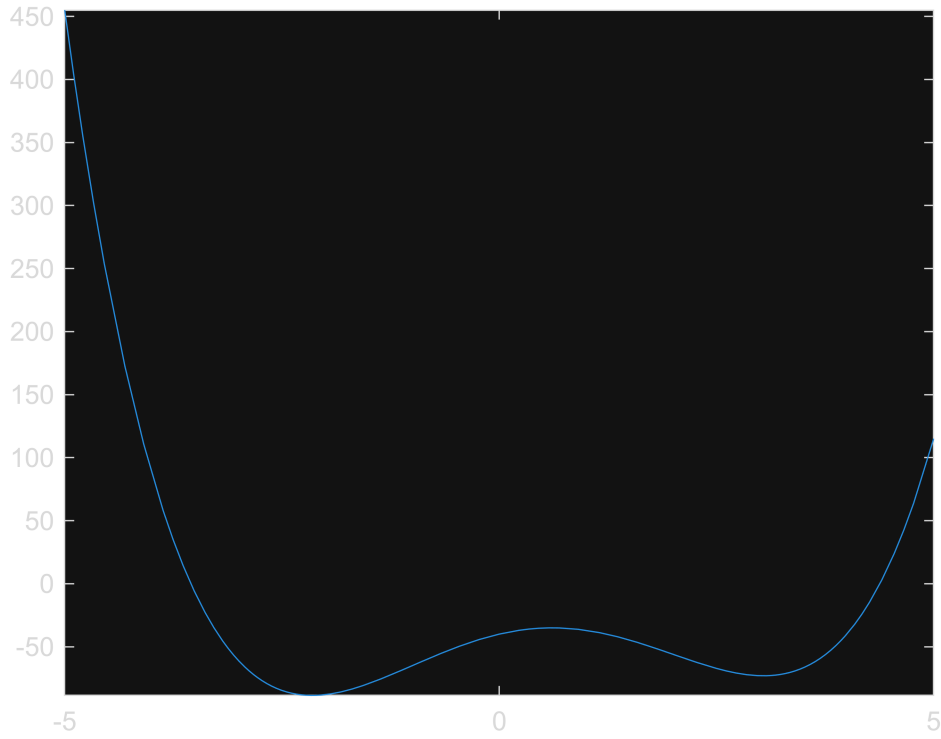
```
clear; clc;

syms x

coeffs = [1 -2 -12 16 -40];

f(x) = poly2sym(coeffs)
```

f(x) = $x^4 - 2\,x^3 - 12\,x^2 + 16\,x - 40$

```
vpa(f(0.5835597))
```

ans = $-35.031032165320712500205913895326$

```
fplot(poly2sym(coeffs))
```




```
MuellerMethod(coeffs, 1, 2, 3, 10^-5);
```

```
n             p                   f(p)
3             -0.7047 +0      i   -56.288
4             0.65918 +3.214  i   209.54
5             0.27268 +0.53586i   -32.695
6             0.38851 +1.3029 i   -10.019
7             0.542   +1.4709 i   -1.2194
8             0.58457 +1.4936 i   -0.035052
9             0.58356 +1.4942 i   5.8656e-05
10            0.58356 +1.4942 i   -3.4301e-10
```

```
MuellerMethod(coeffs, -1, -2, -3, 10^-5);
```

```
n             p                   f(p)
3             -3.8366 +0      i   51.588
4             -3.5245 +0      i   -3.5838
5             -3.5478 +0      i   -0.058736
6             -3.5482 +0      i   -4.3176e-05
7             -3.5482 +0      i   4.1489e-11
```

```
MuellerMethod(coeffs, 5, 6, 7, 10^-5);
```

```
n             p                   f(p)
3             4.3964  -0.56232i   -22.392
4             3.8375  -0.59332i   -70.125
5             4.4484  -0.099854i   8.445
6             4.3801  -0.0058419i   -0.13351
7             4.3811  -6.0609e-05i   -0.0030177
8             4.3811  -5.4476e-09i   4.1537e-08
9             4.3811  -2.1934e-16i   -7.1054e-14
```

Problem 7 (6)

```
clear; clc;

n = 1/(5e-2)
```

```
n = 20
```