Question 1:

```
g1 = @(x) x - x^3 - 4*x^2 + 10;
g2 = @(x) (10/x - 4*x)^0.5;
g3 = @(x) (10-x^3)^0.5 / 2;
g4 = @(x) (10/(4+x))^0.5;
g5 = @(x) x-((x^3+4*x^2-10)/(3*x^2+8*x));
MAX_ITER = 30;
tol = 1e-8;

pold = Inf;
%a = -1.5; b = 1;  % bisection start
%assert(sign(a)~=sign(b));
%p = a + (b-a)/2;

%p = 1;  % fixed point
p = 1.5;  % Newton method
%pd = 0.5;   % extra initial condition for secant method

v_err = [];
```

```
k = 0;
gap = 3;
v_p = zeros(1,gap);
j = gap;
n = [0 1 2 3 4 5 6 7 8 9 10 15 20 25 30]';
gres1 = [];
gres2 = [];
gres3 = [];
gres4 = [];
gres5 = [];
for index=1:15
    MAX_ITER = n(index);
    k=0;
    p1 = 1.5;
    p2 = 1.5;
    p3 = 1.5;
    p4 = 1.5;
    p5 = 1.5;
    while k < MAX_ITER

    %  if sign(f(a))<sign(f(p)); b = p; else a = p; end  % bisection
```

```
% pold = p;
%  p = a + (b-a)/2;



  p1 = g1(p1);   % fixed-point iteration
    p2 = g2(p2);
    p3 = g3(p3);
    p4 = g4(p4);
    p5 = g5(p5);
%  if (j==0) % steffensens
%   p = v_p(1) - (v_p(2)-v_p(1))^2/(v_p(3)-2*v_p(2)+v_p(1));
%   j = gap;
%  else
%   v_p(j) = p;
%   j = j -1;
%  endif

  %p = p - f(p)/fp(p)  % Newton method
  %p = p - f(p)*(pd-p)/(f(pd)-f(p))  % secant method
  %pd = pold;
```

```
      k = k + 1;
    end
    [p1 p2 p3 p4 p5]
    gres1(index) = p1;
    gres2(index) = p2;
    gres3(index) = p3;
    gres4(index) = p4;
    gres5(index) = p5;
end
a = gres1';
b = gres2';
c = gres3';
d = gres4';
e = gres5';
format long;
table(n, a, b, c, d, e)


% figure(1);
% hold on;
```

```
% semilogy(1:numel(v_err),exp(-(1:numel(v_err))), 'k+'); % reference linear line
% semilogy(1:numel(v_err),v_err, 'o');
% hold off;

ans =

  15×6 table

    n               a                                  b                                  c                   d
e
    __    _____________________    ___________________________________    _________________
_________________    _________________

     0                       1.5                  1.5+0i                                1.5
1.5                  1.5
     1                    -0.875    0.816496580927726+0i                  1.28695376762338
1.34839972492648    1.37333333333333
     2                 6.732421875     2.99690880578722+0i                  1.40254080353958
1.36737637199128    1.36526201487463
     3          -469.720012001693                   0-2.94123506147697i    1.34545837402329
1.36495701540249    1.36523001391615
     4           102754555.187385      2.7536223884358+2.7536223884358i     1.37517025281604
1.36526474811344     1.3652300134141
```

```
     5     -1.08493387053175e+24      1.8149915190343-3.5345287899111i     1.36009419276173
1.36522559416052     1.3652300134141

     6      1.27705559144438e+72     2.38426584828215+3.43438806399137i    1.36784696759213
1.36523057567343     1.3652300134141

     7    -2.08271290858103e+216     2.18277190004049-3.59687922821261i    1.36388700388402
1.36522994187818     1.3652300134141

     8                       NaN     2.29699758691958+3.5741044617663i     1.36591673339004
1.36523002251557     1.3652300134141

     9                       NaN     2.25651028617868-3.60656121990802i    1.36487821719368
1.36523001225612     1.3652300134141

    10                       NaN     2.27917904904579+3.60193657266051i    1.36541006116996
1.36523001356143     1.3652300134141

    15                       NaN     2.27461338398065-3.60879548114993i    1.36522368022528
1.36523001341409     1.3652300134141

    20                       NaN     2.27475622316243+3.60881063508048i    1.36523023615818
1.3652300134141     1.3652300134141

    25                       NaN     2.27475483544281-3.60881271786348i    1.36523000557995
1.3652300134141     1.3652300134141

    30                       NaN     2.27475487880644+3.60881272246345i    1.36523001368963
1.3652300134141     1.3652300134141
```

Formatted:

```
ans =

  15×6 table
```

n	a	b	c	d	e
0	1.5	1.5+0i	1.5	1.5	1.5
1	-0.875	0.816496580927726+0i	1.28695376762338	1.34839972492648	1.37333333333333
2	6.732421875	2.99690880578722+0i	1.40254080353958	1.36737637199128	1.36526201487463
3	-469.720012001693	0-2.94123506147697i	1.34545837402329	1.36495701540249	1.36523001391615
4	102754555.187385	2.7536223884358+2.7536223884358i	1.37517025281604	1.36526474811344	1.3652300134141
5	-1.08493387053175e+24	1.8149915190343-3.5345287899111i	1.36009419276173	1.36522559416052	1.3652300134141
6	1.27705559144438e+72	2.38426584828215+3.43438806399137i	1.36784696759213	1.36523057567343	1.3652300134141
7	-2.08271290858103e+216	2.18277190004049-3.59687922821261i	1.36388700388402	1.36522994187818	1.3652300134141
8	NaN	2.29699758691958+3.5741044617663i	1.36591673339004	1.36523002251557	1.3652300134141
9	NaN	2.25651028617868-3.60656121990802i	1.36487821719368	1.36523001225612	1.3652300134141
10	NaN	2.27917904904579+3.60193657266051i	1.36541006116996	1.36523001356143	1.3652300134141
15	NaN	2.27461338398065-3.60879548114993i	1.36522368022528	1.36523001341409	1.3652300134141
20	NaN	2.27475622316243+3.60881063508048i	1.36523023615818	1.3652300134141	1.3652300134141
25	NaN	2.27475483544281-3.60881271786348i	1.36523000557995	1.3652300134141	1.3652300134141
30	NaN	2.27475487880644+3.60881272246345i	1.36523001368963	1.3652300134141	1.3652300134141

Question 2:

```
>> f = @(x) cos(x) - x;

>> p0 = 0.5;

>> p1 = pi/4;

>> tol = 10^-7;
```

Reproducing Example 3 from 2.3:

```
>> c = [0 1 2 3 4 5 6];

>> for x=1:7
```

```
newtonresult(x) = newton(f, p1, tol, c(x));
secantresult(x) = secant(f, p0, p1, tol, c(x));
fpresult(x) = falsePosition(f, p0, p1, tol, c(x));
end
>> N = c'; FalsePosition = fpresult'; Secant = secantresult'; Newton = newtonresult';
>> T = table(N, FalsePosition, Secant, Newton)

T =

  7×4 table

    N      FalsePosition           Secant              Newton
    _    _________________    _________________    _________________

    0                  0.5                  0.5    0.785398163397448
    1    0.785398163397448    0.785398163397448    0.739536133515238
    2    0.736384138836582    0.736384138836582     0.73908517810601
    3     0.73905813921389     0.73905813921389    0.739085133215161
    4     0.73908486381471    0.739085149337276    0.739085133215161
    5    0.739085130526579    0.739085133215065    0.739085133215161
    6    0.739085133188329    0.739085133215065    0.739085133215161
```

```
Estimating:
>> f = @(x) 230*x^4 + 18*x^3 + 9*x^2 - 221*x - 9;
>> max_iter = 100;
>> tol = 0.000001;
>> p0a = -1;
>> p1a = 0;
>> p0b = 0.5;
>> p1b = 1;

With Newton:

>> [p, iter] = newton(f, p0a, tol, max_iter)

p =

  -0.040659288315759


iter =
```

```
     6

>> [p, iter] = newton(f, p0b, tol, max_iter)

p =

   0.962398418750541


iter =

     4
```

With secant:

```
>> [p, iter] = secant(f, p0a, p1a, tol, max_iter)

p =

  -0.040659288315725
```

```
iter =

     5

>> [p, iter] = secant(f, p0b, p1b, tol, max_iter)

p =

   0.962398418750561


iter =

     9
```

With False Position:

```
>> [p, iter] = falsePosition(f, p0a, p1a, tol, max_iter)
```

```
p =

  -0.040658499043342


iter =

    17

>> [p, iter] = falsePosition(f, p0b, p1b, tol, max_iter)

p =

   0.962398408376707


iter =

     8
```