

$$1/a) \quad x_0 \quad f(x_0) \quad x_1 \quad f(x_1)$$

$$+1$$

$$8.452988$$

$f(a)$	$x_0$	$f(x_0)$	$x_1$	$f(x_1)$
	1.1	-0.6822	8.452988	6.8008
	8.452988	6.8008	5.256402	6.9678
	5.256402	6.9678	203.496561	202.198614
	203.496561	202.198614	123.281273	124.657718
	123.281273	124.657718	72.417725	71.942
	72.417725	71.942	47.960442	49.441

$$x_1 = \frac{x_0 - f(x_0)}{f'(x_0)}$$

$$x_0 = 1.1$$

$$f(x) = x - 2 \sin x$$

$$f'(x) = 1 - 2 \cos x$$

After 6 iterations also, range of solution is varying. So, we can see the solution is not converging.

$$b) \quad x_0 = 1.5$$

$x_0$	$f(x_0)$	$x_1$	$f(x_1)$
1.5	-0.49479	2.016558	0.326947
2.016558	0.326947	1.910507	0.024804
1.910507	0.024804	1.895622	0.000209
1.895622	0.000209	1.895494	0.000000



Now by a different initial guess, we are able to nearly calculate the solution.

<1) Due to multiple roots, it converges slowly.

ii) Root jumping is taking place, so we are not able to get required solution.

iii) Its convergence is not guaranteed

Q2)  $x \log_e x = 12$  Initial guess = 2.5

$x_0$	$f(x_0)$	$x_1$	$f(x_1)$
2.5	-0.205150	2.746505	0.005113
2.746505	0.005113	2.740649	0.000003

So root is 2.740649

Q3)  $x e^x - \cos x = 0$

i) Secant method:

$x_0 = 0.4$

$x_1 = 0.6$

$x_2 = x_1 - \frac{f(x_1)(x_1 - x_0)}{f(x_1) - f(x_0)}$

$x_0$	$x_1$	$x_2$	$f(x_2)$
0.4	0.6	0.509522	-0.024881
0.6	0.509522	0.517210	-0.001665
0.509522	0.517210	0.517761	0.000012
0.517210	0.517761	0.517757	0.000000



1) Regula falsi method

$$x_2 = x_0 - \frac{f(x_0)(x_1 - x_0)}{f(x_1) - f(x_0)}$$

$x_0$	$x_1$	$x_2$	$f(x_2)$
0.4	0.6	0.509522	-0.024881
0.509522	0.6	0.517210	-0.001665
0.517210	0.6	0.517721	-0.000110
0.517721	0.6	0.517755	-0.000007

Root is 0.517755

These two methods are quite effective than Newton raphson method.

```

9
10 #include <iostream>
11 #include <iomanip>
12 #include <cmath>
13 using namespace std;
14 float f(float x){
15     return pow(x,3)-2*x-5;
16 }
17 float df(float x){
18     return 3*pow(x,2)-2;
19 }
20 int main(){
21     int itr,maxitr;
22     float h,x0,x1,aerr;
23     cout << "Enter x0,allowed error,"
24     << "maximum iterations" << endl;
25     cin >> x0 >> aerr >> maxitr;
26     cout << fixed;
27     for (itr=1;itr<=maxitr;itr++){
28         h = f(x0)/df(x0);
29         x1 = x0-h;
30         cout << "Iteration no. "<< itr
31         << " X = " << setprecision(6)
32         << x1 << endl;
33         if (fabs(h) < aerr) {
34             cout << "After " << itr
35             << " iterations, root = "
36             << setprecision(6) << x1;
37             return 0; }
38         x0 = x1; }
39     cout << "Iterations not sufficient,"
40     << "solution does not converge" << endl;
41     return 1;
42 }
43

```



Enter x0, allowed error, maximum iterations

0 1e-3 1000

Iteration no. 1 X = -2.500000

Iteration no. 2 X = -1.567164

Iteration no. 3 X = -0.502592

Iteration no. 4 X = -3.820706

Iteration no. 5 X = -2.549393

Iteration no. 6 X = -1.608111

Iteration no. 7 X = -0.576100

Iteration no. 8 X = -4.597703

Iteration no. 9 X = -3.083539

Iteration no. 10 X = -2.022191

Iteration no. 11 X = -1.123761

Iteration no. 12 X = 1.208680

Iteration no. 13 X = 3.580587

Iteration no. 14 X = 2.655123

Iteration no. 15 X = 2.216066

Iteration no. 16 X = 2.102120

Iteration no. 17 X = 2.094584

Iteration no. 18 X = 2.094552

After 18 iterations, root = 2.094552

...Program finished with exit code 0

Press ENTER to exit console.

```
8
9  #include <iostream>
10 #include <iomanip>
11 #include <cmath>
12 using namespace std;
13 float f(float x){
14     return x-2*sin(x);
15 }
16 float df(float x){
17     return 1-2*cos(x);
18 }
19 int main(){
20     int itr,maxitr;
21     float h,x0,x1,aerr;
22     cout << "Enter x0,allowed error,"
23     << "maximum iterations" << endl;
24     cin >> x0 >> aerr >> maxitr;
25     cout << fixed;
26     for (itr=1;itr<=maxitr;itr++){
27         h = f(x0)/df(x0);
28         x1 = x0-h;
29         cout << "Iteration no. " << itr
30         << " X = " << setprecision(6)
31         << x1 << endl;
32         if (fabs(h) < aerr) {
33             cout << "After " << itr
34             << " iterations, root = "
35             << setprecision(6) << x1;
36             return 0; }
37         x0 = x1;
38     cout << "Iterations not sufficient,"
39     << "solution does not converge" << endl;
40     return 1;
41 }
42
```



Enter x0, allowed error, maximum iterations

1.1 1e-3 1000

Iteration no. 1 X = 8.452988  
Iteration no. 2 X = 5.256402  
Iteration no. 3 X = 203.496567  
Iteration no. 4 X = 123.281273  
Iteration no. 5 X = 72.417725  
Iteration no. 6 X = 47.960442  
Iteration no. 7 X = 26.830530  
Iteration no. 8 X = 7.005608  
Iteration no. 9 X = 18.362637  
Iteration no. 10 X = 43.505325  
Iteration no. 11 X = 100.694748  
Iteration no. 12 X = 203.823639  
Iteration no. 13 X = 132.751709  
Iteration no. 14 X = 472.506531  
Iteration no. 15 X = -695.467712  
Iteration no. 16 X = -301.444611  
Iteration no. 17 X = -609.955933  
Iteration no. 18 X = -1403.445679  
Iteration no. 19 X = -800.615479  
Iteration no. 20 X = -511.303925  
Iteration no. 21 X = -301.284973  
Iteration no. 22 X = -634.523499  
Iteration no. 23 X = -1273.108154  
Iteration no. 24 X = -751.919373  
Iteration no. 25 X = -364.402069  
Iteration no. 26 X = -729.036987  
Iteration no. 27 X = -1484.168701



Iteration no. 977 X = 47705604464366187882479616.000000  
Iteration no. 978 X = 109068089883006578917900288.000000  
Iteration no. 979 X = -245804137607520861242261504.000000  
Iteration no. 980 X = -93626237408555981567164416.000000  
Iteration no. 981 X = -416428532849150297454411776.000000  
Iteration no. 982 X = -1531382284720701620774502400.000000  
Iteration no. 983 X = -995442462106327777074479104.000000  
Iteration no. 984 X = -191572757619406961251450880.000000  
Iteration no. 985 X = -127463090839589375241617408.000000  
Iteration no. 986 X = -60987827434817331614711808.000000  
Iteration no. 987 X = -37295415030669123797385216.000000  
Iteration no. 988 X = -84100431002612737660420096.000000  
Iteration no. 989 X = -170888792424437915215462400.000000  
Iteration no. 990 X = 44410794611872777449242624.000000  
Iteration no. 991 X = 90183825933356784156672000.000000  
Iteration no. 992 X = 197030595788495406288076800.000000  
Iteration no. 993 X = -1149545012571595179672207360.000000  
Iteration no. 994 X = -2313136851820438708708966400.000000  
Iteration no. 995 X = 2080385574979242505061531648.000000  
Iteration no. 996 X = 8516844620253199578643300352.000000  
Iteration no. 997 X = 4850563975484297113606553600.000000  
Iteration no. 998 X = 11212536691502093504203456512.000000  
Iteration no. 999 X = 5934751435932976403521208320.000000  
Iteration no. 1000 X = 3206626741975544113339039744.000000  
Iterations not sufficient, solution does not converge