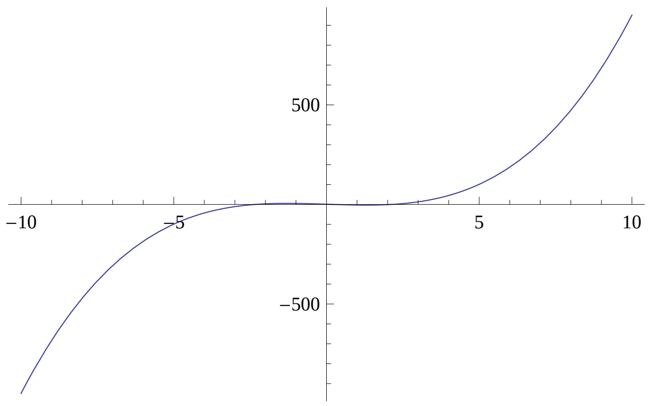
Practical-3

Newton Raphson Method

(1) To find a smallest positive root of the function $f(x) = x^3 - 5x + 1$ perform 5 iterations of the Newton Raphson Method

```
NewtonRaphson[x0_, n_, f_] := Module[
  {xk1, xk = N[x0]}, k = 0; Output = {{k, x0, f[x0]}};
  While[k < n, fPrimexk = f'[xk]; If[fPrimexk == 0,
    Print["The derivative of function at ", k,
     "th iteration is zero,we can not proceed
       further with the iterative scheme"];
    Break[]]; xk1 = xk - f[xk] / fPrimexk; xk = xk1;
   k++; Output = Append[Output, {k, xk, f[xk]}];];
  Print[NumberForm[TableForm[Output,
     TableHeadings -> {None, {"k", "xk", "f[xk]"}}], 10]];
  Print["Root after ", n, " iterations xk = ",
   NumberForm[xk, 10]]; Print[
   "Function value at approximated root,f[xk] = ",
   NumberForm[f[xk], 10]];];
f[x_] := x^3 - 5 x + 1;
Plot[f[x], {x, -10, 10}]
NewtonRaphson[0.5, 5, f]
```



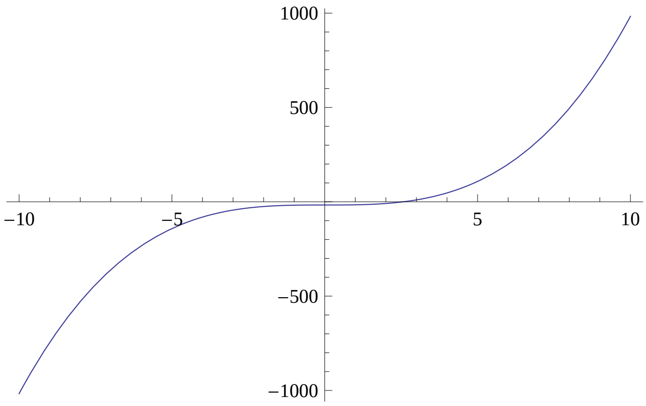
k	xk	f[xk]
0	0.5	−1.375
1	0.1764705882	0.1231426827
2	0.2015680743	0.0003492763989
3	0.2016396751	$3.100484314 \times 10^{-9}$
4	0.2016396757	$1.110223025 \times 10^{-16}$
5	0.2016396757	$1.110223025 \times 10^{-16}$

Root after 5 iterations xk = 0.2016396757

Function value at approximated root,f[xk] = $1.110223025 \times 10^{-16}$

(2) Perform 4 iterations of the Newton Raphson Method to obtain approximate value of $(17)^{1/3}$ starting with the initial approximation x0=2.

```
f[x_] = x^3 - 17;
Plot[f[x], {x, -10, 10}]
NewtonRaphson[2, 4, f]
```



k	xk	f[xk]
0	2	−9
1	2.75	3.796875
2	2.582644628	0.2263772599
3	2.571331512	0.0009901837441
4	2.571281592	$1.922353121 \times 10^{-8}$

Root after 4 iterations xk = 2.571281592

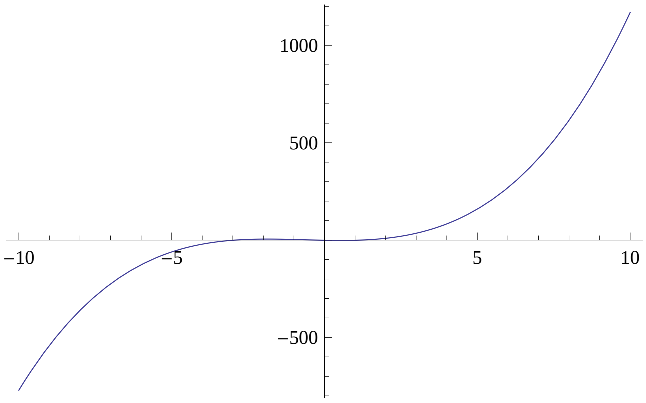
Function value at approximated root,f[xk] = $1.922353121 \times 10^{-8}$

```
B = N[17^(1/3), 10]
```

2.571281591

(3) Perform 4 iterations of the Newton Raphson Method to approximate the root of the function f(x) = x^3 + 2 x^2-3x-1 near = -3.

```
f[x_] := x^3 + 2 x^2 - 3 x - 1;
Plot[f[x], {x, -10, 10}]
NewtonRaphson[-3, 4, f]
```



k	xk	f[xk]
0	−3	−1
1	−2.916666667	−0.04803240741
2	−2.912241416	−0.0001320975296
3	−2.912229179	$-1.008864103 \times 10^{-9}$
4	−2.912229178	0.

Root after 4 iterations xk = −2.912229178

Function value at approximated root,f[xk] = 0.