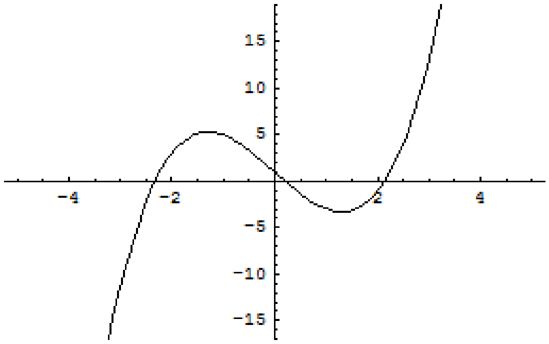
Practical:
(iv) (b) Newton Raphson Method

```
In[21]:= 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,
    "  iteratios  xk = ",
    NumberForm[xk, 10]];
   Print[
    "Function value at approximated
      root, f[xk] = ",
    NumberForm[f[xk], 10]];];
```

Q1: Perform 5 iterationsof the Newton Raphson Method to find out the smallest positive root of the function f(x) = x^3 - 5 x + 1.

Solution: First lets have an idea aout initial approximation by plotting the function.

```
f[x_] := x^3 - 5 * x + 1;
Plot[f[x], {x, -5, 5}]
```



Out[38]= - Graphics -

From the graph we see that one of the smallest positive root lies in the interval [0, 1]. So, lets start with the initial approximation x0 = 0.5.

```
In[40]:= 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 iteratios xk = 0.2016396757

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

Q2: Perform four iterations f the Newton-Raphson Method to obtain approximate value of ■ $(17)^{1/3}$ starting with the initial approximation x0 = 2.

Solution: **We can take the function f(x) = x^3 - 17 having ■ $(17)^{1/3}$ as its root. Here initial approximation is given as x0=2.**

```
In[22]:= f[x_] = x^3 - 17;
         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 iteratios xk = 2.571281592

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

**Next we find out the Actual Value of ▪ $17^{1/3}$ to compare it with the approximated root
obtained by Newton Raphson Method**

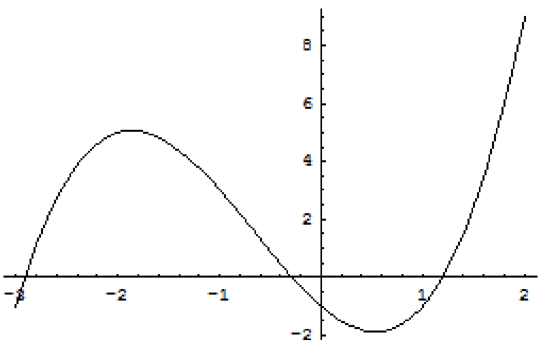
```
In[29]:= actualValue = N[17^(1/3), 20]

Out[29]= 2.5712815906582353555
```

Q3 Perform four iterations of the Newton-Raphson Method to approximate the root of the function f(x) = ▪ x^3 +2 ▪ x^2 - 3x - 1 near x = - 3.

Solution: **First lets have an idea aout initial approximation by plotting the function**

```
In[34]:= f[x_] := x^3 + 2 x^2 - 3 * x - 1;
         Plot[f[x], {x, -3, 2}]
```




```
Out[35]= - Graphics -
```

**From the graph we see that one of the root lies in the interval [−3, −2].
So, lets start with the initial approximation x0 = −3.**

```
In[36]:= 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  iteratios  xk = -2.912229178

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

Converted by *Mathematica* August 31, 2020