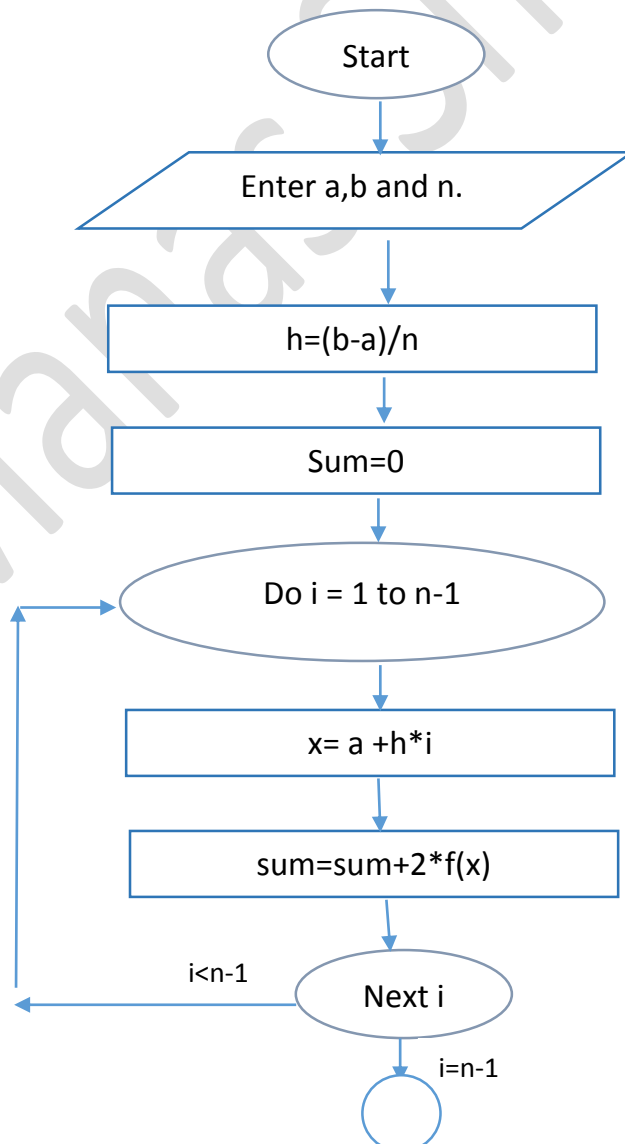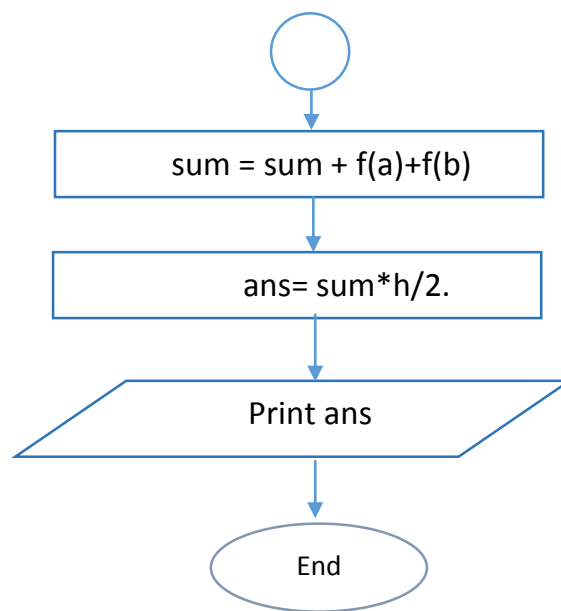**Aim**: To evaluate a definite integral by Trapezoidal Rule

Algorithm:

1. Given a function f(x):
2. (Get user inputs)
   Input
     a,b=endpoints of interval
      n=number of intervals
   (Do the integration)
3. Set h= (b-a)/n.
4. Set sum=0.
5. Begin For i= 1 to n-1
     Set x =a + h*i.
     Set sum=sum+2*f(x)
   End For
6. Set sum = sum + f(a)+f(b)
7. Set ans = sum*h/2.
8. End

Flow Chart:

```
                    ┌─────────────┐
                    │    Start     │
                    └──────┬──────┘
                           │
                           ▼
               ╱───────────────────────╲
              ╱    Enter a,b and n.      ╲
              ╲─────────────────────────╱
                           │
                           ▼
                 ┌──────────────────┐
                 │    h=(b-a)/n      │
                 └─────────┬────────┘
                           │
                           ▼
                 ┌──────────────────┐
                 │      Sum=0        │
                 └─────────┬────────┘
                           │
                           ▼
               ╭───────────────────────╮
          ┌───▶│    Do i = 1 to n-1     │
          │    ╰───────────┬───────────╯
          │                │
          │                ▼
          │      ┌──────────────────┐
          │      │     x= a +h*i     │
          │      └─────────┬────────┘
          │                │
          │                ▼
          │      ┌──────────────────┐
          │      │  sum=sum+2*f(x)   │
          │      └─────────┬────────┘
          │                │
          │      i<n-1      ▼
          └──────────╭──────────────╮
     ◀────────────── │    Next i     │
                     ╰───────┬──────╯
                             │  i=n-1
                             ▼
                          (    )
```

```
sum = sum + f(a)+f(b)
```

```
ans= sum*h/2.
```

Print ans

End

Program:

```cpp
//Trapezoidal Method for the evaluation of Definite Integrals
#include<iostream>
#include<cmath>
using namespace std;
double f(double x)      //write the function whose definite integral is to be calcuated here
{
   double a=1/(1+x*x);
   return a;
}
int main()
{
   int n,i;      //n is for subintervals and i is for loop
   double a,b,h,sum=0,integral;
   cout<<"Enter the limits of integration,\nInitial limit,a=";   //get the limits of integration
   cin>>a;
   cout<<"Final limit, b=";
   cin>>b;
   cout<<"Enter the no. of subintervals, n=";        //get the no. of subintervals
   cin>>n;
   double x[n+1],y[n+1];
   h=(b-a)/n;           //get the width of the subintervals
   for (i=0;i<=n;i++)
   {            //loop to evaluate x0,...xn and y0,...yn
      x[i]=a+i*h;         //and store them in arrays
      y[i]=f(x[i]);
   }
   for (i=1;i<n;i++)        //loop to evaluate h*(y1+...+yn-1)
   {
      sum=sum+h*y[i];
   }
   integral=h/2.0*(y[0]+y[n])+sum;      //h/2*[y0+yn+2(y1+y2+y3+...yn-1)]
   cout<<"The definite integral  is "<<integral<<endl;
   return 0;
}
```

Output:

For f(x)=1/(1+x*x):

```
manas@manas-VirtualBox:~/NA$ g++ trapezoidal1.cc
manas@manas-VirtualBox:~/NA$ ./a.out
Enter the limits of integration,
Initial limit,a=0
Final limit, b=6
Enter the no. of subintervals, n=6
The definite integral  is 1.4108
```

```
Enter the limits of integration,
Initial limit,a=0
Final limit, b=6
Enter the no. of subintervals, n=100
The definite integral  is 1.40565
```