EXPERIMENT-5

AIM-To perform Numerical Integration using Trapezoidal rule.

THEORY-

The trapezoidal rule is a numerical method that approximates the value of a definite integral. We consider the definite integral

$$\int_0^b f(x)dx$$

We assume that f(x) is continnous on [a, b] and we divide [a, b] into n subintervals of equal length

$$\Delta x = \frac{b-a}{n}$$

using the $n+1$ points

$$x_0 = a, \quad x_1 = a + \Delta x, \quad x_2 = a + 2\Delta x, \quad \ldots, \quad x_n = a + n\Delta x = b$$

We can compute the value of f(x) at these points.

$$y_0 = f(x_0), \quad y_1 = f(x_1), \quad y_2 = f(x_2), \quad \ldots, \quad y_n = f(x_n)$$

We approximate the integral by using n trapezoids formed by using straight line segments between the points (x_{i-1}, y_{i-1}) and (x_i, y_i) for $1 \leq i \leq n$ as shown in the figure below.

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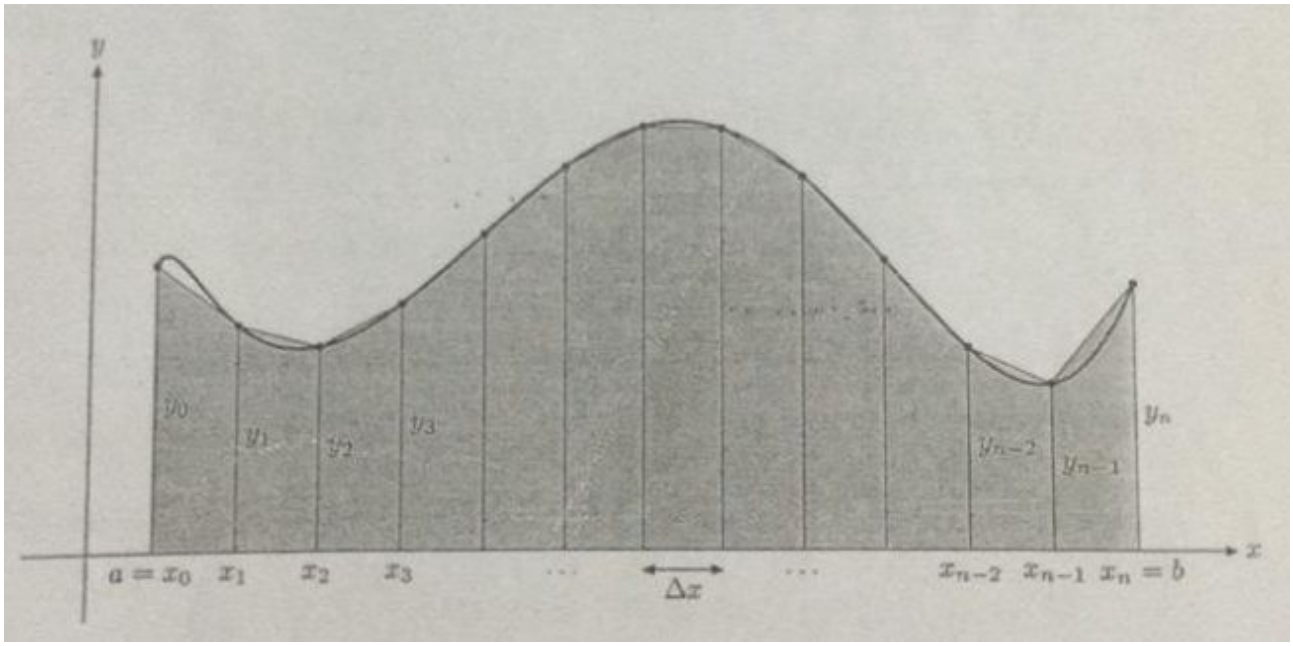
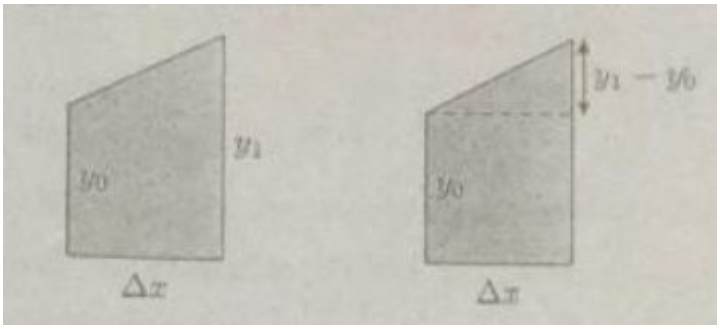


The area of a trapezoid is obtained by adding the area of a rectangle and a triangle.

$$A = y_0 \Delta x + \frac{1}{2}(y_1 - y_0)\Delta x = \frac{(y_0 + y_1)\Delta x}{2}$$



By adding the area of the n trapezoids, we obtain the approximation

$$\int_a^b f(x)dx \approx \frac{\Delta x}{2}(y_0^a + 2y_1 + 2y_2 + \cdots + 2y_{n-1} + y_n)$$

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which simplifies to the trapezoidal rule formula.

$$\int_a^b f(x)dx \approx \frac{\Delta x}{2}\left(y_0^{\lambda} + 2y_1 + 2y_2 + \cdots + 2y_{n-1} + y_n\right)$$

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)
6. Set sum = sum + f(a)+f(b)
7. Set ans = sum*h/2.
8. End

CODE-

```
#include<iostream>
#include<math.h>
using namespace std;
float func(float x)
{
    float a;
    a=sqrt(1+pow(x,2));
    return a;
}
int main()
{
    int n,i;
    float a,b,h,sum,integral;
    cout<<"\n Enter the upper limit: ";
```

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```
    cin>>a;
    cout<<"\n Enter the lower limit: ";
    cin>>b;
    cout<<"\n Enter the interval: ";
    cin>>n;
    h=(a-b)/n;
    sum=func(a)+func(b);
    i=2;
    while(i<=n)
    {
        sum=sum+2*func(b+(i-1)*h);
        i++;
    }
    integral=h*sum/2;
    cout<<"\n the answer is "<<integral<<"\n\n";
    return 0;
}
```

OUTPUT-