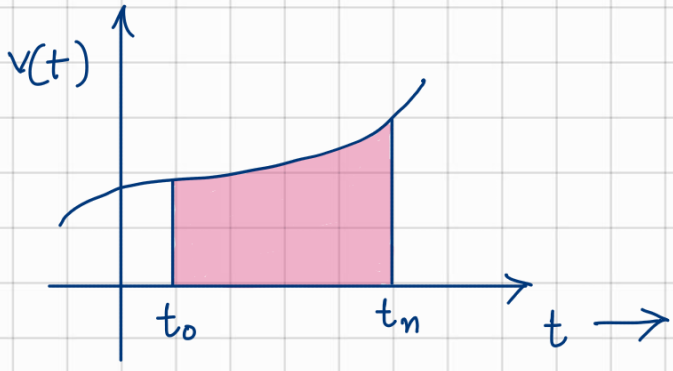
Aim : To calculate distance covered in given time from velocity - time graph using trapezoidal rule of numerical integration.

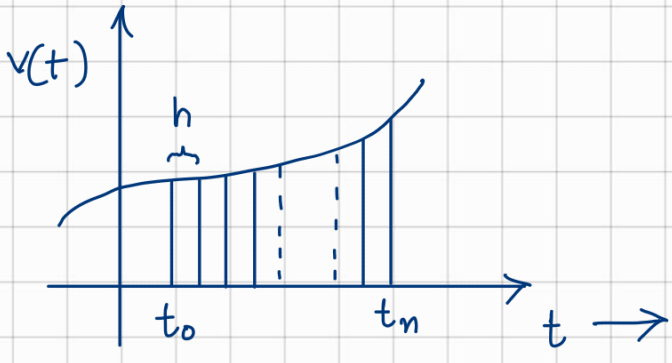
Theory :



The area under the velocity - time graph gives the distance covered. Mathematically,

$$x(t) = \int_{t_0}^{t_n} v(t)\,dt$$

Trapezoidal Rule of Numerical Integration



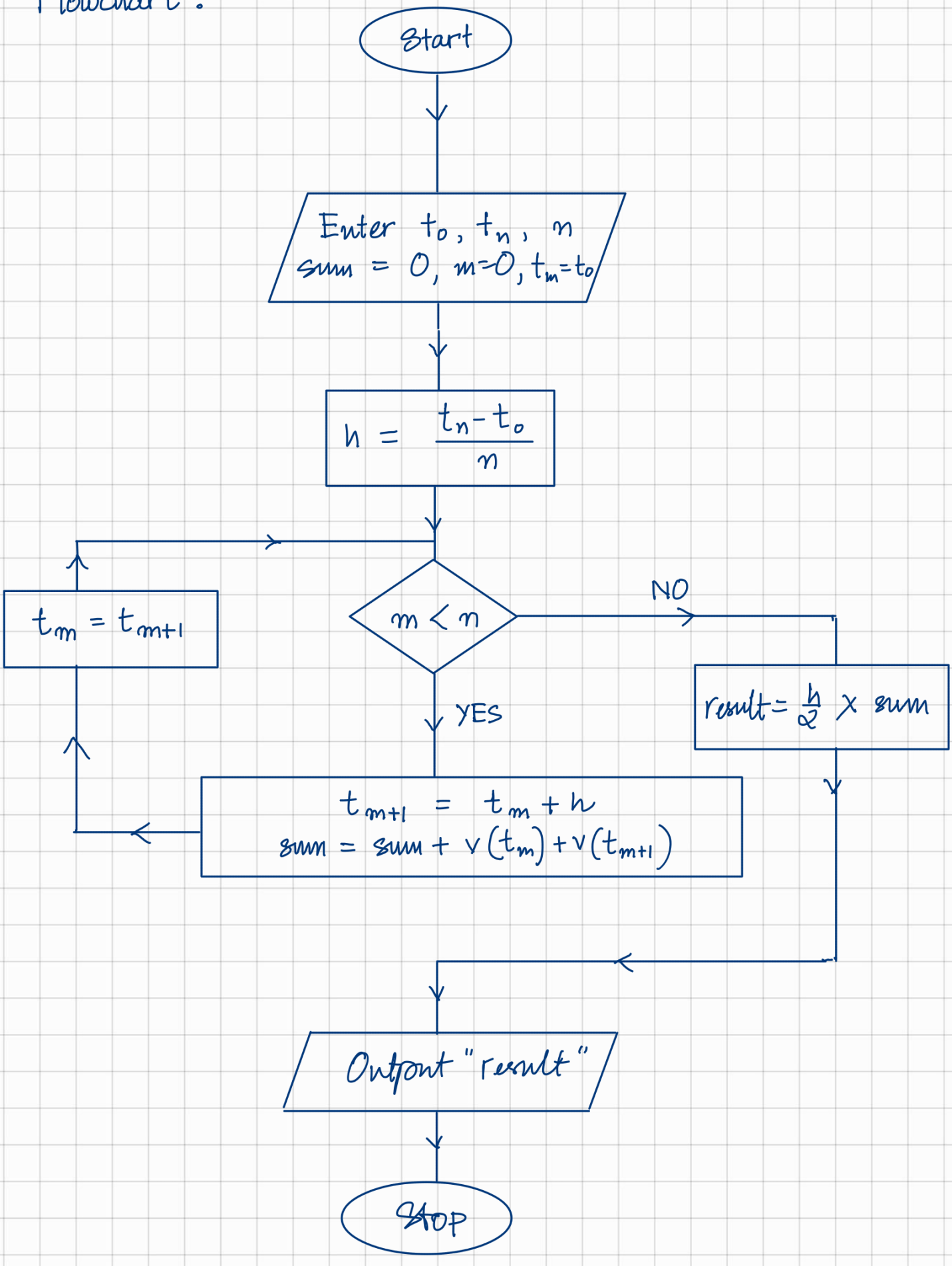
The formula for numerical integration is given by -

$$x(t_n) - x(t_0) = \int_{t_0}^{t_n} v(t)\,dt$$

$$= \frac{h}{2}\left[(v_0 + v_1) + (v_1 + v_2) + \cdots + (v_{n-1} + v_n)\right]$$

$$= \frac{h}{2}\left[v_0 + 2(v_1 + v_2 + \cdots + v_{n-1}) + v_n\right]$$

Flowchart :


Start
Enter t_0, t_n, n
sum = 0, m=0, $t_m = t_0$
$h = \frac{t_n - t_0}{n}$
$m < n$
NO
YES
$t_m = t_{m+1}$
result = $\frac{h}{2}$ x sum
$t_{m+1} = t_m + h$
sum = sum + v(t_m) + v(t_{m+1})
Output "result"
Stop

```c
#include<stdio.h>
#include<math.h>

float v(float t)
{
    float f;
    f = 2*pow(t,3) + 3*pow(t,2) + 4*t +3;
    return(f);
}



int main()
{
    float t0,tn,n,h,sum, tm, tm_plus_one, result;
    int m;


    printf("Enter initial time t0 \n: ");
    scanf("%f",&t0);
    printf("Enter final time tn \n: ");
    scanf("%f",&tn);

    printf("Enter number of steps in the interval (t0,tn) \n: ");
    scanf("%f",&n);

    h = (tn - t0)/(n);
    printf("\n \nstep-size h = %f \n \n",h);

    sum = 0;
    t0 = tm;

    for (m=0;m<n;++m)
    {
        tm_plus_one = tm + h;
        sum = sum + v(tm) + v(tm_plus_one);
        tm = tm_plus_one;
    }

    result = (h/2)*sum;
    printf("The result is: %f \n",result);
    return(0);


}
```

Observations :

velocity function,

$$v(t) = (2t^3 + 3t^2 + 4t + 3) \text{ m/s}$$

initial time, t_0 =

final time, t_n =

no. of steps, n =

step-size, h =

Result :- The distance covered in the time interval is

Discussion : 1. Step-size h should neither be too small nor too large.