Project Report: 1
Date: 18.12.2023

Ajay Patil | registration Number: 126655

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[1] Exact result of the integration: 633.275

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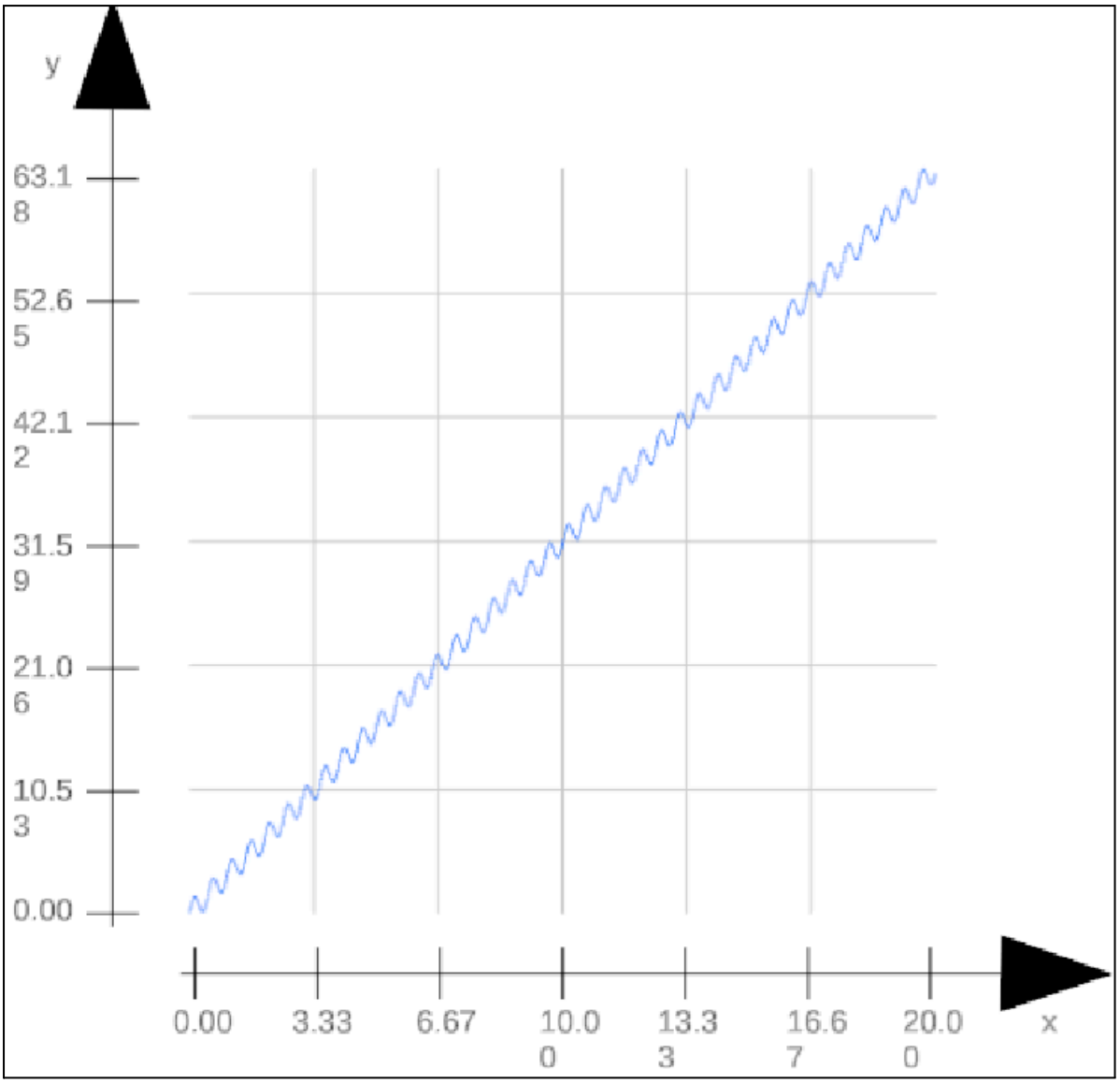
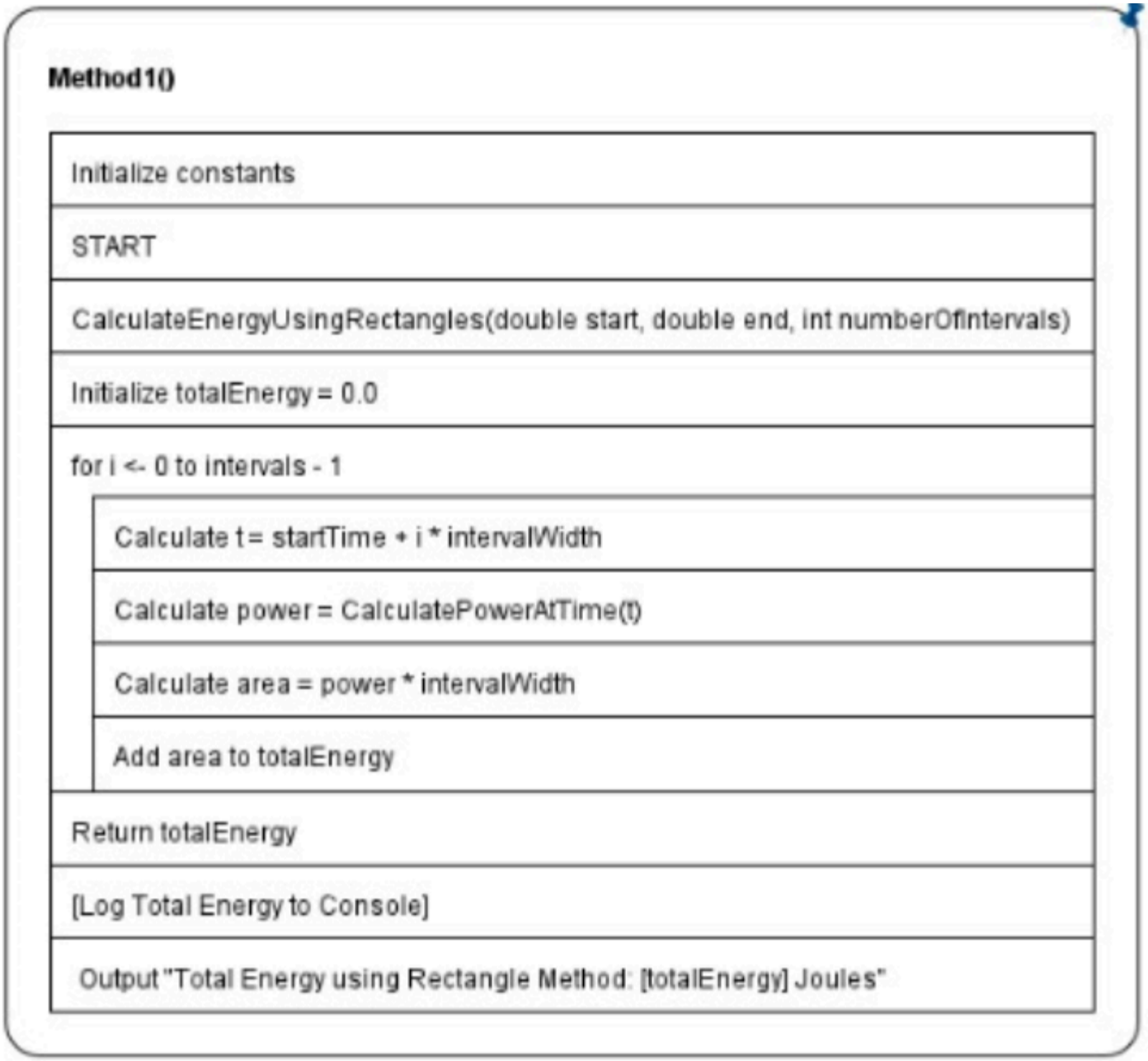
[2] Plot of the function P(t):

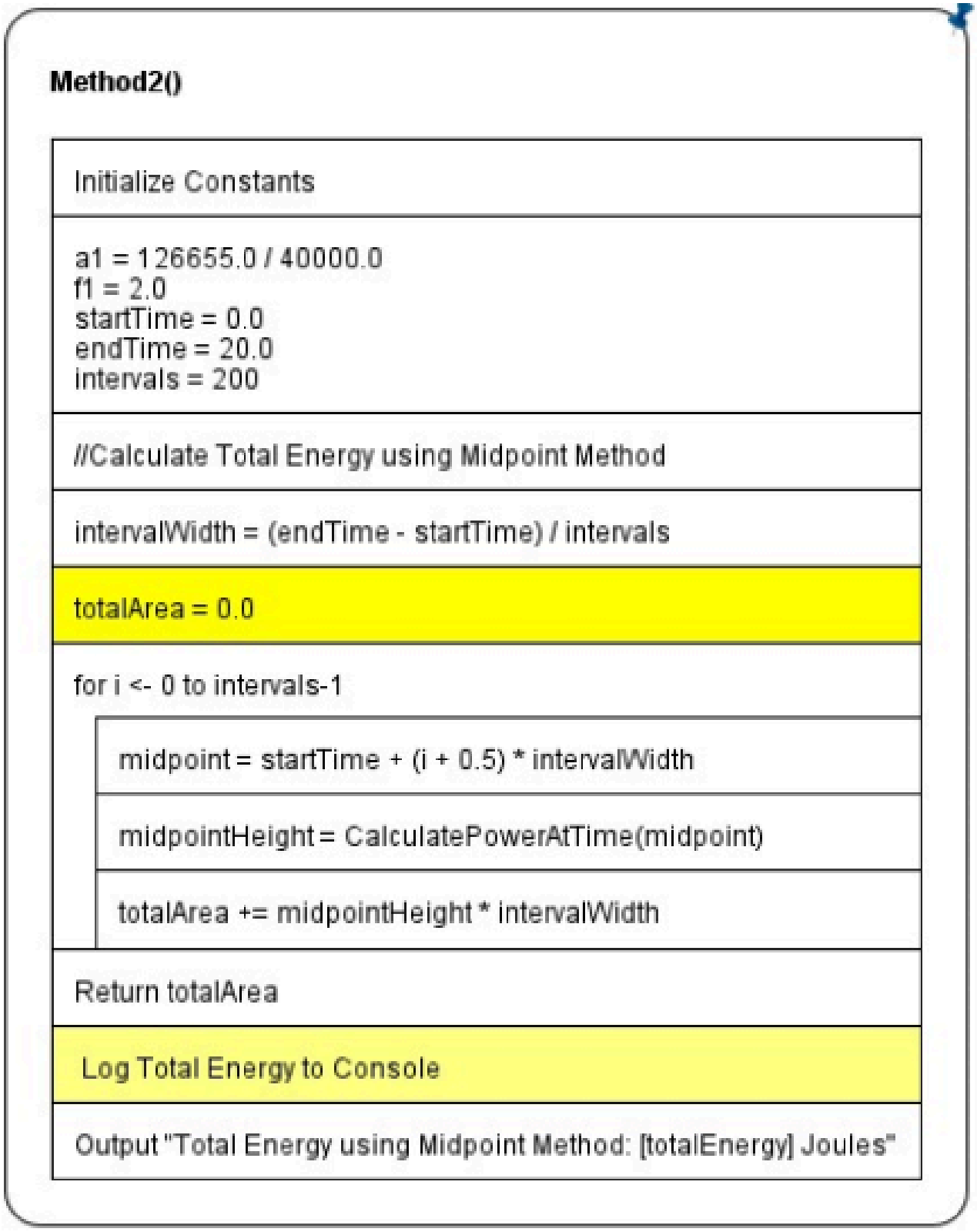


[3] Nassi-Schneiderman diagrams for all three algorithms:

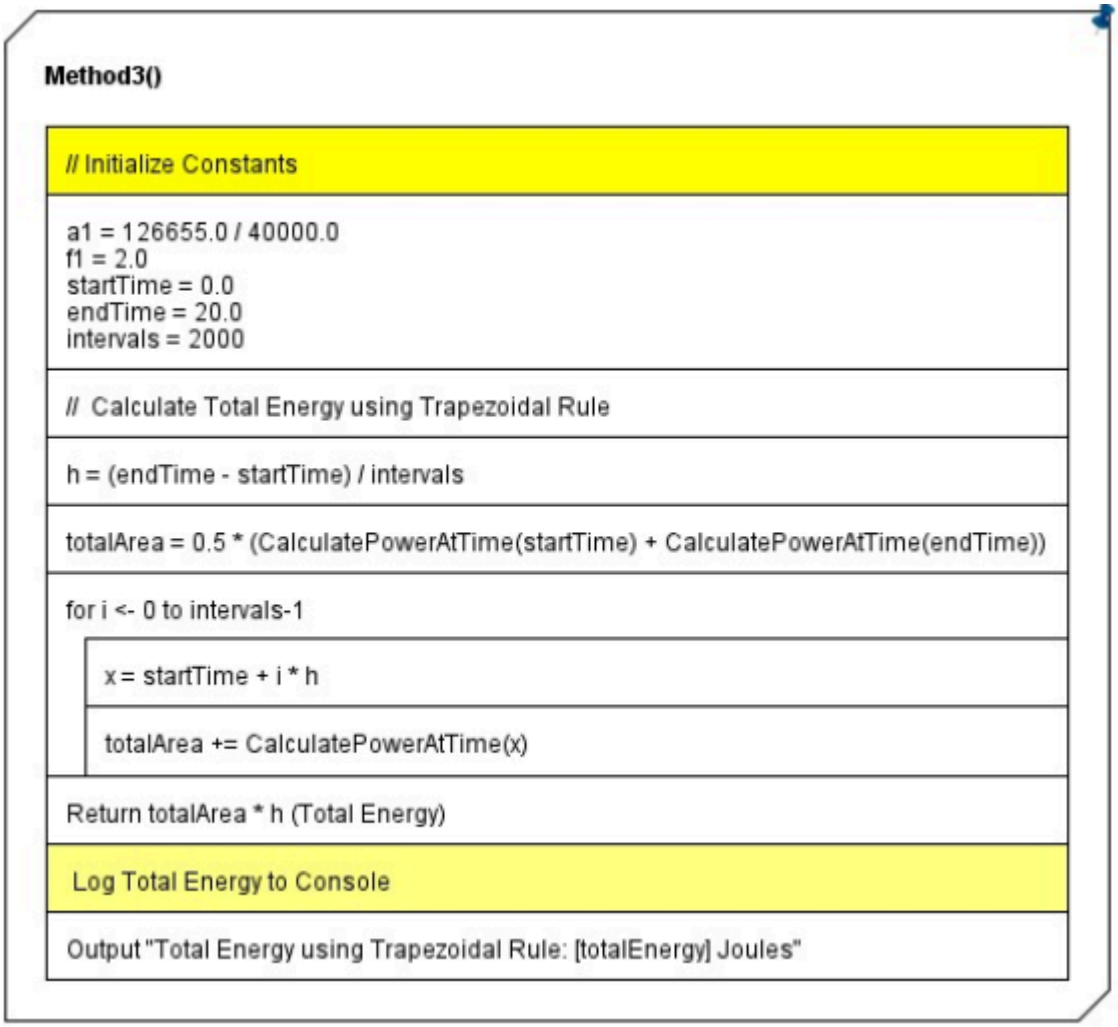
Method1:



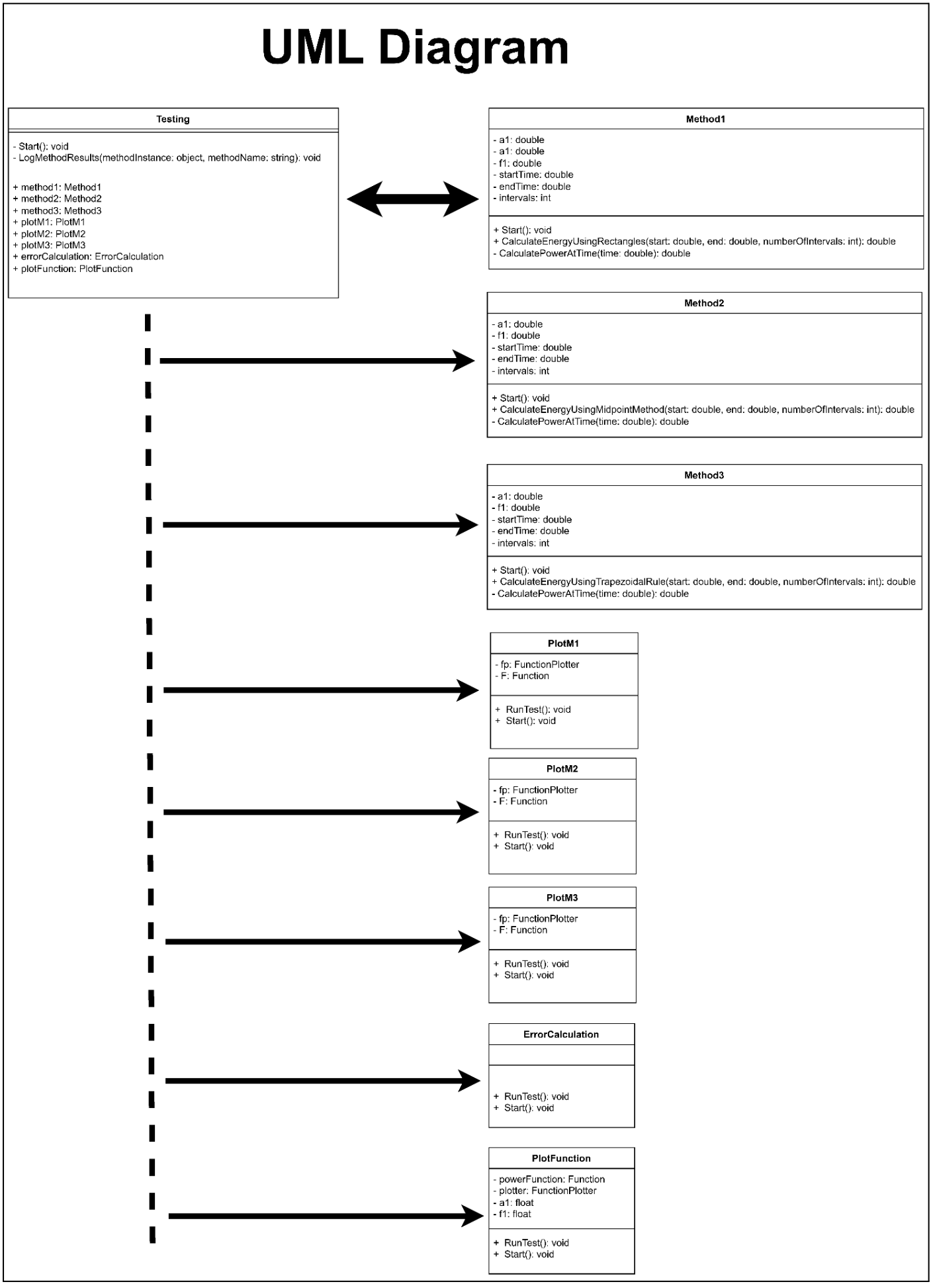
Method2:


Method2()
Initialize Constants
a1 = 126655.0 / 40000.0
f1 = 2.0
startTime = 0.0
endTime = 20.0
intervals = 200
//Calculate Total Energy using Midpoint Method
intervalWidth = (endTime - startTime) / intervals
totalArea = 0.0
for i <- 0 to intervals-1
midpoint = startTime + (i + 0.5) * intervalWidth
midpointHeight = CalculatePowerAtTime(midpoint)
totalArea += midpointHeight * intervalWidth
Return totalArea
Log Total Energy to Console
Output "Total Energy using Midpoint Method: [totalEnergy] Joules"

Method3:


Method3()
// Initialize Constants
a1 = 126655.0 / 40000.0
f1 = 2.0
startTime = 0.0
endTime = 20.0
intervals = 2000
// Calculate Total Energy using Trapezoidal Rule
h = (endTime - startTime) / intervals
totalArea = 0.5 * (CalculatePowerAtTime(startTime) + CalculatePowerAtTime(endTime))
for i <- 0 to intervals-1
x = startTime + i * h
totalArea += CalculatePowerAtTime(x)
Return totalArea * h (Total Energy)
Log Total Energy to Console
Output "Total Energy using Trapezoidal Rule: [totalEnergy] Joules"

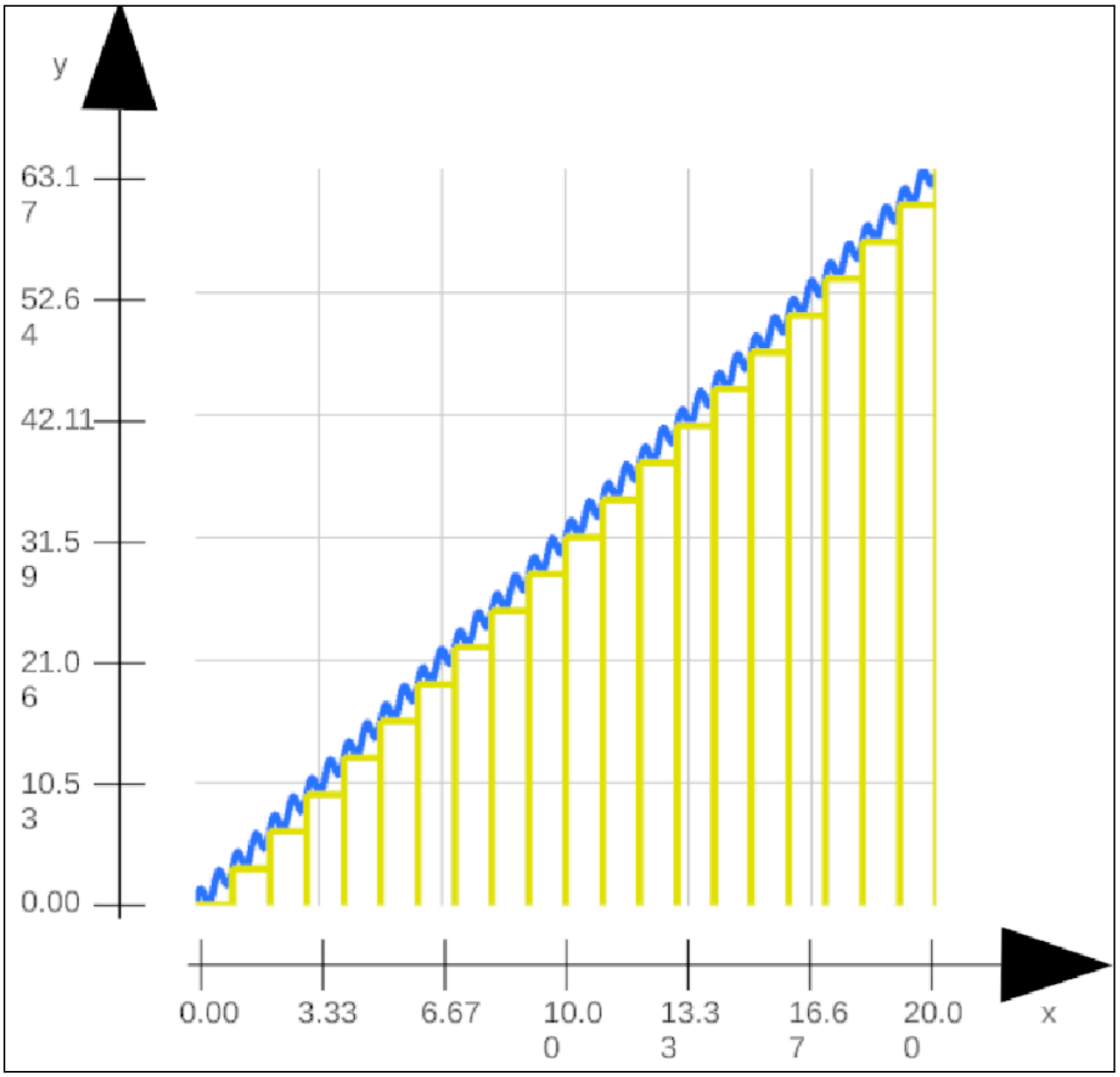
[4] UML-diagram



[5] Results of the numerical integration:

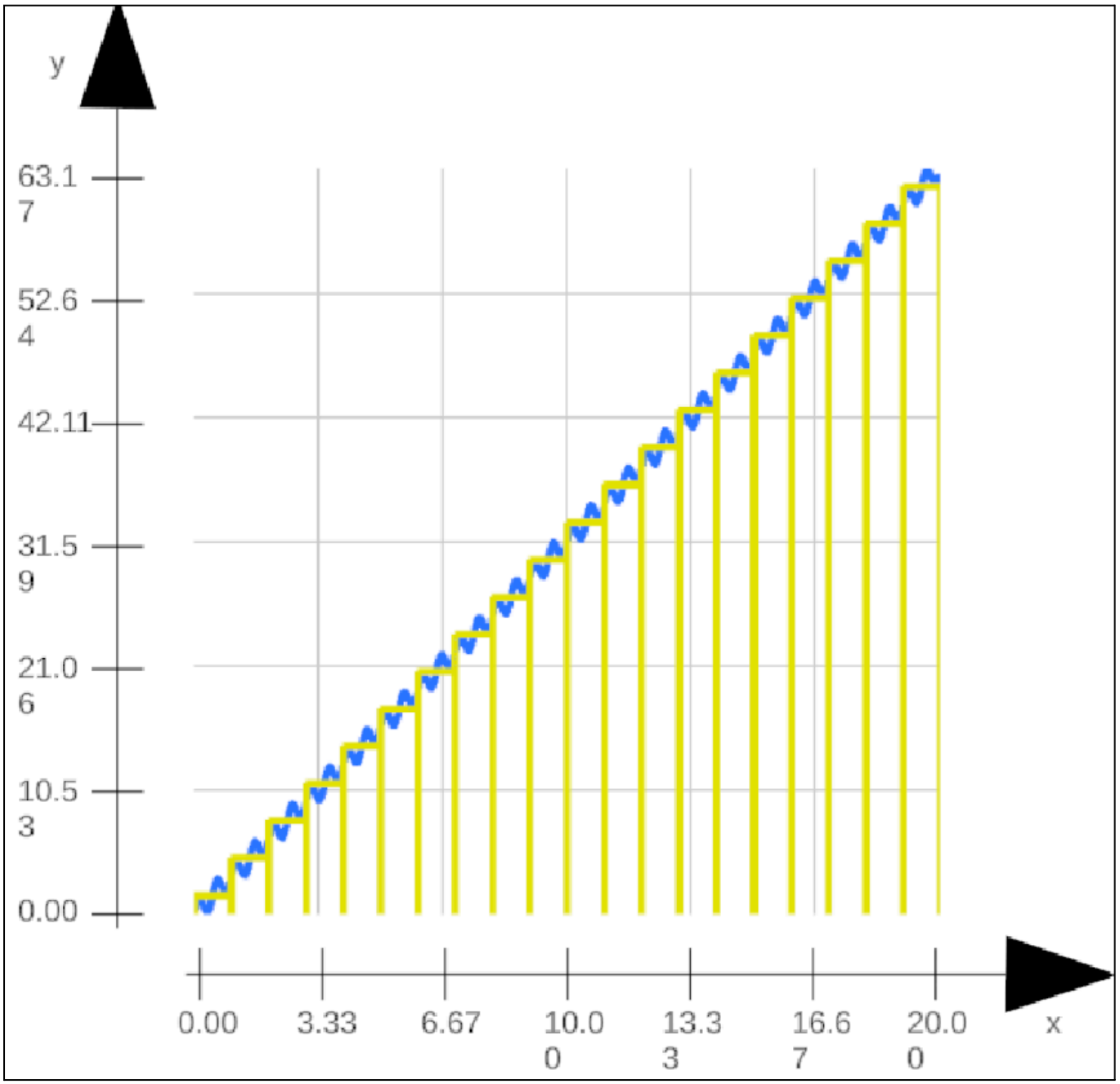
Method 1:

Total Energy using Rectangle Method: **630.108625** Joules

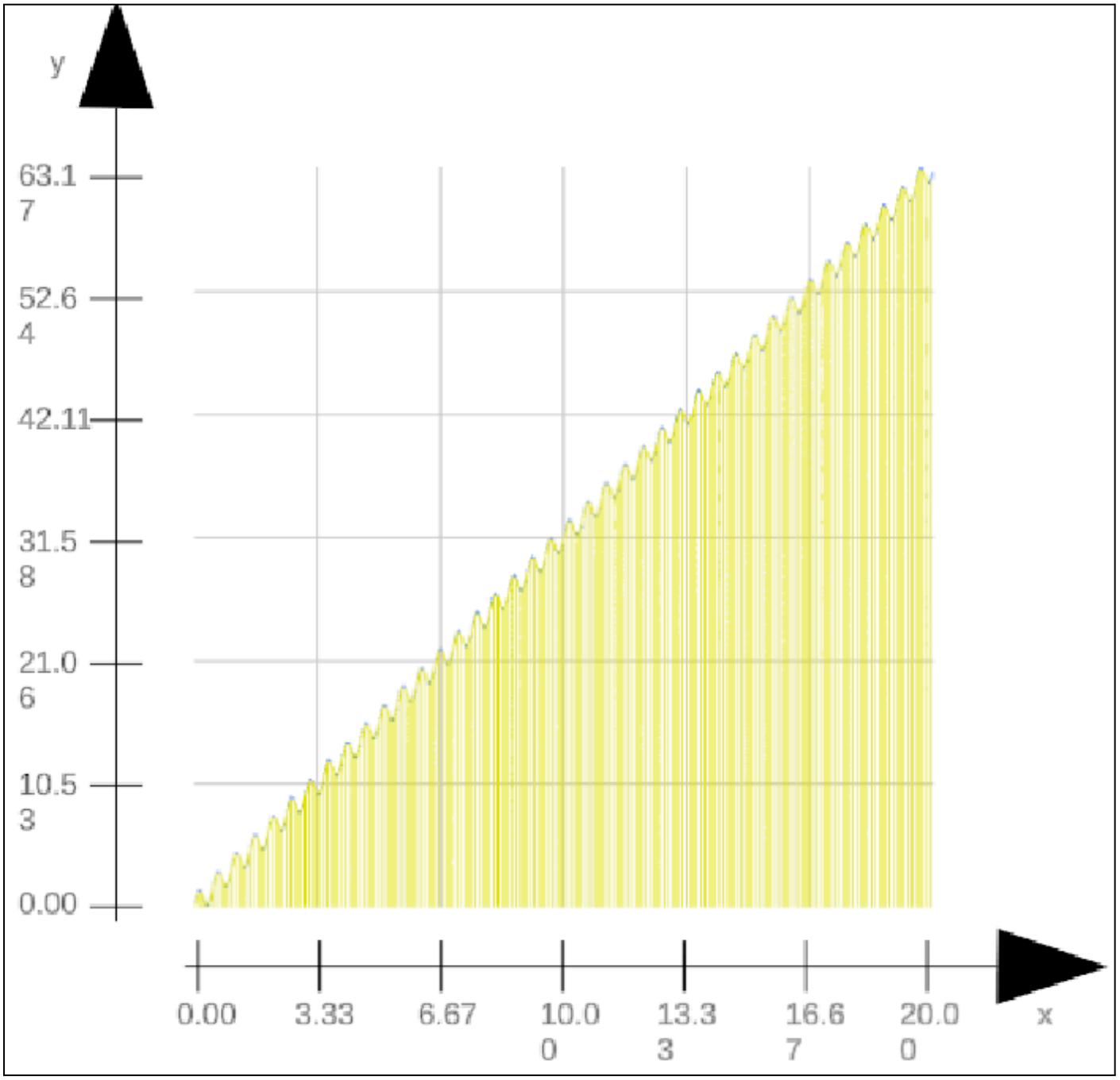


Method 2:

Total Energy using Midpoint Method: **633.275** Joules



Method 3:
Total Energy using Trapezoidal Rule: **633.2749** Joules



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[6] Absolut and relative error of the numerical results:
Absolute Error = (Approximate Value - Exact Value)
Relative Error = (Approximate Value - Exact Value) / (Exact Value)

Analytical Value = 633.275
Numerical Value of Method1 = 630.108625
Numerical Value of Method1 = 0
Numerical Value of Method1 = 633.2749

Absolute Error for Method 1 is: -3.16637500000002
Absolute Error for Method 2 is: 0
Absolute Error for Method 3 is: -9.99999999748979E-05

Relative Error for Method 1 is: -0.00500000000000003
Relative Error for Method 2 is: 0
Relative Error for Method 3 is: -1.57909281078359E-07

Relative Error Percentage for Method 1 is: -0.500000000000003%
Relative Error Percentage for Method 2 is: 0%
Relative Error Percentage for Method 3 is: -1.57909281078359E-05%