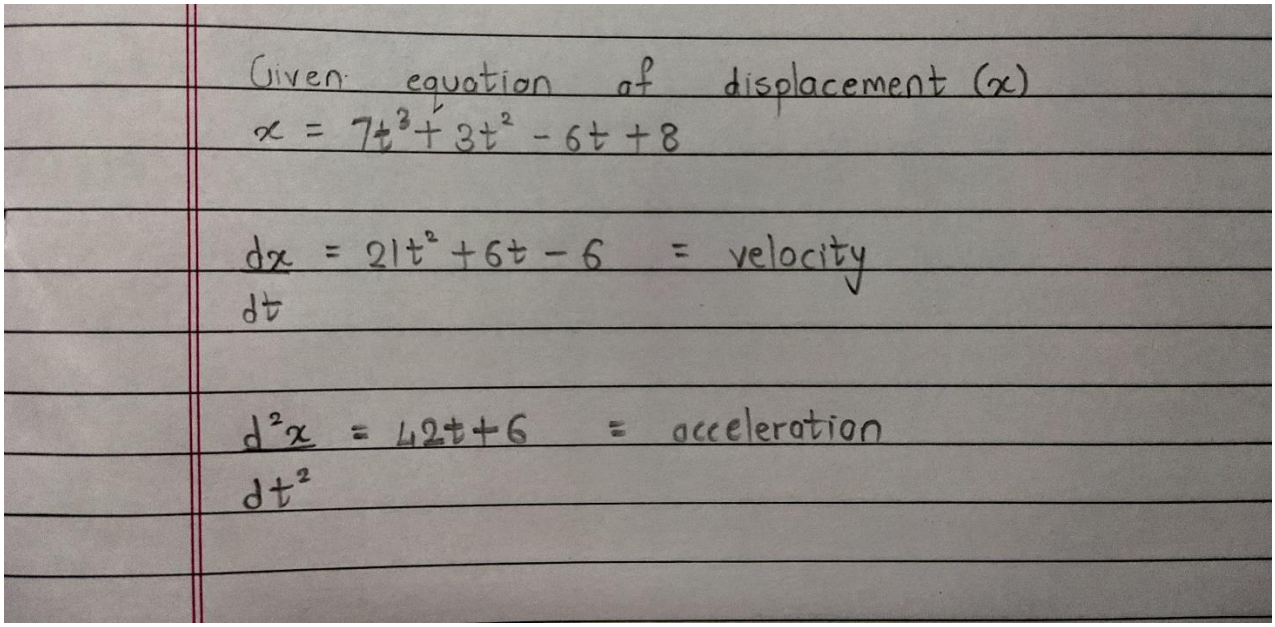
Name: Ritesh S. Jha		
Batch: P4-1	**Roll No.: 16010423076**	**Experiment No.: 10**
Marks:		
Signature of Lab Teacher with date:		

1) Problem statement

Given the equation of motion x=7t^3+3t^2-6t+8

1. Find the expressions for velocity and acceleration.
2. Plot the graphs of displacement, velocity, and acceleration from t=0 to t=15s.

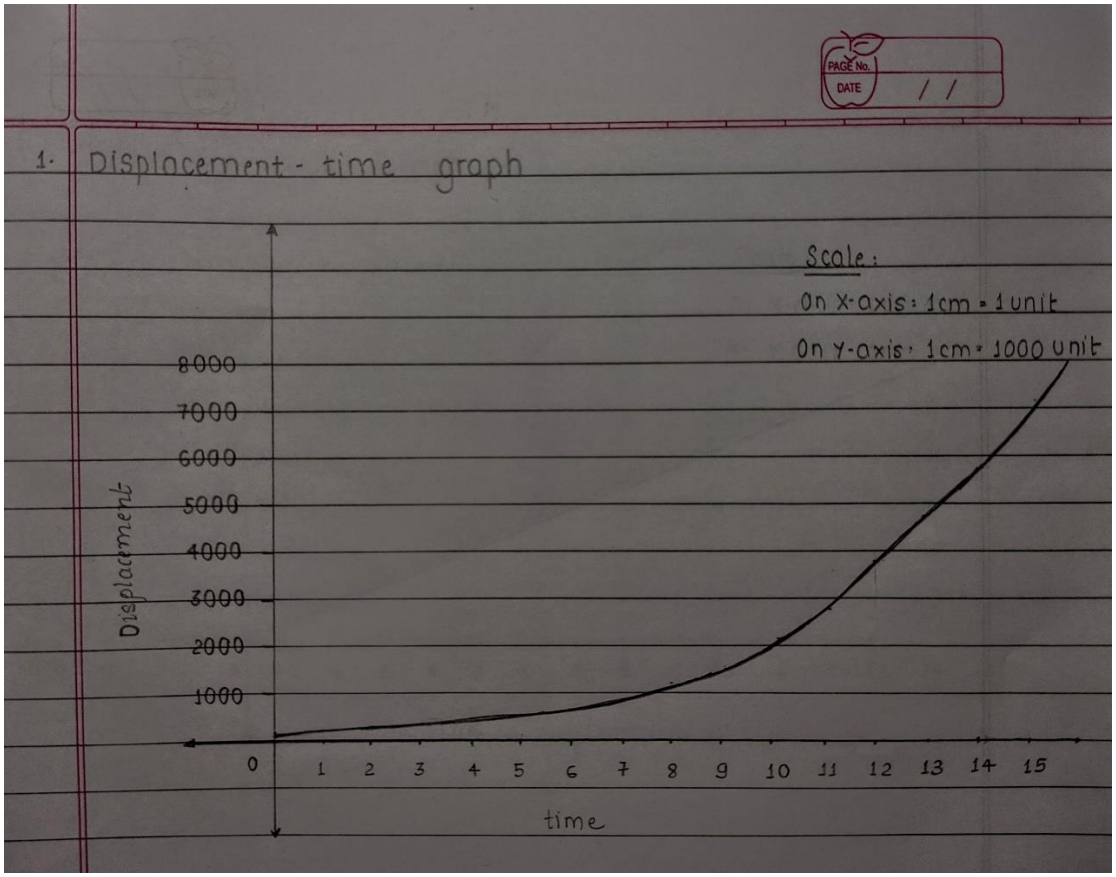
2) Analytical solution of the problem

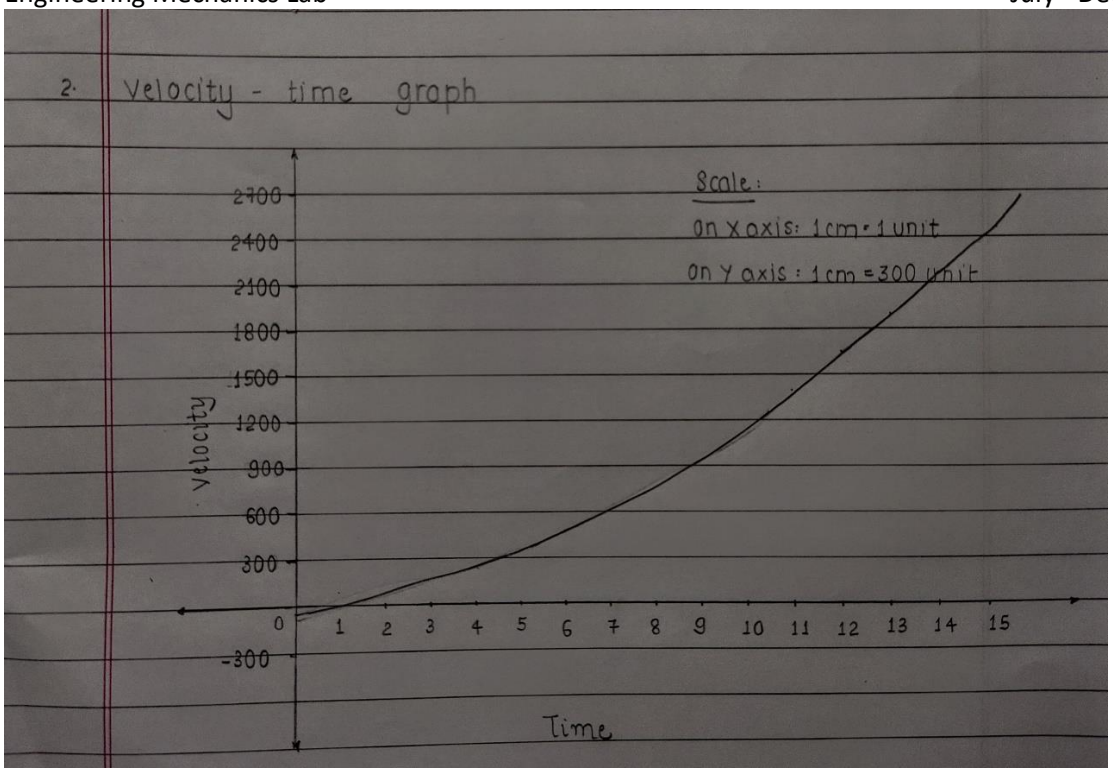


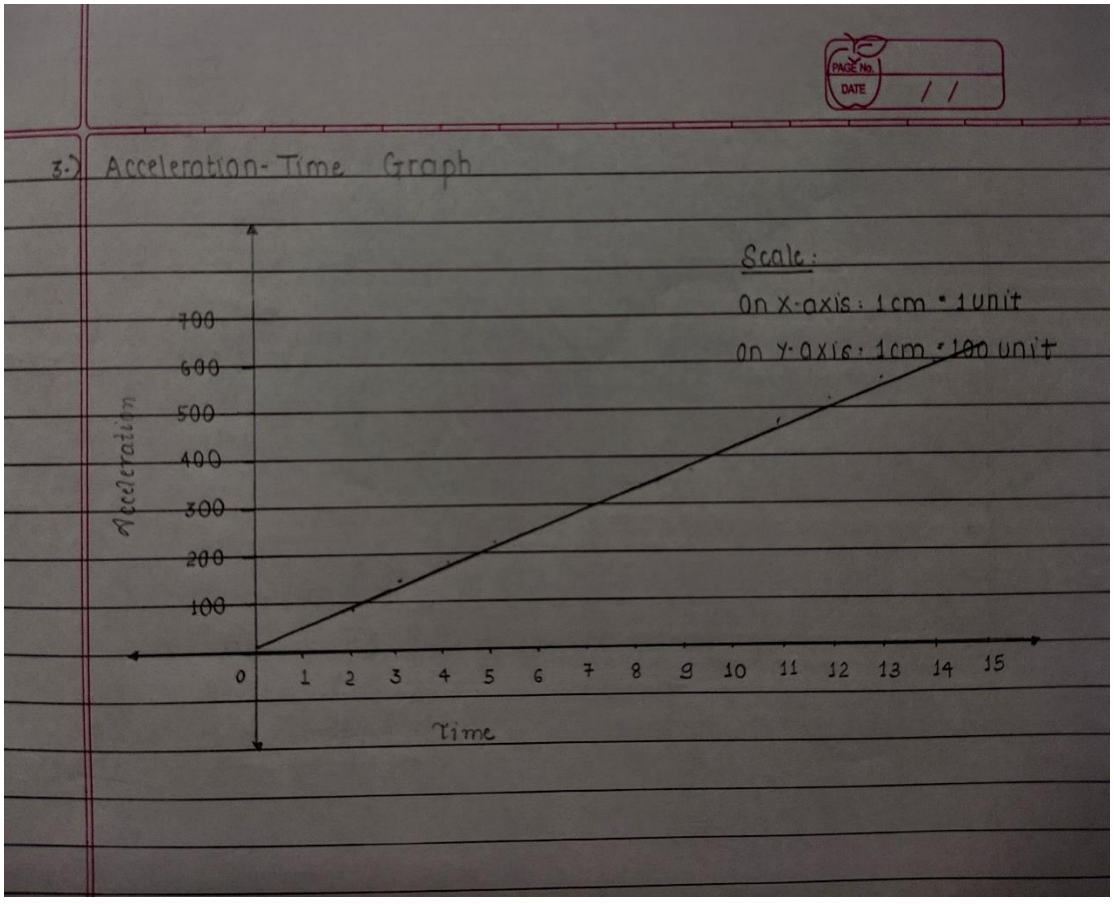
For the graph,
we substitute the value of time t from
0 to 15s in the three equations,

t	x	y	a
0	8	-6	6
2	46	78	90
4	200	246	174
6	532	486	258
8	1144	798	342
10	2154	1182	426
12	3696	1638	510
14	5880	2166	594
15	7248	2457	636

1. Displacement - time graph




2. Velocity - time graph
Scale:
On X axis: 1 cm = 1 unit
On Y axis: 1 cm = 300 unit
Velocity
2700
2400
2100
1800
1500
1200
900
600
300
0
-300
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Time


3. Acceleration-Time Graph
Scale:
On X-axis: 1 cm = 1 unit
On Y-axis: 1 cm = 100 unit
Acceleration
700
600
500
400
300
200
100
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Time

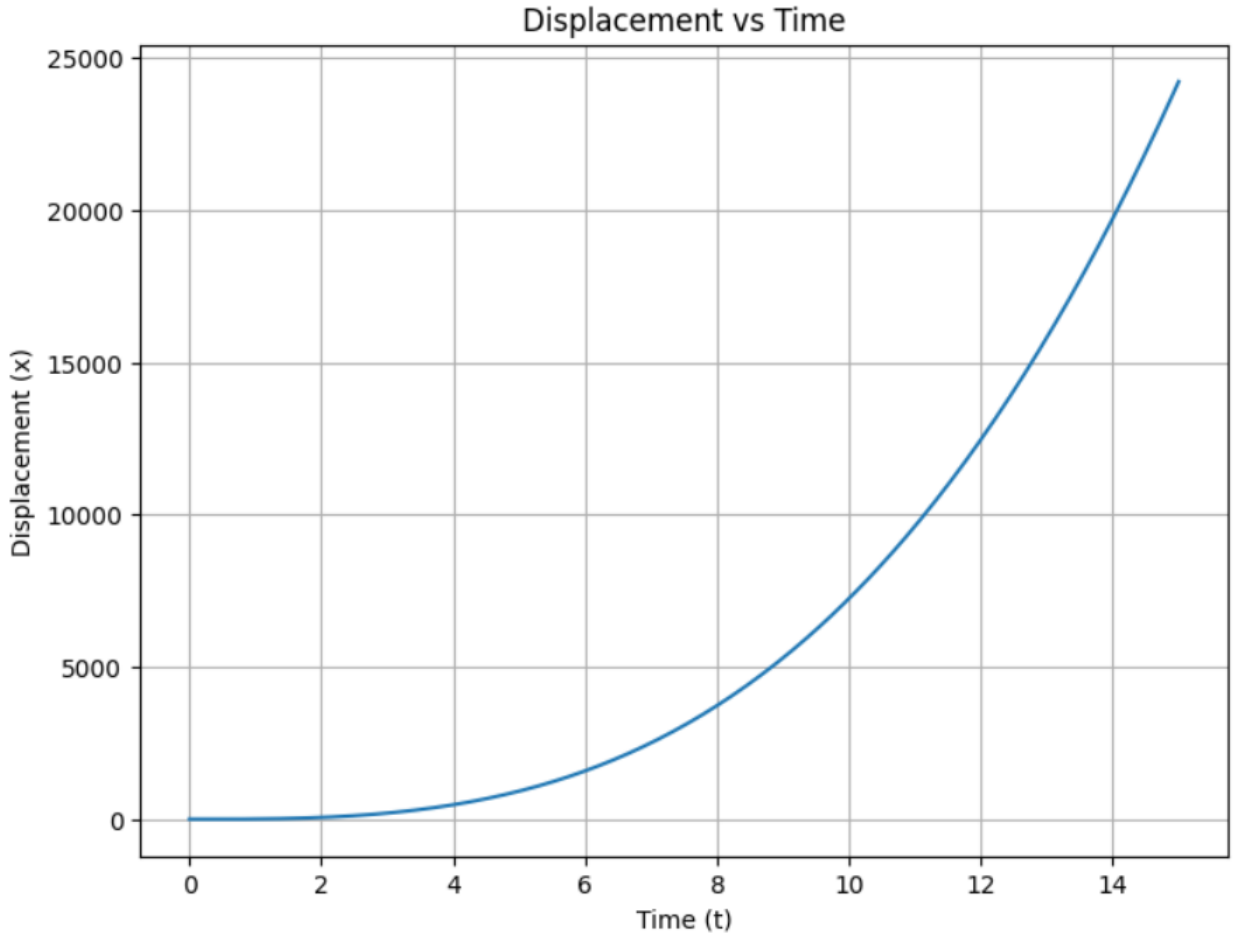
3) Screenshots of the work done in software showing input parameters, coding, graphs, results etc.

Calculation of velocity and acceleration equations from displacement equations:

```
[3]  import matplotlib.pyplot as plt
     import numpy as np
     from sympy import symbols,diff,lambdify
     from sympy.integrals.integrals import integrate

[4]  t = symbols('t')

[5]  eqn_x = (7*t**3)+(3*t**2)-(6*t)+8

[6]  eqn_v = diff(eqn_x,t)
     eqn_a = diff(eqn_v,t)

[7]  int_v = integrate(eqn_v)
     int_a = integrate(eqn_a,t)

     print("Velocity(dx/dt) = ",eqn_v)
     print("Acceleration(dv/dt) = ",eqn_a)
     print("\n\nIntegration of velocity is displacement= ",int_v)
     print("Integration of acceleration is velocity = ",int_a)

     Velocity(dx/dt) =  21*t**2 + 6*t - 6
     Acceleration(dv/dt) =  42*t + 6


     Integration of velocity is displacement=  7*t**3 + 3*t**2 - 6*t
     Integration of acceleration is velocity =  21*t**2 + 6*t
```

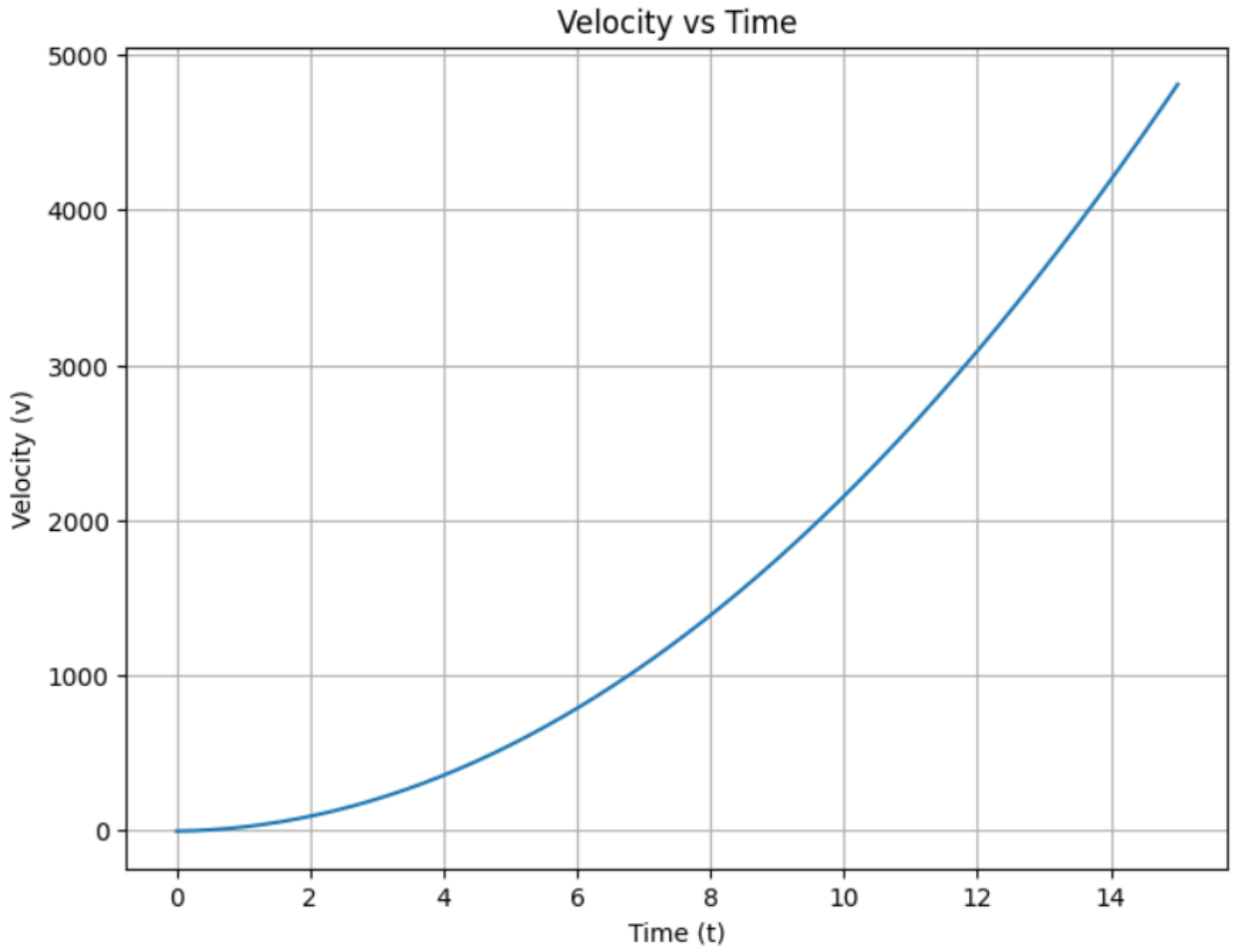
1)Graph of displacement(x):

```
eq_fn = lambdify(t, eqn_x, modules='numpy')
tvalue = np.linspace(0,15,400)
xvalue = eq_fn(tvalue)
fig = plt.figure(figsize = (8,6))
plt.plot(tvalue,xvalue)
plt.xlabel('Time (t)')
plt.ylabel('Displacement (x)')
plt.title('Displacement vs Time')
plt.grid(True)
plt.show()
```



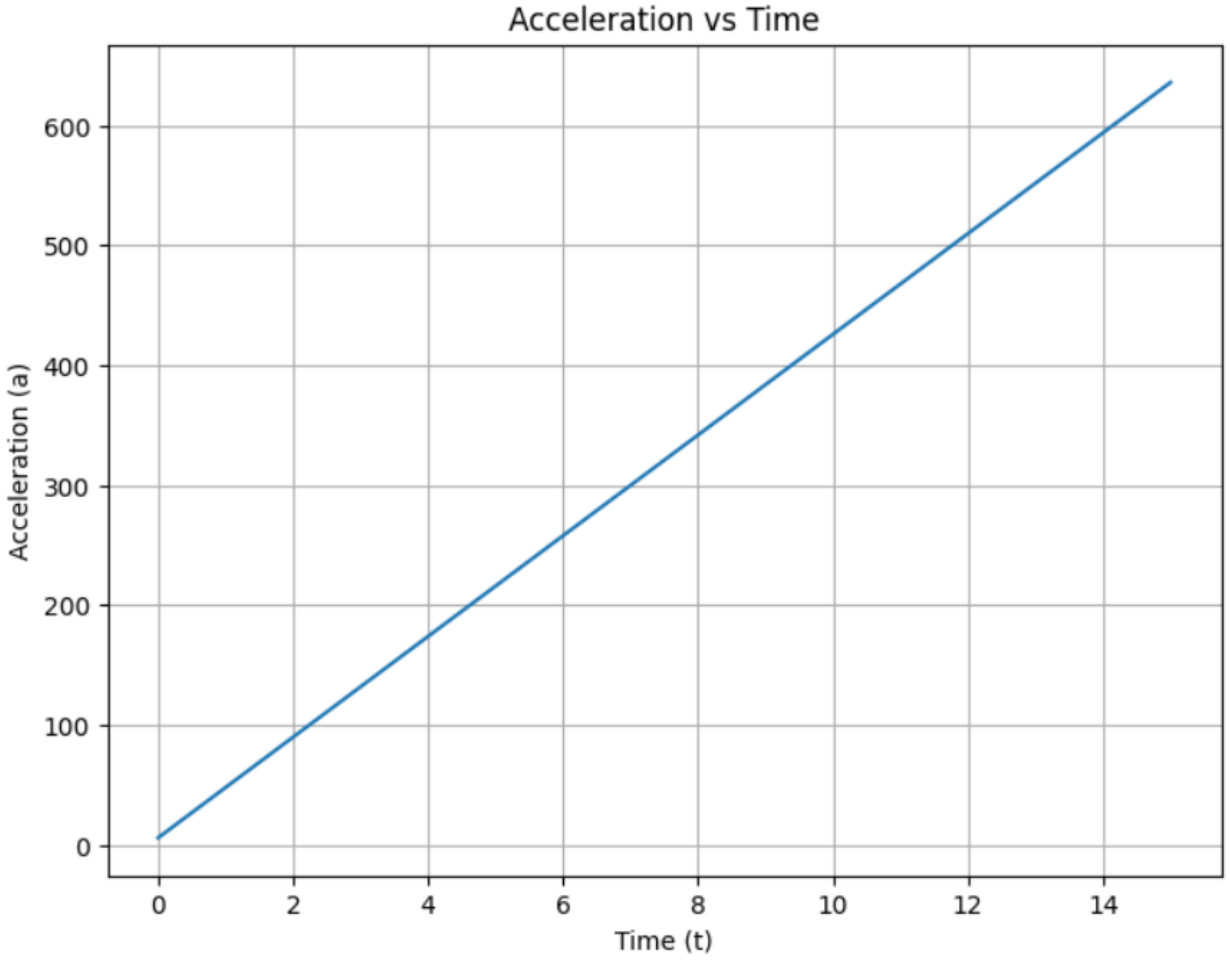
2)Graph of velocity(v):

```
eq_fn = lambdify(t, eqn_v, modules='numpy')
tvalue = np.linspace(0,15,400)
xvalue = eq_fn(tvalue)
fig = plt.figure(figsize = (8,6))
plt.plot(tvalue,xvalue)
plt.xlabel('Time (t)')
plt.ylabel('Velocity (v)')
plt.title('Velocity vs Time')
plt.grid(True)
plt.show()
```



3)Graph of acceleration(a):

```
eq_fn = lambdify(t, eqn_a, modules='numpy')
tvalue = np.linspace(0,15,400)
xvalue = eq_fn(tvalue)
fig = plt.figure(figsize = (8,6))
plt.plot(tvalue,xvalue)
plt.xlabel('Time (t)')
plt.ylabel('Acceleration (a)')
plt.title('Acceleration vs Time')
plt.grid(True)
plt.show()
```



4) Result

The velocity(v) is equal to 21t^2+6t-6 and the acceleration(a) is equal to 42t+6.
The graph of Displacement(x) vs Time(t) is of 3rd order , the graph of Velocity(v) vs Time(t) is of 2rd order & the graph Acceleration(a) vs Time(t) is linear.

5) Conclusion

We solved an Engineering Mechanics problem using both analytical methods and computational tools. Through mathematical derivations and expressions, we'll solve it analytically. Furthermore, Python will aid in graphical analysis, providing visual and numerical insights.