

```

1 #Problem 2-9
2
3 import numpy as np
4 import matplotlib.pyplot as plt
5
6 def TrajectorySolver(h,m=1):
7     x_vec=[2]
8     v_vec=[0]
9
10    current_x=2
11    current_v=0
12
13    while current_x<=2:
14        x_vec.append(current_x+h*current_v)
15        v_vec.append(current_v+(h/m)*((48/(current_x**13
16        ))-(24/(current_x**7))))
17        current_x=x_vec[-1]
18        current_v=v_vec[-1]
19
20    return(x_vec,v_vec)
21
22 h_list=[10**-2,10**-3,10**-4,10**-5]
23
24 plt.style.use('ggplot')
25 fig = plt.figure()
26 ax1 = fig.add_subplot(111)
27
28 # part (a)
29 # for h in h_list:
30 #     x=TrajectorySolver(h)[0]
31 #     t=np.array(range(len(x)))*h
32 #     ax1.plot(t, x, label='h = '+str(h))
33 #
34 # ax1.set_xlabel("t")
35 # ax1.set_ylabel("x")
36 # plt.title('Problem 2-9 (m = 1)')
37 # plt.legend()
38 # plt.show()
39
40 # part (b)
41 # for h in h_list:
42 #     x, v=TrajectorySolver(h)
43 #     x=np.array(x)
44 #     v=np.array(v)
45 #     E=(0.5*(x**2))+(0.5*(v**2))
46 #     t=np.array(range(len(x)))*h
47 #     ax1.plot(t, E, label='h = '+str(h))
48 #
49 # ax1.set_xlabel("t")

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50 # ax1.set_ylabel("E")
51 # plt.title('Problem 2-9 (m = 1)')
52 # plt.legend()
53 # plt.show()
54
55 # part (c)
56 # E_list=[]
57 # for h in h_list:
58 #     x, v=TrajectorySolver(h)
59 #     x=np.array(x)
60 #     v=np.array(v)
61 #     E=(0.5*(x**2))+(0.5*(v**2))
62 #     E_list.append(E[-1])
63 # print(E_list)
64 # ax1.semilogx(h_list, E_list)
65 # ax1.set_xlabel("h")
66 # ax1.set_ylabel("E(T)")
67 # plt.title('Problem 2-9 (m = 1)')
68 # plt.legend()
69 # plt.show()
```