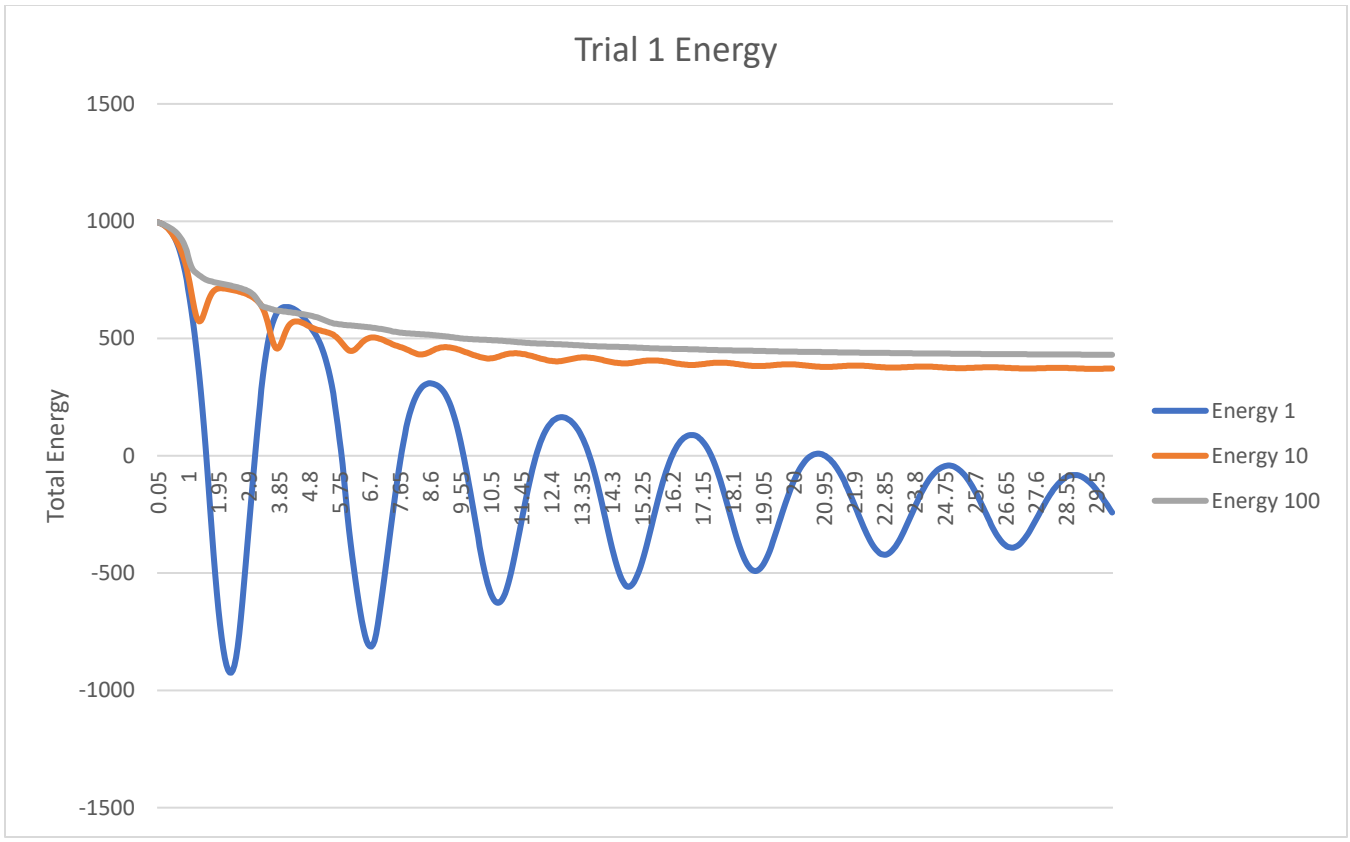
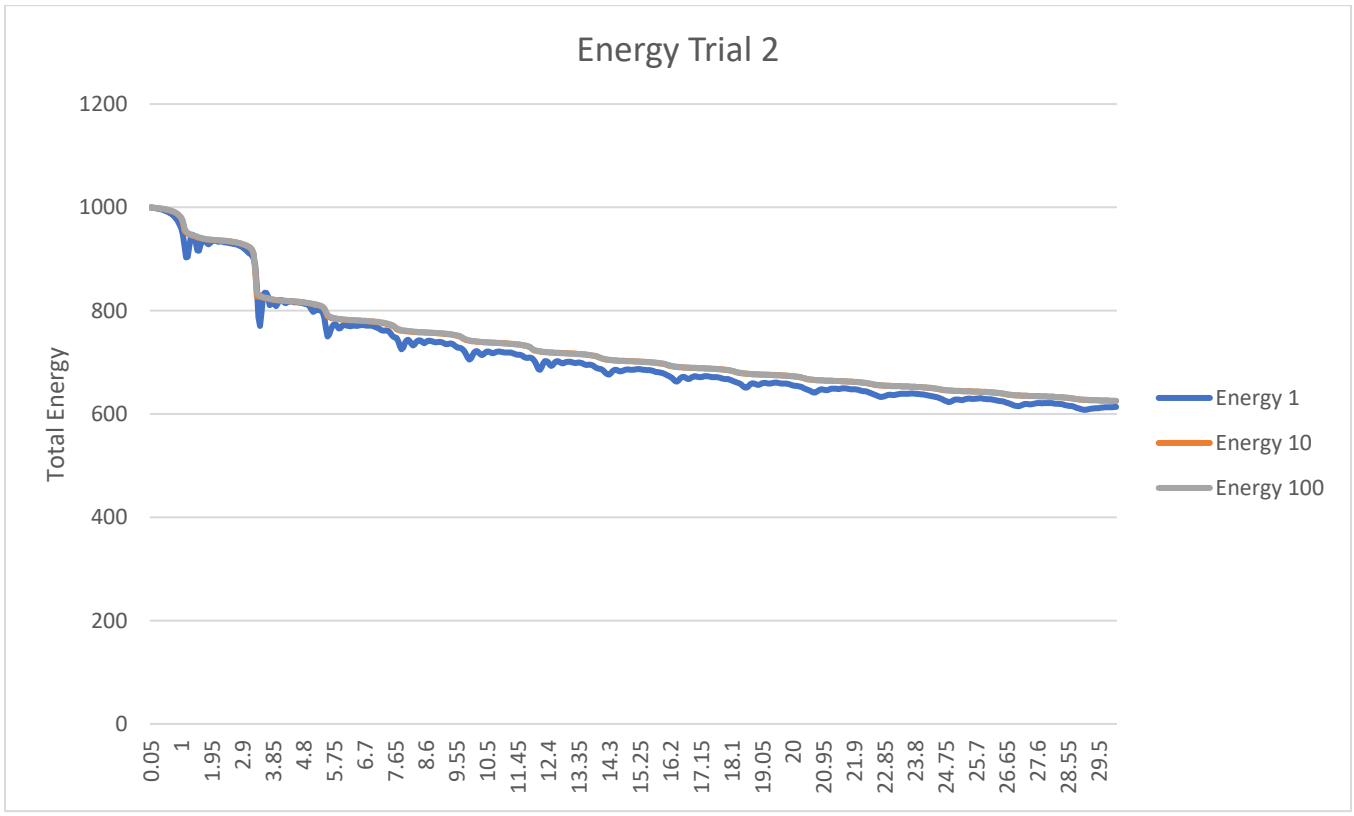

Trial 1 Energy
Total Energy
1500
1000
500
0
-500
-1000
-1500
0.05
1
1.95
2.9
3.85
4.8
5.75
6.7
7.65
8.6
9.55
10.5
11.45
12.4
13.35
14.3
15.25
16.2
17.15
18.1
19.05
20
20.95
21.9
22.85
23.8
24.75
25.7
26.65
27.6
28.55
29.5
Energy 1
Energy 10
Energy 100


Energy Trial 2
Total Energy
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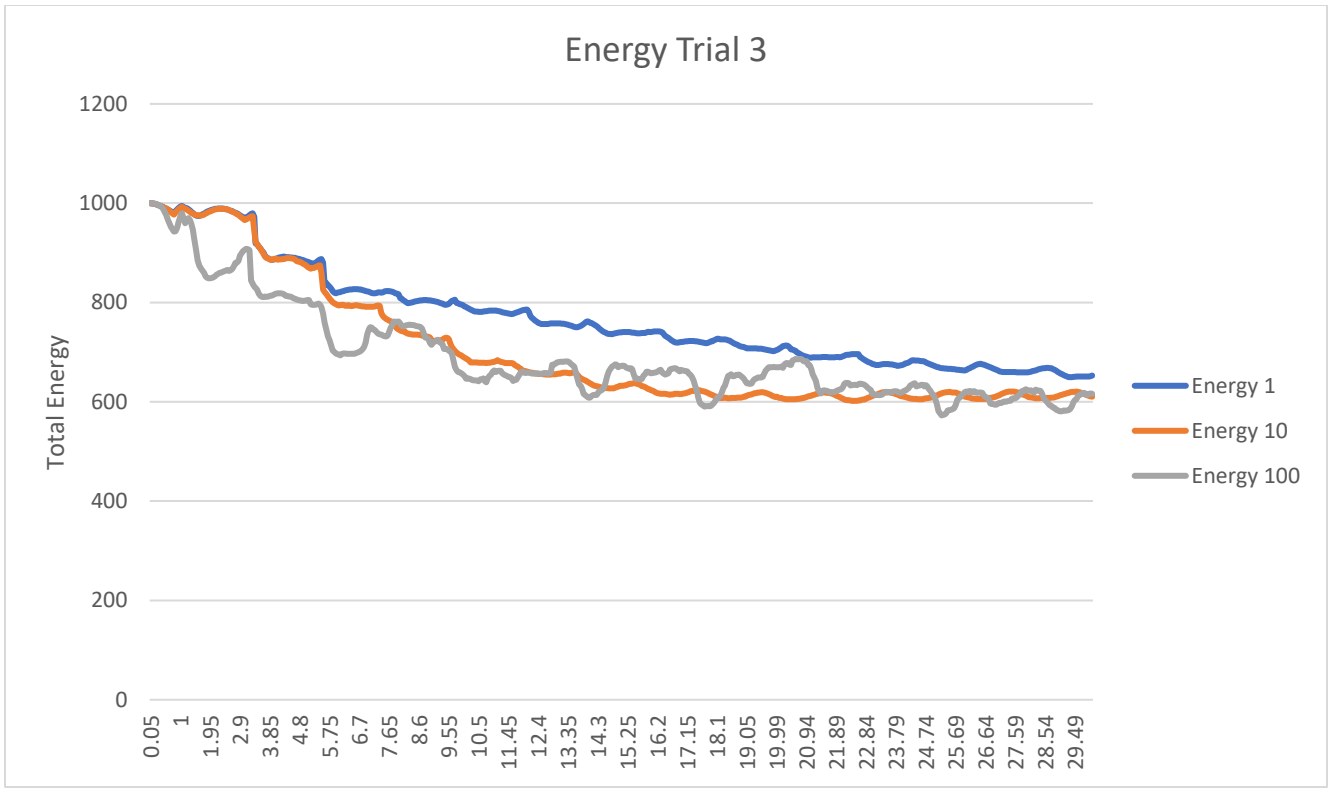
1000
800
600
400
200
0
0.05
1
1.95
2.9
3.85
4.8
5.75
6.7
7.65
8.6
9.55
10.5
11.45
12.4
13.35
14.3
15.25
16.2
17.15
18.1
19.05
20
20.95
21.9
22.85
23.8
24.75
25.7
26.65
27.6
28.55
29.5
Energy 1
Energy 10
Energy 100


Energy Trial 3
Total Energy
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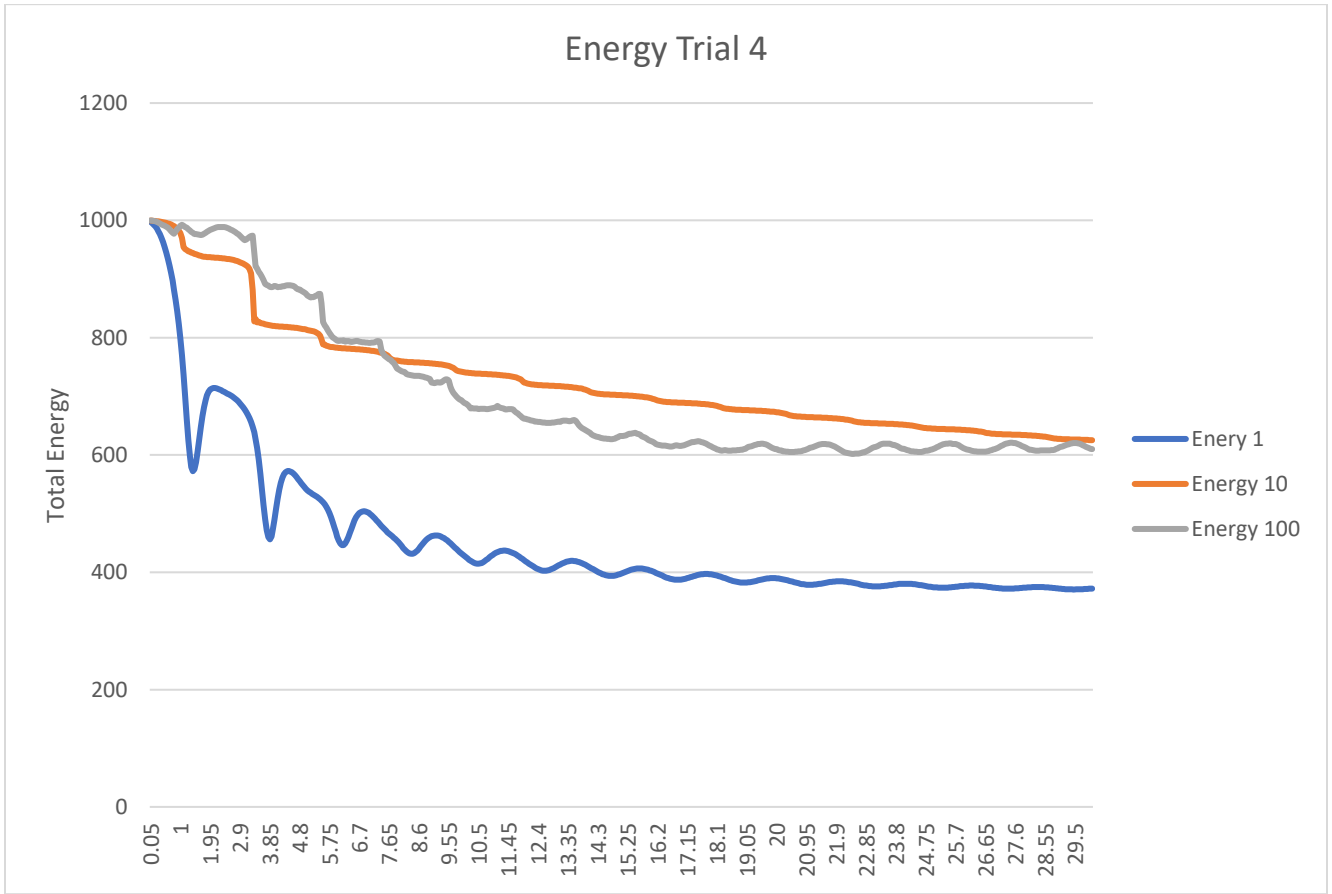
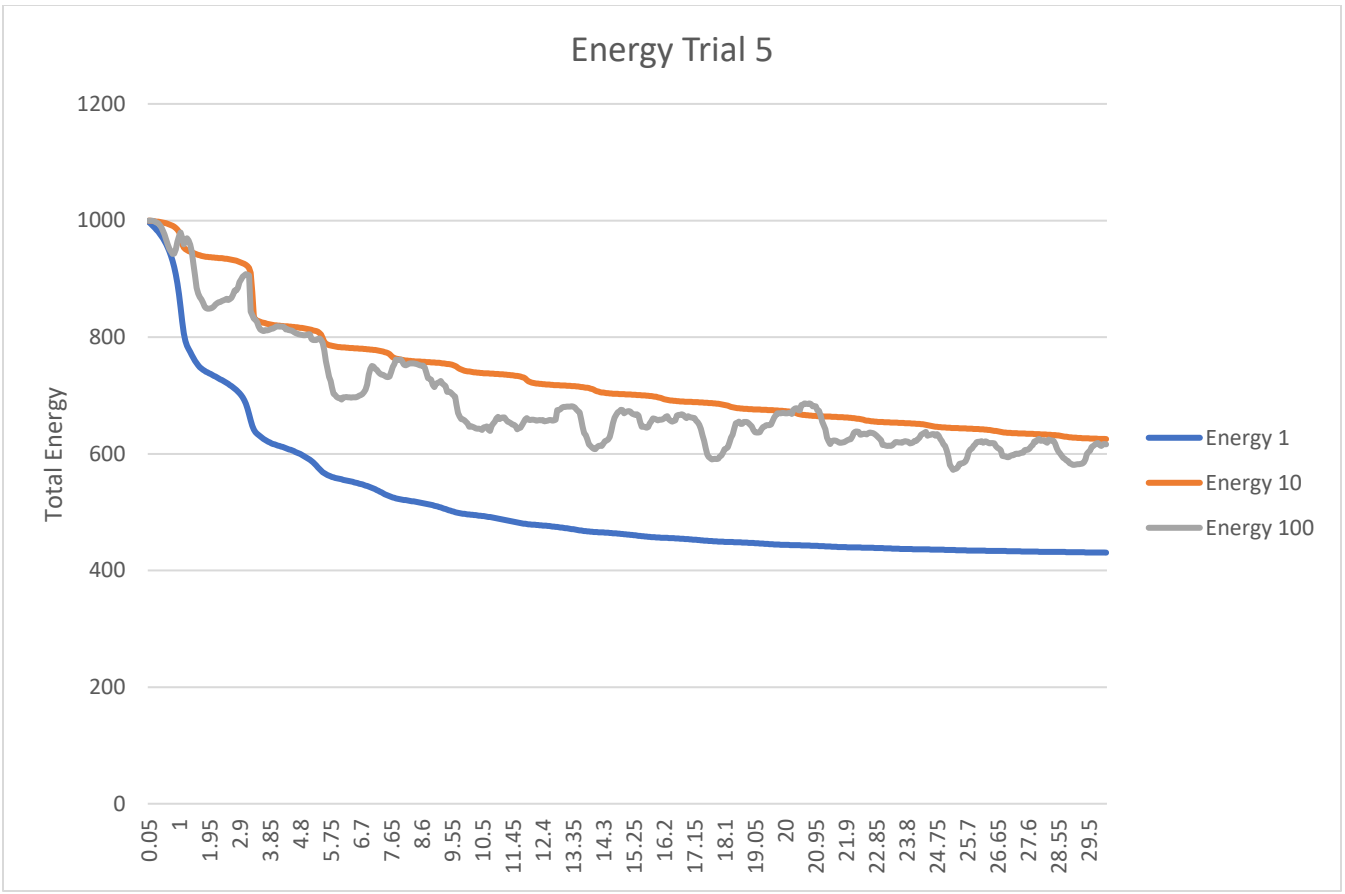
1000
800
600
400
200
0
0.05
1
1.95
2.9
3.85
4.8
5.75
6.7
7.65
8.6
9.55
10.5
11.45
12.4
13.35
14.3
15.25
16.2
17.15
18.1
19.05
19.99
20.94
21.89
22.84
23.79
24.74
25.69
26.64
27.59
28.54
29.49
Energy 1
Energy 10
Energy 100


Energy Trial 4
Total Energy
1200
1000
800
600
400
200
0
0.05
1
1.95
2.9
3.85
4.8
5.75
6.7
7.65
8.6
9.55
10.5
11.45
12.4
13.35
14.3
15.25
16.2
17.15
18.1
19.05
20
20.95
21.9
22.85
23.8
24.75
25.7
26.65
27.6
28.55
29.5
Enery 1
Energy 10
Energy 100


Energy Trial 5
Total Energy
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1000
800
600
400
200
0
0.05
1
1.95
2.9
3.85
4.8
5.75
6.7
7.65
8.6
9.55
10.5
11.45
12.4
13.35
14.3
15.25
16.2
17.15
18.1
19.05
20
20.95
21.9
22.85
23.8
24.75
25.7
26.65
27.6
28.55
29.5
Energy 1
Energy 10
Energy 100


Double Pendulum

Above are the graphs for the five trials in order as well as the screenshot.

Trial 1: This was the trial with the fixed sub step count of 1 and the increasing relaxation steps. With only 1 sub step it was horrendous in how it looked and went as seen from the energy going negative. The other two tests were similar with it slowing down to about 500 for the peak with the 100 relaxation steps being a much smoother ride with less jumps compared to the 10 relaxation steps.

Trial 2: For this trial almost all of the different tests resulted in the same results. Big jumps at the start and then a gradual descent to about 600. Again when the relaxation steps were at 100 it was a smooth process at the 10 sub steps. Compared to less sub steps the overall energy was preserved better but still not well.

Trial 3: This trial had 100 sub steps and was much more erratic than the last two. At least with 1 sub step the swings were smooth. Here everything is all over the place. Compared to the first two trials only having 1 relaxation step resulted in a smoother operation. Again the total energy ended at about 600 but this time with 1 relaxation step the energy was closer to 700.

Trial 4: Now we are changing the sub steps with each test instead of the relaxation steps. With a relaxation step of 10 it was horrible with 1 sub step. With 10 of each it was smooth after the start, similar to trial 2. However, the third test with 100 sub steps caused it to fluctuate a bit more.

Trial 5: With 100 relaxation steps each time it was smooth for less than 100 sub steps. When it got to 100 sub steps it started to go more wild. Overall there is an energy decrease with 1 sub step being the worst.

Overall Analysis: From looking at this having only 1 sub step is almost never ideal as it always had the lowest amount of energy left at the end. With relaxation steps when the sub step was really high a lower relaxation step was surprisingly better. Overall at about 10 sub steps and 10 relaxation steps we saw the best in terms of energy of the system. As the amount of steps increased so did the rigidity of the system. This helped with energy overall but too much lead to it overcorrecting things and ups and downs instead of the smoothness found at about 10 of each step.