Rachel Buttry
PHYS 305
Homework #4

Problem 1
a) <mark>Found that $|E-E0| < 10^{-4}$ when eta = 10.0</mark>
Outputs from run:
Initial E = -0.633125580652
t = 0.0 dE = 0.0 steps = 0
t = 0.999963107718
dE = 2.33087202761e-06
t = 1.99985197982
dE = 9.60924363413e-07
t = 2.99990817074
dE = 2.12635795549e-06
t = 3.99974829292
dE = 1.74670396835e-06
t = 4.9998658393
dE = 2.20022037012e-06
t = 5.99987553794
dE = 1.96976851596e-06
t = 6.99965037188
dE = 2.53089682301e-06
t = 7.99963291147
dE = 2.25821757183e-06
t = 8.9999304935
dE = 2.14995433734e-06
t = 9.99999644255
dE = 1.36442835452e-06
t = 10.9997731563
dE = 1.30143292121e-06
t = 11.999630772
dE = 1.16410692774e-06
t = 12.9998341897
dE = 7.70038738329e-08
t = 13.9997451903
dE = 1.13316367734e-07
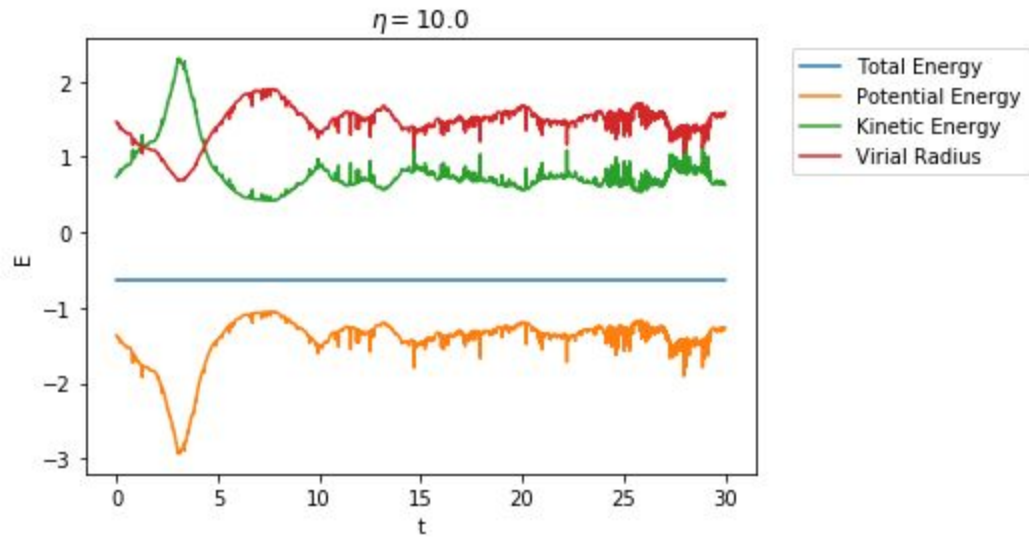t = 14.9995660761
dE = 2.38499322402e-07
t = 15.999954362
dE = 1.95268934933e-06
t = 16.9999815773
dE = 3.01998942531e-06

t = 17.9998550185
dE = 7.384910927e-06
t = 18.9999874282
dE = 6.63579637616e-06
t = 19.9999942466
dE = 6.51381887884e-06
t = 20.9999901416
dE = 1.17633464892e-05
t = 21.9999040736
dE = 8.35034269409e-06
t = 22.9999072531
dE = 8.31223492914e-06
t = 23.9999691169
dE = 9.13012318071e-06
t = 24.9998343657
dE = 1.05748280596e-05
t = 25.9999871503
dE = 1.05476919797e-05
t = 26.9999690174
dE = 1.269709372e-05
t = 27.9997240098
dE = 9.86970645911e-06
t = 28.9999036538
dE = 9.71938133065e-06
t = 29.9996730601
dE = 1.08143458581e-05
t = 30.0000525667 dE = 1.08201471964e-05 steps = 188201
<mark>timesteps taken: 188201</mark>

$\eta = 10.0$

b) <mark>Found that $|E-E0| < 10^{-4}$ when dt = 1e-5</mark>
Output:
Initial E = -0.65445539614
t = 0.0 dE = 0.0
t = 0.999999999998
|E-E0| 2.95429303243e-09
t = 1.99999
|E-E0| 1.59543489531e-10
t = 2.99999000001
|E-E0| 2.30514407562e-09
t = 3.99999000002
|E-E0| 3.4019640438e-09
t = 4.99999999998
|E-E0| 4.2375047915e-10
t = 5.99999999994
|E-E0| 2.28981889006e-09
t = 6.9999999999
|E-E0| 4.74070460665e-09
t = 7.99999999987
|E-E0| 4.00637967246e-10
t = 8.99999999983
|E-E0| 1.84133486236e-10
t = 9.99999999979
|E-E0| 8.3173667953e-10
t = 10.9999999998
|E-E0| 1.42087127841e-07
t = 11.9999999997

|E-E0| 3.70802335503e-07
t = 12.9999999997
|E-E0| 8.56207869049e-08
t = 13.9999999996
|E-E0| 5.03529358209e-08
t = 14.9999999996
|E-E0| 6.34343211292e-08
t = 15.9999999996
|E-E0| 2.50502394494e-07
t = 16.9999999995
|E-E0| 2.19460428164e-07
t = 17.9999999995
|E-E0| 4.16439530637e-08
t = 18.9999999994
|E-E0| 1.92167970425e-07
t = 19.9999999994
|E-E0| 1.08050253189e-07
t = 20.9999999994
|E-E0| 4.1781250204e-07
t = 21.9999999993
|E-E0| 1.24210701413e-06
t = 22.9999999993
|E-E0| 3.08227449664e-06
t = 23.9999999993
|E-E0| 6.54748998019e-07
t = 24.9999999992
|E-E0| 1.33513330614e-07
t = 25.9999999992
|E-E0| 2.01491675489e-06
t = 26.9999999991
|E-E0| 1.52932757458e-07
t = 27.9999999991
|E-E0| 3.57046013977e-07
t = 28.9999999991
|E-E0| 4.29972229266e-07
t = 29.999999999
|E-E0| 2.63686196722e-06
t = 29.999999999 dE = 2.63686196722e-06
Done loop
dt = 1e-05
Total time steps taken: 3000000

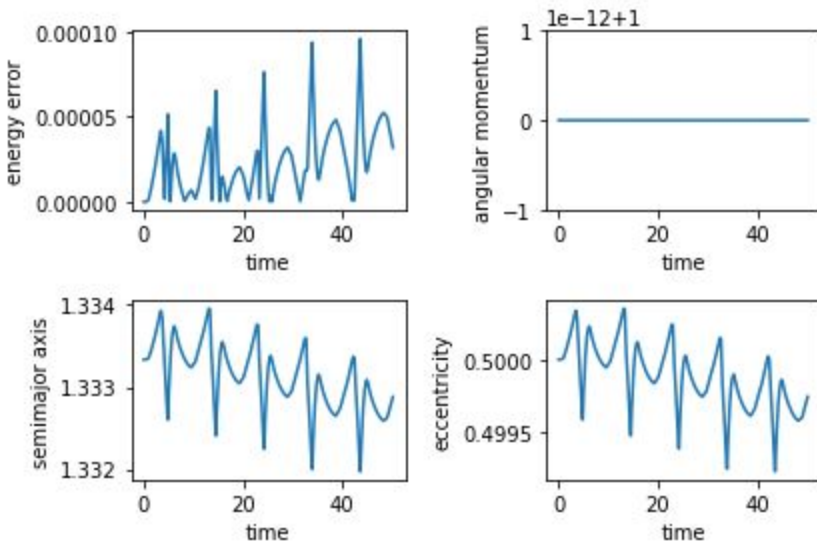(Forgot to copy plotting stuff into 1b code and it takes to long to run again)

Problem 2

Found that $|E-E0| < 10^{-4}$ when dEtol = 2e-6

Output:

t = 50.1208291858 dE = -3.1762289079e-05 steps = 305

dEtol = 2e-06

Max $|E-E0|$ = 9.56201067479e-05

Problem 3

Found that $|E-E0| < 10^{-4}$ when dEtol = 5e-8

Output:

Initial E = -0.65445539614

t = 0.0 dE = 0.0

t= 0.99998962584

dE = 3.22404423359e-06

t= 2.00049140661

dE = 8.6882825423e-07

t= 3.00075332059

dE = 4.73677330604e-06

t= 4.00015468901

dE = 9.28321593263e-06

t= 5.00064562397

dE = 8.78523333903e-06

t= 5.9971090232

dE = 5.25580018729e-06

t= 6.99986688908

dE = 4.5968061041e-06

t= 8.0000369786
dE = 1.23570418558e-05
t= 9.00010874813
dE = 7.18129078003e-06
t= 9.9996337611
dE = 6.72457326689e-06
t= 10.9998790833
dE = 3.01294250626e-06
t= 12.0001276343
dE = 3.31338988158e-06
t= 12.9999173167
dE = 2.76128227183e-06
t= 13.9998910196
dE = 9.52717506308e-06
t= 14.9996856341
dE = 1.27040192074e-05
t= 16.0000409052
dE = 3.18289554646e-06
t= 16.99990591
dE = 4.13207063288e-06
t= 18.0000974904
dE = 8.31439236959e-06
t= 18.9994666943
dE = 6.67990141423e-06
t= 19.9991977049
dE = 8.65000750783e-06
t= 20.9996583709
dE = 9.62756902512e-06
t= 21.9994009453
dE = 7.54948261827e-06
t= 22.9999735852
dE = 6.5754658799e-06
t= 23.9998262037
dE = 9.95995201591e-06
t= 24.9999933976
dE = 1.12403794895e-05
t= 26.0005454279
dE = 5.2004125245e-06
t= 26.9997867066
dE = 4.0295574899e-07
t= 28.0000174976
dE = 9.42446671703e-07
t= 28.9998385544

dE = 1.05977254562e-05
t= 29.9999464277
dE = 1.51325685882e-05
t = 29.9999464277 dE = -1.51325685882e-05
dEtol = 5e-08
Max |E-E0| = 2.45063915959e-05