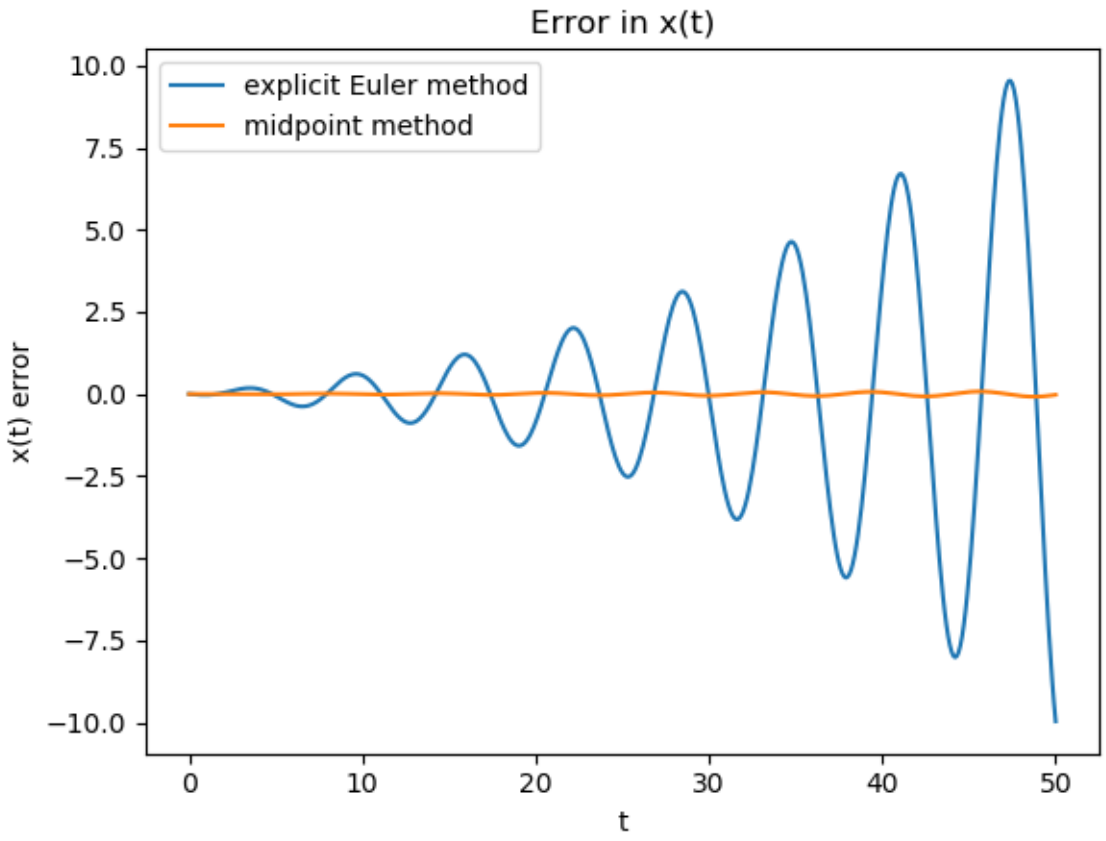
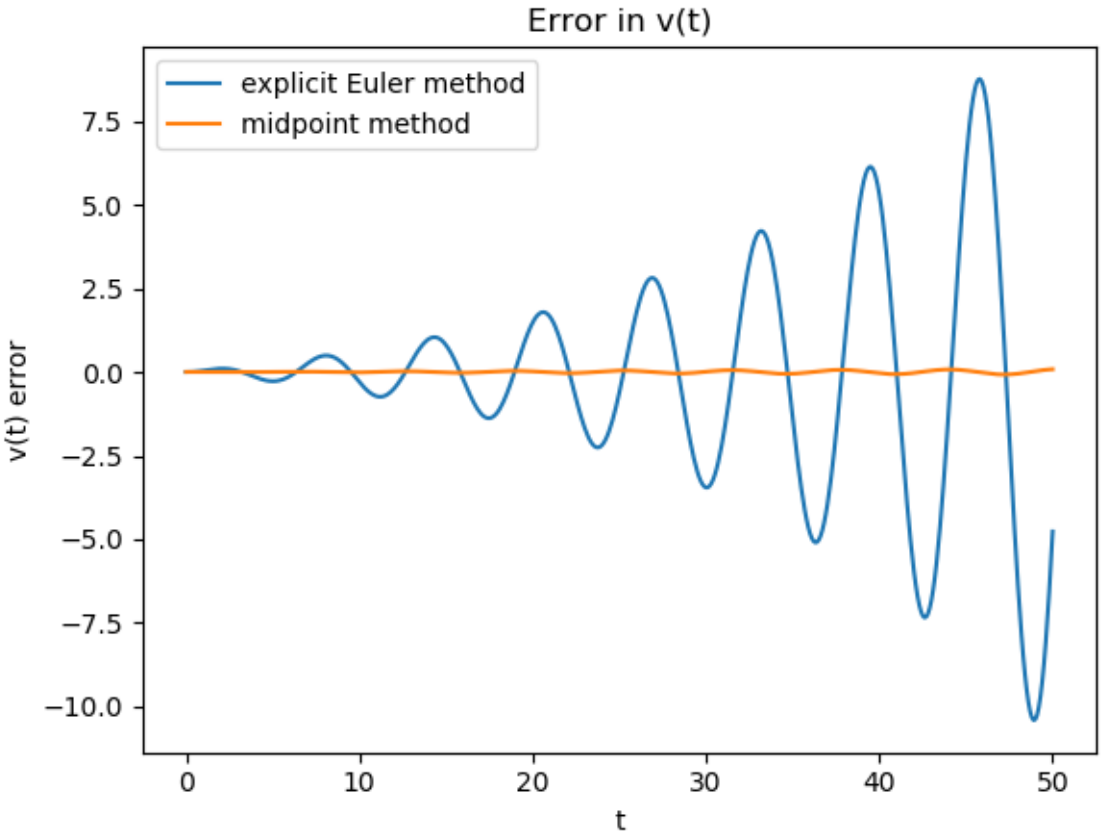
Ph 22 Computational Physics **Winter 2020**

Homework 1
Philip Carr

1.

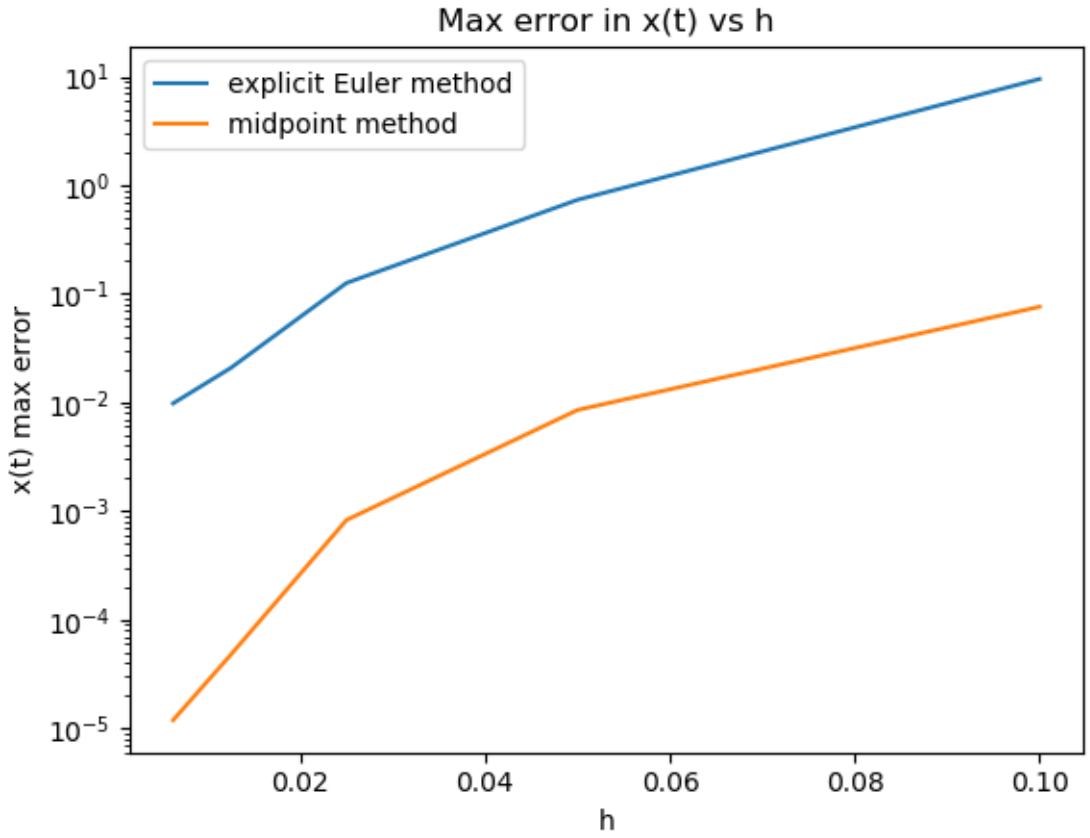
2. Harmonic-oscillator global error plots:

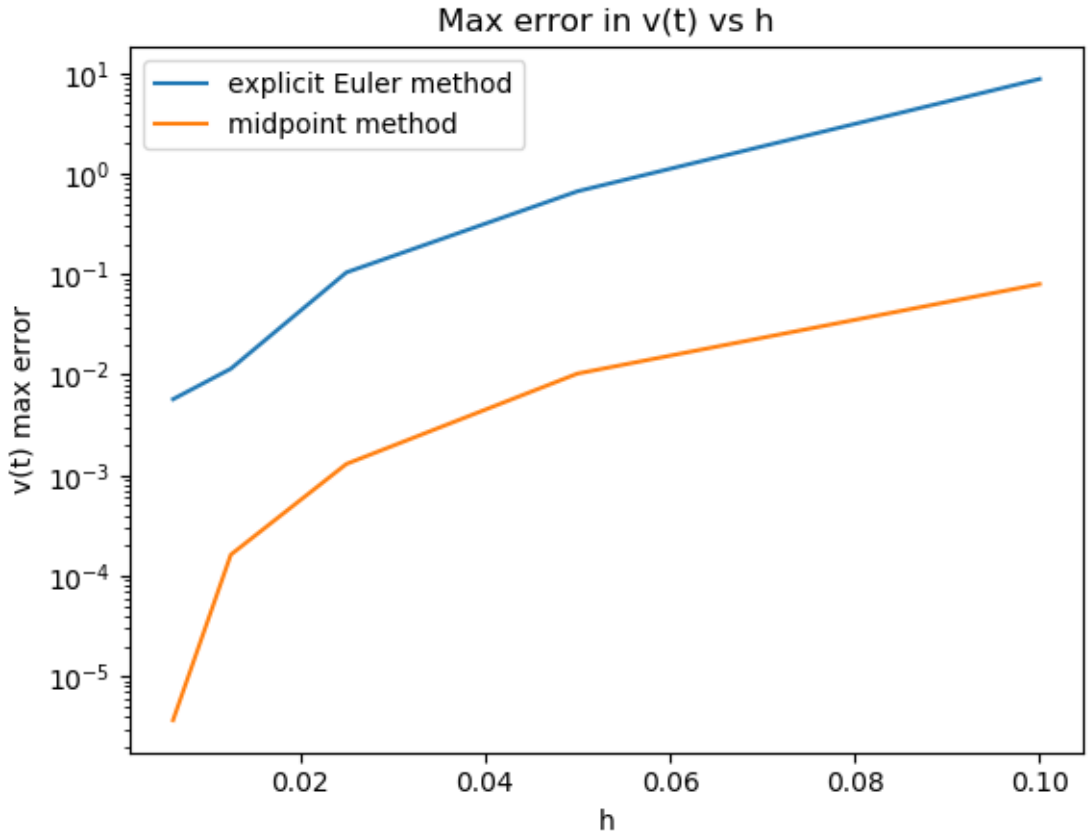




As seen in the above two plots, the midpoint method produces much less global error in both position and velocity compared to the explicit Euler method.

3. Scaling of the global error for explicit Euler vs. midpoint method:

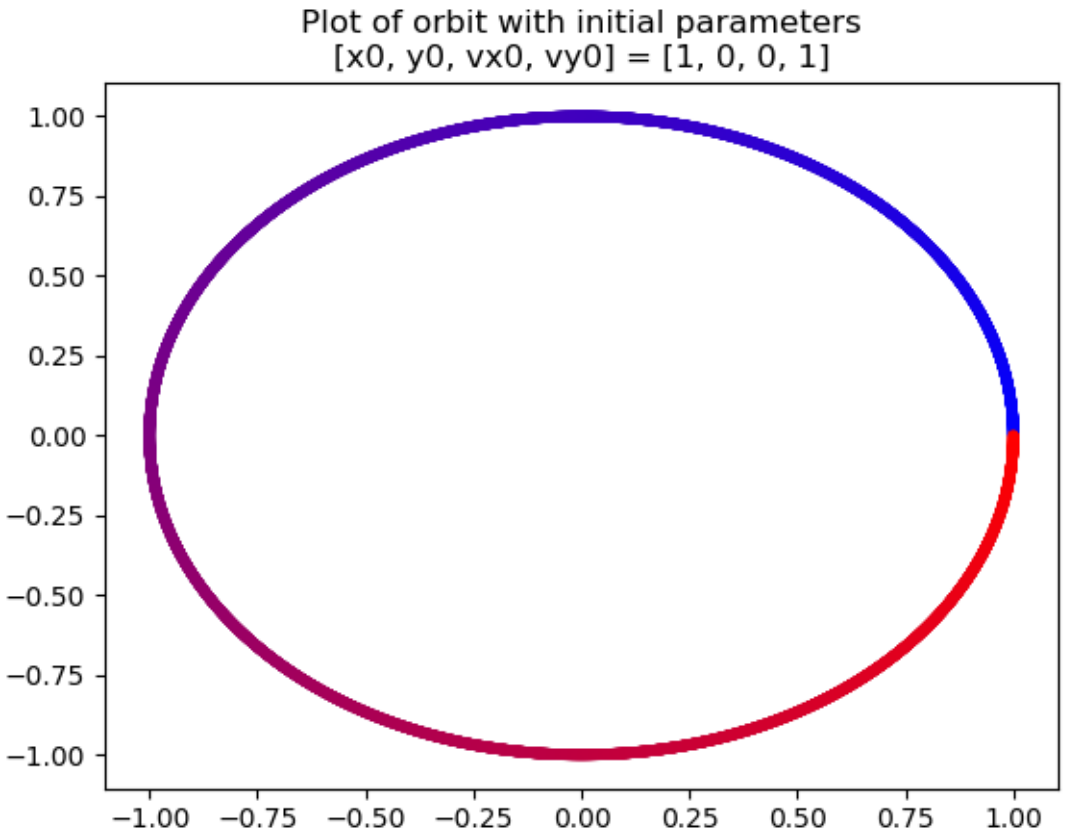

Max error in x(t) vs h
explicit Euler method
midpoint method
x(t) max error
h
10^{1}
10^{0}
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-5}
0.02
0.04
0.06
0.08
0.10



As seen in the above two plots, the midpoint method produces max error with about 2 fewer orders of magnitude in both position and velocity compared to the explicit Euler method.

4. (See code.)

5. (Plot color changes from blue to red as orbit advances in time.)


Plot of orbit with initial parameters
[x0, y0, vx0, vy0] = [1, 0, 0, 1]
1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
−1.00
−1.00
−0.75
−0.50
−0.25
0.00
0.25
0.50
0.75
1.00