**Part a)**

See attached least squares fit MATLAB codes.

Using the least squares fit on the spring force and the damping force, the coefficient were determined to be as follows:



Figure 1. Plot of spring force data and its corresponding least squares fit



Figure 2. Plot of damping force data and its corresponding least squares fit

**Part b)**

Equations (1) and (2) get converted into the following 4-equation system of 1st order ODEs:

🡪

🡪

Final 4-equation system of 1st order ODEs:

**Part c)**

See attached 4th order Runge-Kutta and simulation MATLAB codes.

**Simulation**

**Part a)**

See attached 4th order Runge-Kutta and simulation MATLAB codes.

Characteristic time scale and timestep, h, used:

V = 10 km/hr: T = 1.8720 seconds and h = T/100 = 0.0187 seconds

V = 40 km/hr: T = 0.4680 seconds and h = T/50 = 0.0094 seconds

**Part b)**



Figure 3. Plot displacements and velocities of sprung and unsprung masses versus time for V = 10 km/hr



Figure 4. Plot displacements and velocities of sprung and unsprung masses versus time for V = 40 km/hr

**Part c)**

See attached forward Euler and simulation MATLAB codes.