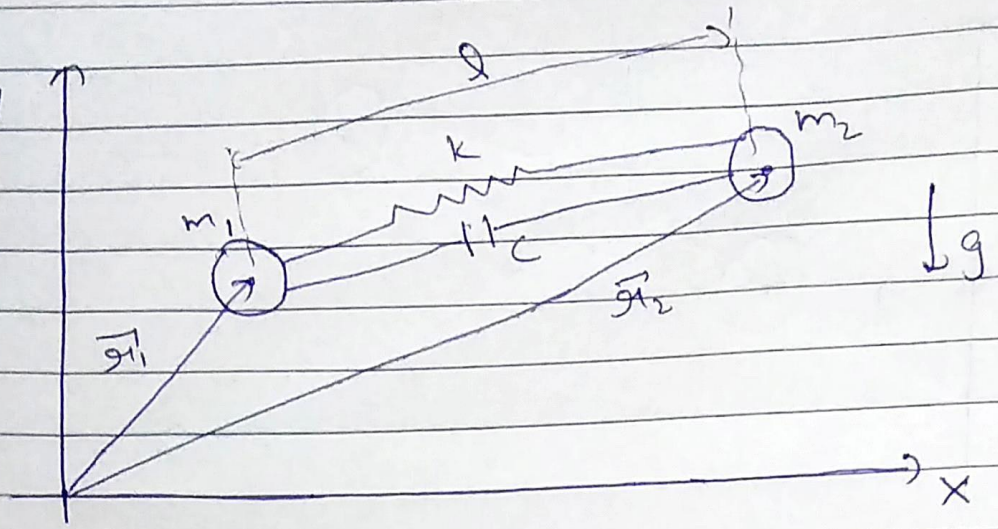
Date.....

ME 3030
Assignment - 1

Q



Spring force

$$\vec{F}_s = k\left(|\bar{r}_2 - \bar{r}_1| - l\right)\left(\frac{\bar{r}_2 - \bar{r}_1}{|\bar{r}_2 - \bar{r}_1|}\right)$$

Damping force $\quad \bar{f}_d = c(\dot{\bar{r}}_2 - \dot{\bar{r}}_1)$

Gravity force $\quad \vec{f}_g = -m\vec{g}$

$$\bar{r}_1 = \begin{Bmatrix} x_1(t) \\ y_1(t) \end{Bmatrix} \quad \bar{r}_2 = \begin{Bmatrix} x_2(t) \\ y_2(t) \end{Bmatrix} \quad \dot{\bar{r}}_1 = \begin{Bmatrix} \dot{x}_1(t) \\ \dot{y}_1(t) \end{Bmatrix}$$

$$\dot{\bar{r}}_2 = \begin{Bmatrix} \dot{x}_2(t) \\ \dot{y}_2(t) \end{Bmatrix}$$

Writing equations for m_1:

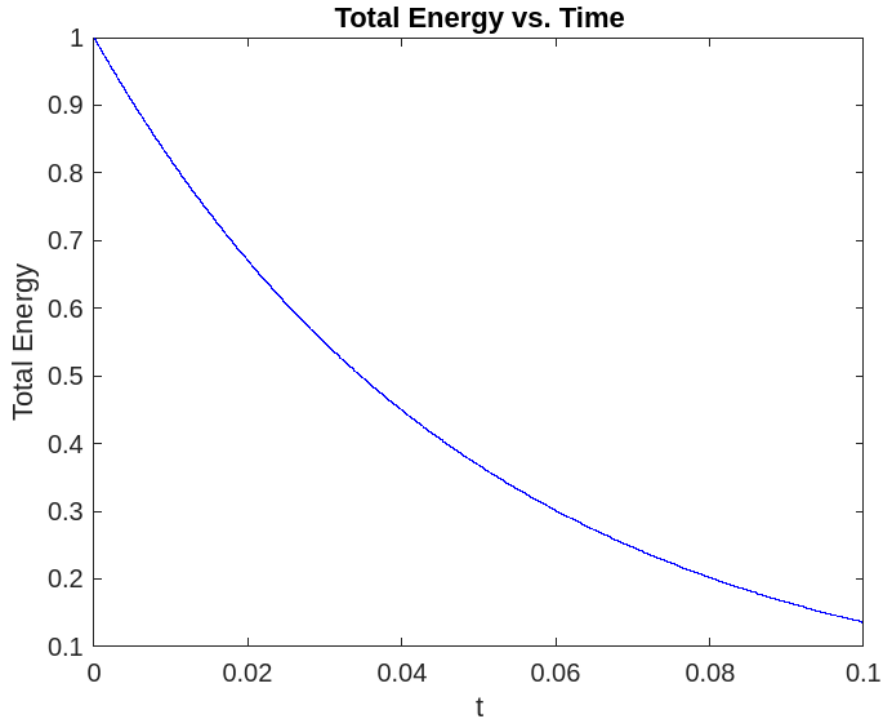
$$m_1 \begin{Bmatrix} \ddot{x}_1(t) \\ \ddot{y}_1(t) \end{Bmatrix} = k\frac{\left(|\bar{r}_2 - \bar{r}_1| - l\right)}{|\bar{r}_2 - \bar{r}_1|} \begin{Bmatrix} x_2 - x_1 \\ y_2 - y_1 \end{Bmatrix} + c \begin{Bmatrix} \dot{x}_2 - \dot{x}_1 \\ \dot{y}_2 - \dot{y}_1 \end{Bmatrix} - m_1 \begin{Bmatrix} 0 \\ g \end{Bmatrix}$$

Writing equations for m_2:

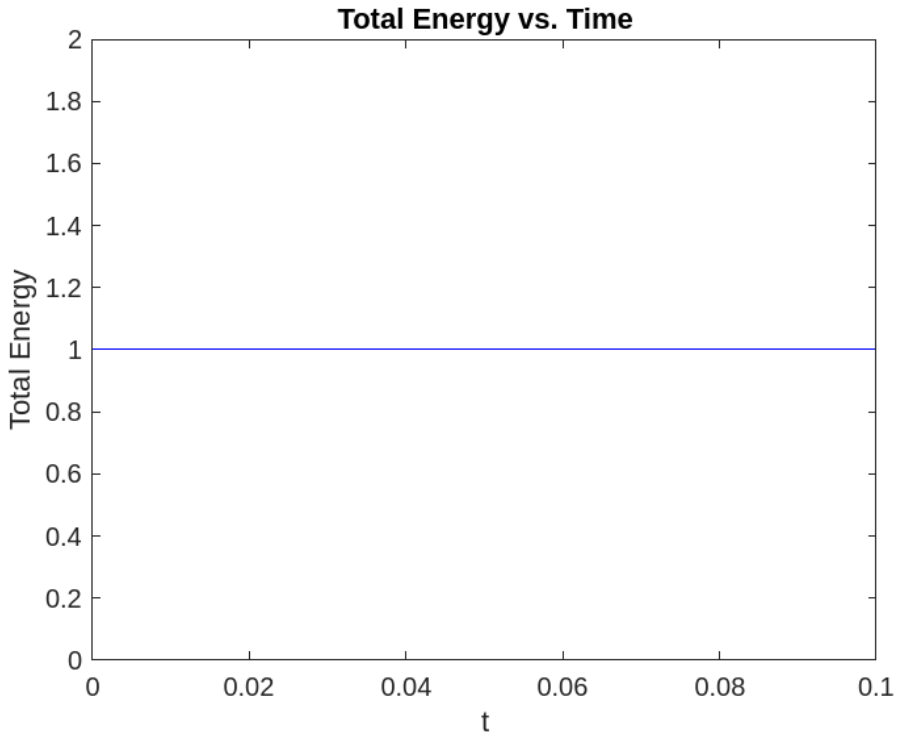
$$m_2 \begin{Bmatrix} \ddot{x}_2(t) \\ \ddot{y}_2(t) \end{Bmatrix} = k\left(\frac{|\bar{r}_2 - \bar{r}_1| - l}{|\bar{r}_2 - \bar{r}_1|}\right) \begin{Bmatrix} x_1 - x_2 \\ y_1 - y_2 \end{Bmatrix} - c \begin{Bmatrix} \dot{x}_2 - \dot{x}_1 \\ \dot{y}_2 - \dot{y}_1 \end{Bmatrix} - m_2 \begin{Bmatrix} 0 \\ g \end{Bmatrix}$$

Teacher's Sign .....

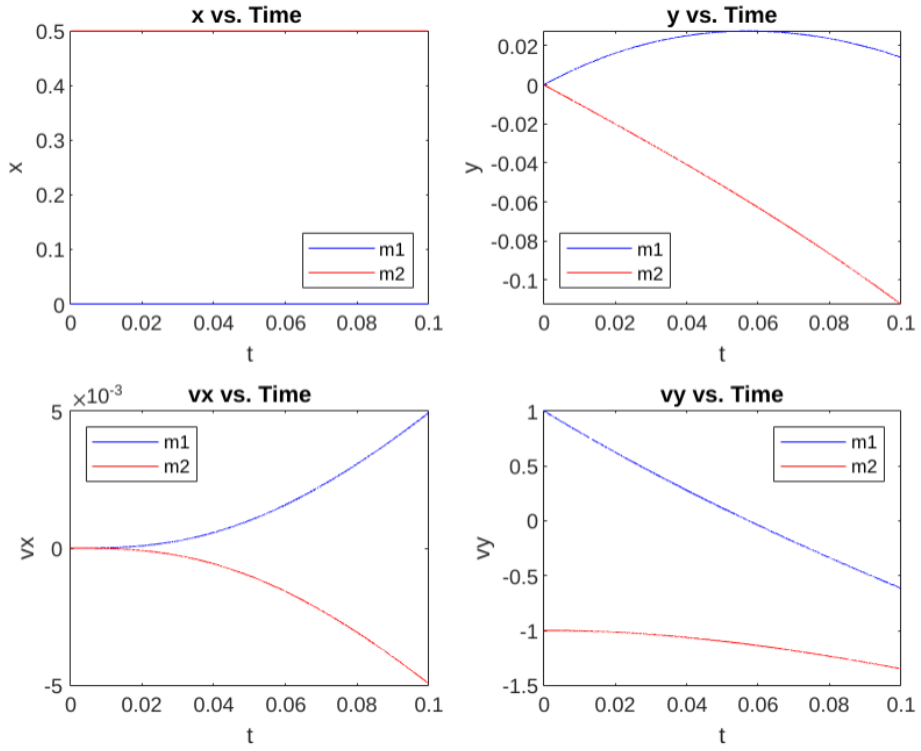
1. Plot of total energy vs time when damping is non zero:



2. Plot of total energy vs time when damping is zero:



3. Plot of x, y, vx and vy when damping is non zero



4. Plot of x, y, vx and vy when damping is zero