5(a) For three body problem.

$$\ddot{R}_1 = -GM\left(\frac{r_1-r_2}{|r_1-r_2|^3} - \frac{r_1-r_3}{|r_1-r_3|^3}\right)$$

$$\ddot{R}_2 = -GM\left(\frac{r_2-r_3}{|r_2-r_3|^3} - \frac{r_2-r_1}{|r_2-r_1|^3}\right)$$

$$\ddot{R}_3 = -GM\left(\frac{r_3-r_1}{|r_3-r_1|^3} - \frac{r_3-r_2}{|r_3-r_2|^3}\right)$$

If we apply $\frac{1}{GM}\frac{\partial^2 R}{\partial t^2} = \frac{\partial^2 r_i}{\partial t^2}$, Then we have

$$\ddot{r}_1 = -\frac{r_1-r_2}{|r_1-r_2|^3} - \frac{r_1-r_3}{|r_1-r_3|^3} \qquad \ddot{r}_2 = -\frac{r_2-r_1}{|r_1-r_2|^3} - \frac{r_2-r_3}{|r_2-r_3|^3}$$

$$\ddot{r}_3 = -\frac{r_3-r_1}{|r_1-r_3|^3} - \frac{r_3-r_2}{|r_2-r_3|^3}$$

Velocity of 1km/s :

$$\frac{1}{GM}\cdot R = r.$$

$$v = \frac{R}{t} = 1\ \text{Km/s}$$

$$\frac{r\cdot GM}{t} = 10^3\ \text{m/s} \implies \frac{r}{t} = v = 10^3/GM$$

5(b).

$$\ddot{r}_1 = -\frac{r_1-r_2}{|r_1-r_2|^3} - \frac{r_1-r_3}{|r_1-r_3|^3}$$

We have $r_1 = (0, 0)$ $r_2 = -r_3$

$$\ddot{r}_1 = -\frac{(-r_2)}{|-r_2|^3} - \frac{(-r_3)}{|-r_3|^3}$$

$$= \frac{r_2}{|r_2|^3} + \frac{r_3}{|r_3|^3}, \text{ since } r_2 = -r_3$$

$$\frac{r_2}{|r_2|^3} + \frac{r_3}{|r_3|^3} = 0 \implies \ddot{r}_1 = 0.$$

thus, it ~~is~~ remain origin ~~f~~or all time.