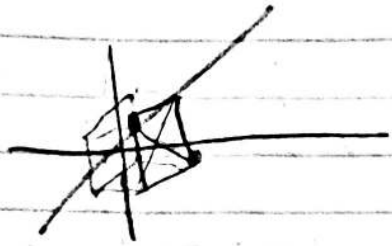

HW #10

(1)

A) U^{ext} from gravity $= m_1 g z_1 + m_2 g z_2 + m_3 g z_3$

$$U^{int} = \frac{kq_1q_2}{r_{12}} + \frac{kq_1q_3}{r_{13}} + \frac{kq_2q_3}{r_{23}}$$

$$r_{12} = |\vec{r}_1 - \vec{r}_2| = \sqrt{(x_1-x_2)^2+(y_1-y_2)^2+(z_1-z_2)^2}$$

$$U^{tot} = U^{ext} + U^{int}$$

$$\boxed{U^{tot} = m_1 g z_1 + m_2 g z_2 + m_3 g z_3 + \frac{kq_1q_2}{r_{12}} + \frac{kq_1q_3}{r_{13}} + \frac{kq_2q_3}{r_{23}}}$$

B) $\vec{r}_1 = \langle a/2, 0, 0\rangle$ $\vec{r}_2 = \langle 0, \sqrt{3}\,a/2, 0\rangle$

$\vec{r}_3 = \langle -a/2, 0, 0\rangle$

$$\vec{F}_2^{tot} = -\nabla U^{tot} = \left\langle -\frac{\partial U^{tot}}{\partial x_2}, -\frac{\partial U^{tot}}{\partial y_2}, -\frac{\partial U^{tot}}{\partial z_2}\right\rangle$$

$$\vec{F}_2^{tot} = \left\langle \frac{-kq_1q_2(x_1-x_2)}{((x_1-x_2)^2+(y_1-y_2)^2+(z_1-z_2)^2)^{3/2}} + \frac{kq_2q_3(x_2-x_3)}{((x_2-x_3)^2+(y_2-y_3)^2+(z_2-z_3)^2)^{3/2}}, \ldots, \ldots \right\rangle$$

$$\left((x_1-x_2)^2+(y_1-y_2)^2+(z_1-z_2)^2\right)^{3/2}=a^3$$

B) continued... place in values for the vector components.

$$\vec{F}_2^{\,tot}=\left\langle \frac{-kq_1q_2\frac{a}{2}}{a^3}+\frac{kq_2q_3\frac{a}{2}}{a^3},\ +\frac{kq_1q_2\frac{\sqrt{3}}{2}a}{a^3}-\frac{kq_2q_3\frac{\sqrt{3}}{2}a}{a^3},\ -gm_2\right\rangle$$

c) The triangle is in the x-y plane, thus the force will be directed in this plane.

Of course, this force direction relies on the charges of q_1, q_2 and q_3 to determine the value of the x and y components. But we can confidently say that the force will have no component in the z direction since only gravity exerts in that direction for this problem and we are ignoring it.