Quiz a

Problem 1

(a) Possible positions for charge 3 are are on the left side of the two charges.

$$\sum \vec{F} = 0$$

$$\frac{Q_0 Q_2}{(X_2 - X_0)^2} + \frac{Q_0 Q_1}{(X_1 - X_0)^2} = 0$$

$$\frac{\sqrt{Q_2}}{X_2 - X_0} = \frac{\pm\sqrt{Q_1}}{X_1 - X_0}$$

$$X_2 = \pm \frac{\sqrt{Q_2}}{\sqrt{Q_1}}(X_1 - X_0) + X_0$$

$X_0 = 0$

$$\Rightarrow X_2 = \pm \frac{\sqrt{Q_2}}{\sqrt{Q_1}} X_1.$$

Since $X_2 < 0$, $X_2 = -\frac{\sqrt{Q_2}}{\sqrt{Q_1}} X_1$

So $x_2 = -x_1$ when $Q_2 = Q_1$

$x_2 = -\sqrt{2}x_1$ when $Q_2 = 2Q_1$

(b)

Using the superposition principle

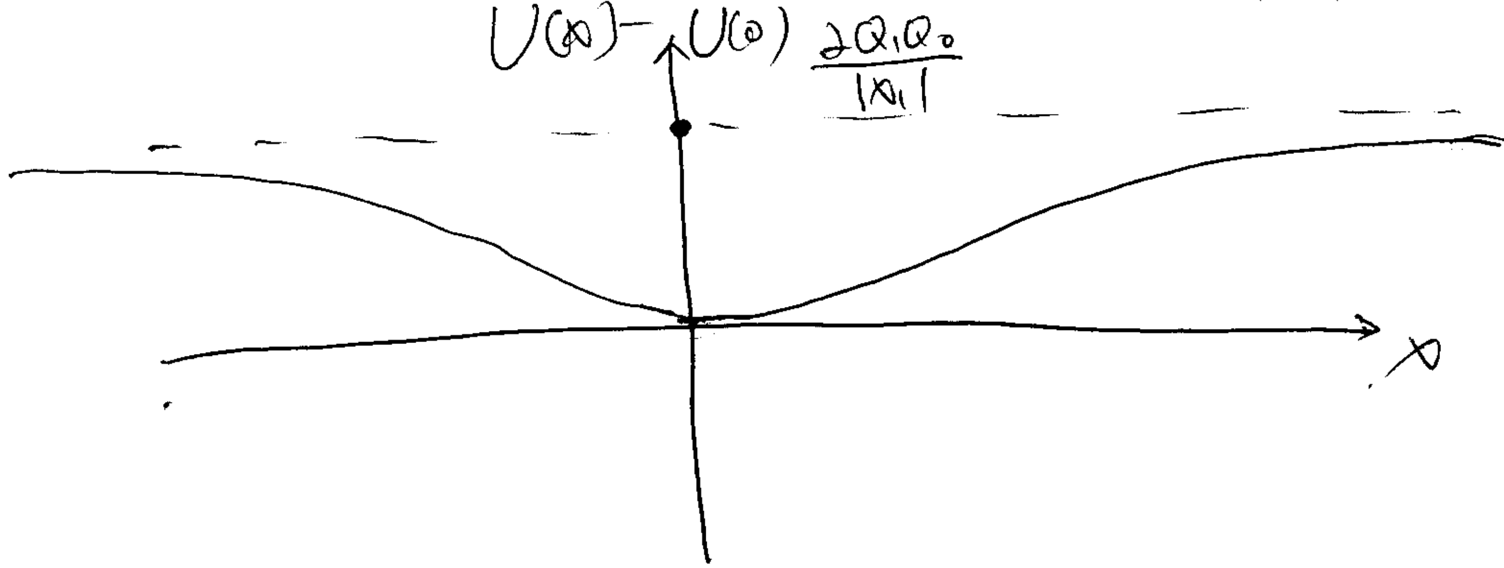
For $Q_2 = Q_1$

$$U(x) = \frac{Q_0 Q_2}{|x_2 - x|} + \frac{Q_0 Q_1}{|x_1 - x|}$$

$$= \frac{Q_0 Q_1}{|x_1 + x|} + \frac{Q_0 Q_1}{|x_1 - x|}$$

$$U(0) = \frac{2Q_1 Q_0}{|x_1|}$$

$$U(x) - U(0) = Q_0 Q_1 \left(\frac{1}{|x_1 + x|} + \frac{1}{|x_1 - x|} \right) - \frac{2Q_1 Q_0}{|x_1|}$$



(c)

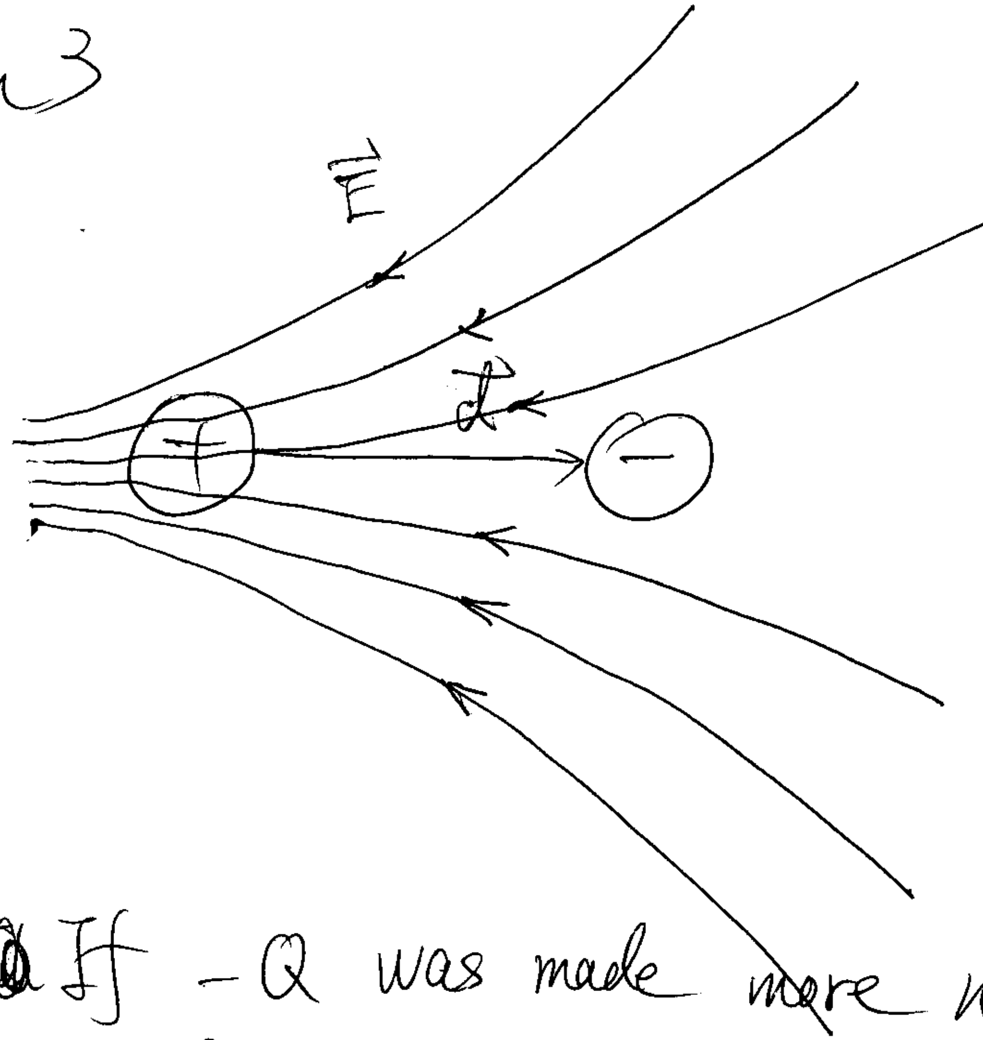
In this case, the total force will point to the right, so the Q_0 will move toward the positive x direction.

Problem 2.

If the object doesn't carry a third type of charge, only possitive or negative then if I mearsure the forces between it and a positive charge, and the force between it and a negative charge, the two forces will be in the different direction. Otherwise, if the forces are both repulsive or attractive, then there must be some~~thing~~ new ~~on the~~ charges

Problem 3

(a)



(b) If −Q was made more negative, the net force may be inversed. Then, if you rotate it again, it will move away from the original orientation.

Problem 4

(a) According to Gaussian theorem,

$E(r)=0$ for $r<r_0$

when $r>r_0$

$$E\cdot 2\pi r L = 2\pi r_0 L \sigma/\varepsilon_0$$

$$E(r) = \frac{\sigma}{\varepsilon_0}\frac{r_0}{r}$$

(b) ~~$V(r) = -\int_{\infty}^{r} \vec{E}\cdot d\vec{r}$~~ ~~$V(r)-V(0) = -\int_0^r \vec{E}\cdot d\vec{r}$~~

~~$= -\int_{\infty}^{r_0} \vec{E}\cdot d\vec{r}$~~ ~~$= -\int_{r_0}^{r} \frac{\sigma}{\varepsilon_0}\frac{r_0}{r} dr$~~

~~$= \frac{\sigma}{\varepsilon_0}\frac{r_0}{r} dr$~~ ~~$= -\frac{\sigma}{\varepsilon_0} r_0 \ln\frac{r}{r_0}$~~

~~$(r>r_0)$~~

~~If $r<r_0$, $V(r)=V(0)$~~

$$V(r)-V(0) = -\int_0^r \vec{E}\cdot d\vec{r}$$

if $r>r_0$, $V(r)=V(0)-\frac{\sigma}{\varepsilon_0} r_0 \ln\frac{r}{r_0}$

if $r < r_0$, $V(r) = V(0)$

(c)