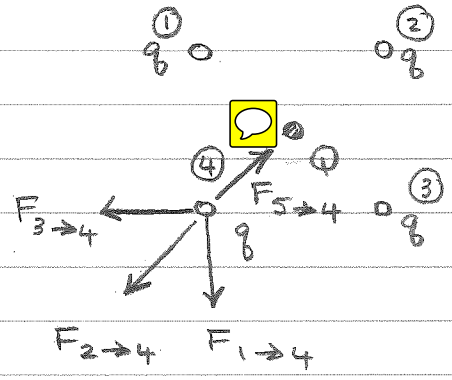
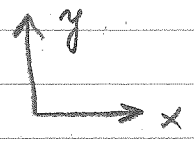
Physics 141/151 KROLL

PROBLEM 3



WE NEED

$$\vec{0} = \vec{F}_{1\to4} + \vec{F}_{2\to4} + \vec{F}_{3\to4} + \vec{F}_{5\to4}$$



USE THIS COOR. SYSTEM

TAKE DISTANCE ① TO ④ = a

SO " ② TO ④ = $\sqrt{2}a$

" " ⑤ TO ④ = $a/\sqrt{2}$

BOTH x AND y COMPONENTS OF FORCE MUST BALANCE

$$F_{x,1\to4} = 0 \; ; \; F_{x,2\to4} = \frac{-kq^2}{2a^2}\frac{1}{\sqrt{2}}$$

DIRECTION FOR POSITIVE Q

$$F_{x,3\to4} = -\frac{kq^2}{a^2} \; ; \; F_{x,5\to4} = -\frac{kqQ}{a^2/2}\frac{1}{\sqrt{2}}$$

$$-\frac{kq^2}{2\sqrt{2}a^2} - \frac{kq^2}{a^2} - \frac{kqQ}{a^2}\sqrt{2} = 0$$

a DOES NOT MATTER

$$-q/2\sqrt{2} - q - \sqrt{2}Q = 0$$

$$\boxed{Q = -q\,\frac{(1+2\sqrt{2})}{4}}$$

M.B., BALANCING x-COMP WAS SUFFICIENT

YOU CAN CHECK THE THE y COMP. GIVE THE SAME RESULT

UNSTABLE EQUILIBRIUM