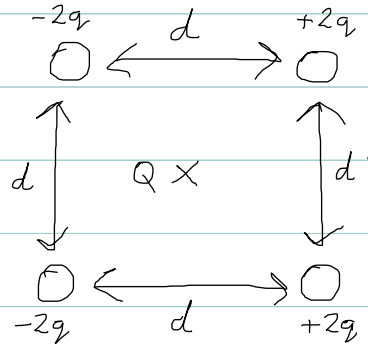

A POINT CHARGE OF $Q=-123.456789\,nC$ IS PLACED AT THE EXACT CENTER OF A SQUARE OF 4 CHARGES, AS SHOWN IN THE DIAGRAM. IF $q=1C$ AND $d=1m$, (1) WHAT IS THE MAGNITUDE AND DIRECTION OF THE RESULTING ELECTRIC FIELD? (2) WHAT IS THE MAGNITUDE AND DIRECTION OF THE RESULTING FORCE? (3) BONUS AFTER WEEK 3! WHAT ARE THE DIRECTIONS OF INCREASING POTENTIAL AND INCREASING POTENTIAL ENERGY?

---

(1) NOTE THAT, FOR ESSENTIALLY ALL ELECTROSTATICS PROBLEMS, ITS EASIEST TO DERIVE THE FIELD AS THE FIRST STEP. (a) PICTURE THE DIRECTION OF THE NET FIELD (OR FORCE). IS THE NET FIELD GOING TO BE ZERO IN ANY DIRECTION, SO THAT YOU CAN SIMPLIFY YOUR CALCULATION? (b) FIRST DETERMINE THE MAGNITUDE OF THE E-FIELD FOR ONE OF THE CHARGES (c) NOW FIND AN EXPRESSION FOR THE MAGNITUDE OF THE E-FIELD IN THE x ($\hat{i}$) AND y ($\hat{j}$) DIRECTIONS (d) NOW REPEAT THIS CALCULATION FOR THE OTHER THREE CHARGES (e) SUPERPOSE YOUR 4 ELECTRIC FIELDS TO GET THE NET FIELD IN THE x ($\hat{i}$) AND y ($\hat{j}$) DIRECTIONS (f) EXPRESS YOUR RESULT AS $\hat{i}$ AND $\hat{j}$ COMPONENTS, OR $|F|^2=|F_x|^2+|F_y|^2$ AND AN ANGLE θ (THE $|F|,\theta$ FORMAT WASN'T REQUESTED HERE, BUT COULD BE IN OTHER QUESTIONS).

---

(2) (a) RELATE THE FORCE ON Q TO THE ELECTRIC FIELD (b) DO THE FORCE AND THE FIELD POINT IN THE SAME DIRECTION FOR THIS CHARGE?

---

(3) (a) DOES THE E-FIELD POINT FROM LOW-TO-HIGH POTENTIAL, OR VICE VERSA? (b) DOES THE FORCE POINT FROM LOW-TO-HIGH POTENTIAL ENERGY, OR VICE VERSA?