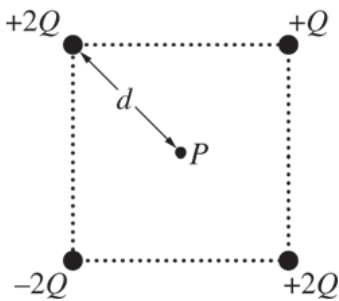
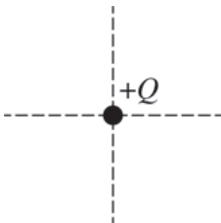




4. (10 points, suggested time 20 minutes)

The figure above represents four objects, with charges as shown, that are held in place at the corners of a square. Point P is at the center of the square, a distance d from each of the objects. Express all algebraic answers to the following in terms of Q , d , and physical constants.

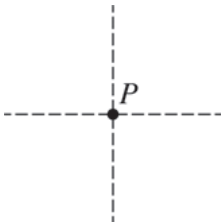
- (a) On the dot below, draw an arrow that represents the direction of the net electric force exerted on the object with charge $+Q$ by the other three objects.



- (b) i. Calculate the magnitude of the electric field at point P due to all four objects. On the dot below, draw an arrow to indicate the direction of the net field at point P .

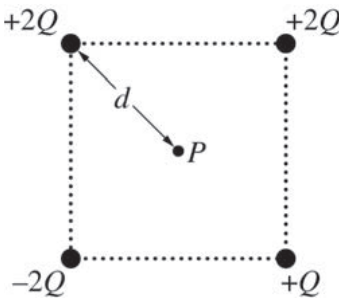
Draw Arrow

Calculate Electric Field



- ii. Calculate the electric potential at point P due to all four objects.

- (c) In a coherent, paragraph-length response, briefly describe the meaning of electric potential energy and explain qualitatively how electric potential energy can be related to work. Also explain qualitatively how the electric potential energy of the four-object system would change if the $+Q$ and $+2Q$ objects on the right side of the square now switch positions as shown in the figure below. Support your explanation using appropriate physics principles.



STOP

END OF EXAM