4C QUIZZ # 1

This Quiz is closed book.
The electron's mass \( m = 9.11 \times 10^{-31} \) Kg and its charge \(|e| = 1.6 \times 10^{-19}\)
C. \( 1/(4\pi\varepsilon_0) = 9 \times 10^9 \) N m\(^2\)/C\(^2\).

PROBLEM 1.
Two point charges have a total charge of 90.0 \( \mu \) C and are placed 1.16 m apart. The force each exerts on the other is 12.0 N and is repulsive.

a. Is the force from one on the other and vice-versa the same or different? Explain.
b. What is the charge on each?
c. Now that you know the charges does your answer in a) change? Explain.
d. What changes if the force were attractive?

PROBLEM 2.
Four charges are located at the corners of a square with side \( d \) as shown in the figure. Note the signs of the charges. A charge \( +Q \) is placed at the center of the square as shown.

![Diagram of a square with charges at the corners and a central charge](image-url)
a. Calculate the total force on the charge in the center. Provide magnitude and direction.

b. Calculate the electric field at the center. Provide magnitude and direction.

c. The positive charge $+Q$ is changed to a negative charge of the same magnitude. Calculate the total force on the charge at the center. Provide magnitude and direction.

d. Calculate the electric field at the center. Provide magnitude and direction.

PROBLEM 3.

The change in potential energy of a dipole in an electric field $\vec{E}$ is given by $U = \vec{p} \cdot \vec{E}$ with $\vec{p}$ the dipole moment. Initially the dipole moment is anti-parallel to the electric field. Remember how $\vec{p}$ is defined. The dipole rotates from its initial direction to a position perpendicular to the electric field.

a. What is the change in potential energy of the dipole?

b. If an observer moves the dipole with her hand from the initial position to the perpendicular position, how much work does she have to do?

PROBLEM 4.

An electron with velocity $v = 27.5 \times 10^6$ m/s is traveling parallel (as opposed to anti-parallel) to a uniform electric field of magnitude $E = 11.4 \times 10^3$ N/C.

a. Will the electron be accelerated or decelerated? Why?

b. What kind of motion will the electron experience?

c. How far will the electron travel before it stops?

d. How much time will elapse before the electron returns to its starting point?

PROBLEM 5 Extra Credit.

A charge $-q$ is placed at the center of a cube. If the total flux from the charge is $\Phi$ what would the flux be through one of the cube's surfaces? Why?