Please BOX your answers.

\[ k = \frac{1}{4\pi \epsilon_0} = 9 \times 10^9 \text{ N m}^2/\text{C}^2 \quad \epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2/\text{N m}^2 \]

1. Three charges are located as shown in the diagram. \( q_1 \) is at the origin and \( q_2 \) and \( q_3 \) are in the \( xy \) plane, \( r = 2 \text{ m} \) from the origin, \( 30^\circ \) above and below the \( x \) axis, respectively. The charges are \( q_1 = +8 \times 10^{-6} \text{ C} \), \( q_2 = -3 \times 10^{-6} \text{ C} \), and \( q_3 = +3 \times 10^{-6} \text{ C} \). What are the magnitude and direction of the electric force on \( q_1 \) due to \( q_2 \) and \( q_3 \)? (4 points)

Rewrite and sign the Honor Pledge: *I pledge my honor that I have not violated the Honor Code during this examination.*

(OVER)
2. A cube is located as shown in the diagram. One vertex is at the origin and three edges lie along the coordinate axes. The length of the cube edge is $a = 0.4\text{ m}$. The faces of the cube are numbered: 1–top, 2–bottom, 3–left, 4–right, 5–front, 6–back. There is a uniform electric field $E_0 = 5\text{ N/C}$ in the $x$ direction throughout the region occupied by the cube.

(a) What is the electric flux through each face of the cube? Be sure to pay attention to the signs! (3 points)

(b) What is the total flux through the cube? (You should be able to get this even if you couldn’t do part (a).) (1 point)

(c) A charge $q = 3 \times 10^{-8}\text{ C}$ is placed at the center of the cube. Now what is the total flux throughout the cube? (2 points)