Solution
FIRST MIDTERM

REPORT ALL NUMBERS TO THREE SIGNIFICANT FIGURES!
Use the conversion constants and data given on the front page.

(a) Calculate the magnitude of the electric field 4.00 \times 10^{-12} \text{ m} away from a proton, which has a positive charge identical in magnitude to the electron.

\[
E = \frac{\mathcal{F} \cdot Q}{r^2} = \frac{(9.00) \times 10^9 \text{ N m}^2/\text{C}^2 \times (1.60 \times 10^{-19} \text{ C})}{(4.82 \times 10^{-12} \text{ m})^2} = 9.00 \times 10^{14} \text{ N/C}.
\]

(b) Calculate the term in \( x^2 \) for the binomial expansion of \((1 - x^{3/2})^6\).

\[
1 + \left(\frac{-3}{2}\right)x^2 + \left(\frac{-3}{2}\right)\left(\frac{-11}{2}\right)\frac{1}{2}x^4 + \left(\frac{-3}{2}\right)\left(\frac{-11}{2}\right)\left(\frac{13}{2}\right)\frac{1}{24}x^6.
\]

\[
\frac{429}{16}x^6.
\]

(c) Calculate the electric force between two protons a distance 2.00 \times 10^{-13} \text{ meters} apart.

\[
F = \frac{\mathcal{F} \cdot Q^2}{r^2} = \frac{(9.00) \times 10^9 \text{ N m}^2/\text{C}^2 \times (1.60 \times 10^{-19} \text{ C})^2}{(2.00 \times 10^{-13} \text{ m})^2} = 2.30 \times 10^6 \text{ N}.
\]

(d) An electron is accelerated from rest in a uniform electric field of 175 \text{ N/C}. Calculate its speed after it travels 1.50 \text{ m} parallel to this field.

\[
U = \frac{\frac{1}{2}m(175 \text{ N/C})(1.60 \times 10^{-19} \text{ C})}{9.11 \times 10^{-31} \text{ kg}} = 9.60 \times 10^6 \text{ m}.
\]

(e) A cube of non-conductor is uniformly charged with 9.30 \times 10^{-3} \text{ C}. Calculate the electric flux through one face of the cube.

\[
\mathcal{F} = \frac{9.30 \times 10^{-3} \text{ C}}{8.85 \times 10^{-12} \text{ m}^2} \times \frac{1}{6} = 1.75 \times 10^7 \text{ C m}^2/\text{N}.
\]

\[
1.9 \times 10^6 \text{ C m}^2/\text{N}.
\]

\[
\text{Equation} + 3
\]

\[
\text{Results} + 2
\]