

Solution

FIRST MIDTERM

1

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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 4.00×10^{-12} m away from a proton, which has a positive charge identical in magnitude to the electron.

Soln.

$$E = \frac{kQ}{r^2} = \frac{(9.00) \times 10^9 \text{ Nm}^2/\text{C}^2 (1.60 \times 10^{-19} \text{ C})}{(4.00 \times 10^{-12} \text{ m})^2} = 9.00 \times 10^{14} \text{ N/C}$$

$$= 9.00 \times 10^{14} \text{ N/C}$$

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

$$1 + \left(-\frac{1}{2}\right)x^2 + \frac{\left(-\frac{1}{2}\right)\left(-\frac{11}{2}\right)}{2!}x^4 + \frac{\left(-\frac{1}{2}\right)\left(-\frac{11}{2}\right)\left(-\frac{13}{2}\right)}{3!}x^6$$

$$\frac{429}{16}x^6$$

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

$$F = \frac{kQ_1Q_2}{r^2} = \frac{(9.00) \times 10^9 \text{ Nm}^2/\text{C}^2 (1.60 \times 10^{-19} \text{ C})^2}{(2.00 \times 10^{-13} \text{ m})^2} = 5.76 \times 10^{-3} \text{ N}$$

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

$$v = \sqrt{2(1.50 \text{ m})(175 \text{ N/C})(1.60 \times 10^{-19} \text{ C}) / 9.11 \times 10^{-31} \text{ kg}} = 4.60 \times 10^6 \text{ m/s}$$

- (e) A cube of non-conductor is uniformly charged with 9.30×10^{-5} C. Calculate the electric flux through one face of the cube.

$$\Phi = \frac{q}{\epsilon_0} = \frac{(9.30 \times 10^{-5} \text{ C})}{8.85 \times 10^{-12} \text{ C}^2/\text{Nm}} \cdot \frac{1}{6} = 1.75 \times 10^6 \text{ Nm}^2/\text{C}$$

Units
 for Sig.

equation +3
 results +2

1.75×10^6