

Second Midterm

Name (print) Walker Name (signed) \_\_\_\_\_

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Discussion Section # \_\_\_\_\_

**REPORT ALL NUMBERS TO THREE SIGNIFICANT FIGURES!**

Use the conversion constants and data given on the front page.

- (a) A wire 27.0 m long carries a total charge of  $+3.00 \times 10^{-12}$  C. If the charge is uniformly distributed (not really true), calculate the electric field 2.00 cm from the center of the wire and at its midpoint. The radius of the wire is less than 2.00 cm.

$$\oint \vec{E} \cdot d\vec{A} = \frac{Q_{enc}}{\epsilon_0} \Rightarrow E 2\pi r L = \frac{\lambda L}{\epsilon_0} \Rightarrow E = \frac{\lambda}{2\pi \epsilon_0 r} = \frac{1.1 \text{ N/C} \cdot \text{m}}{2.00 \text{ cm}}$$

$E = 0.1/2 \text{ @ center}$

- (b) A proton ( $Q = +1.60 \times 10^{-19}$  C) is accelerated from rest through a potential difference of 75.0 volts. Calculate its velocity.

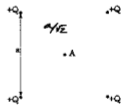
$$eV = \frac{1}{2} m v^2 \Rightarrow v = \sqrt{\frac{2eV}{m_e}} = \boxed{1.19 \times 10^5 \text{ m/s}}$$

- (c) An electric potential is described by  $V = Ax^3y^2z^2$ . Calculate the y component of the electric field at  $x = +2.00$  m,  $y = 3.00$  m and  $z = 1.50$  m. A is a constant.

$$E_y = -\frac{\partial V}{\partial y} = -A \times 3y^2z^2 = \boxed{-121.5 \text{ A V/m}} = -122 \text{ A V/m}$$

- (d) Calculate the electric potential at the center of the square (A) for the array of charges shown.

$$\sum_i V_i = \frac{kQ}{r} = \frac{4\sqrt{2}Qk}{\epsilon_0}$$



- (e) The electric field just above the surface of conducting sphere is  $E = +975$  N/C. Calculate the charge density on the surface of the sphere.

$$E = \frac{\sigma}{\epsilon_0} \Rightarrow \sigma = E \epsilon_0 = \boxed{8.63 \times 10^{-9} \text{ C/m}^2}$$