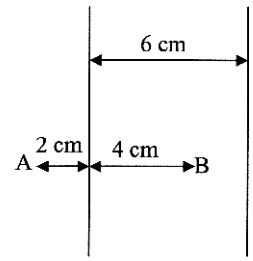
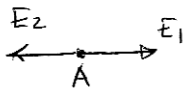
KING FAHD UNIVERSITY OF PERTOLEUM & MINERALS
PHYSICS DEPARTMENT
QUIZ #7- CHAPTER 23

NAME: Key ID# SECTION# 16

Consider two infinitely long parallel wires carrying charges $\lambda_1 = -2\ \mu C/m$ and $\lambda_2 = +6\ \mu C/m$ as shown in the figure. Calculate the magnitude and direction of the electric fields at points A and B.



At point A :

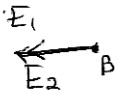


$$E_1 = \frac{2k\lambda_1}{r_1} = \frac{2\times 9\times10^{9}\times 2\times10^{-6}}{(0.02)} = 18\times10^{5}\ N/C \quad \text{to the right}$$

$$E_2 = \frac{2k\lambda_2}{r_2} = \frac{2\times 9\times10^{9}\times 6\times10^{-6}}{(0.08)} = 13.5\times10^{5}\ N/C \quad \text{to the left}$$

$$E_A = E_1 - E_2 = 4.5\times10^{5}\ N/C \quad \text{to the right}$$

At point B :



$$E_1 = \frac{2k\lambda_1}{r_1} = \frac{2\times 9\times10^{9}\times 2\times10^{-6}}{(0.04)} = 9\times10^{5}\ N/C \quad \text{to the left}$$

$$E_2 = \frac{2k\lambda_2}{r_2} = \frac{2\times 9\times10^{9}\times 6\times10^{-6}}{0.02} = 54\times10^{5}\ N/C \quad \text{to the left}$$

$$E_B = E_1 + E_2 = 63\times10^{5}\ N/C \quad \text{to the left}$$

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An insulating sphere with radius R = 0.20 m has charge distributed uniformly through its volume.

(a) What must be the total charge on the sphere if the electric field at 0.30 m from the center of sphere is 250 N/C?

$r = 0.3$ m is outside the sphere!

$$E = \frac{kq}{r^2} \Rightarrow q = \frac{Er^2}{k}$$

$$q = \frac{250 \times (0.3)^2}{9 \times 10^9} = 2.5 \times 10^{-9} C$$

$$= \boxed{2.5 \text{ nC}}$$

(b) What is the electric field at 0.10 m from the center of the sphere?

$r = 0.1$ m is inside the sphere!

$$E = \frac{kq}{R^3} r = \frac{9 \times 10^9 \times 2.5 \times 10^{-9} \times 0.1}{(0.2)^3}$$

$$\boxed{E = 281 \text{ N/C}}$$

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A positive point charge q = –10 nC sits at the center of a conducting spherical shell. The shell, with inner radius a = 10 cm and outer radius b = 15 cm has a net charge of 20 nC.

(a) What is the magnitude of the electric field at r = 5 cm?

$$E = \frac{kq}{r^2} = \frac{9\times10^{9}\times 10\times10^{-9}}{(0.05)^2} = \boxed{36\times10^{3}\ N/C}$$

(b) What is the magnitude of the electric field at r = 12 cm?

$E = 0$ (inside the conductor)

(c) What is the magnitude of the electric field at r = 20 cm?

$$E = \frac{kQ}{r^2} - \frac{kq}{r^2}$$

$$= \frac{k}{r^2}(Q-q)$$

$$= \frac{9\times10^{9}\times 10\times10^{-9}}{(0.2)^2}$$

$$\boxed{E = 2250\ N/C}$$