

P24.1 $\Phi_E = EA \cos \theta$, $\theta = 0^\circ$ for max flux

$$\Phi_E = EA \rightarrow E = \frac{\Phi_E}{A} = \frac{5.20 \times 10^5}{\pi (10.2)^2} = \boxed{4.14 \times 10^6 \text{ N/C}}$$

or

$$= \boxed{4.14 \text{ MN/C}}$$

P24.4 (a) $A' = (10.0 \text{ cm})(30.0 \text{ cm})$
 $A' = 300 \text{ cm}^2 = 0.0300 \text{ m}^2$
 $\Phi_{E, A'} = EA' \cos \theta$
 $\Phi_{E, A'} = (7.80 \times 10^4)(0.0300) \cos 180^\circ$
 $\Phi_{E, A'} = \boxed{-2.34 \text{ kN} \cdot \text{m}^2/\text{C}}$

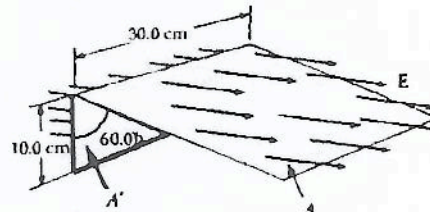


FIG. P24.4

(b) $\Phi_{E, A} = EA \cos \theta = (7.80 \times 10^4)(A) \cos 60.0^\circ$
 $A = (30.0 \text{ cm})(w) = (30.0 \text{ cm})\left(\frac{10.0 \text{ cm}}{\cos 60.0^\circ}\right) = 600 \text{ cm}^2 = 0.0600 \text{ m}^2$
 $\Phi_{E, A} = (7.80 \times 10^4)(0.0600) \cos 60.0^\circ = \boxed{+2.34 \text{ kN} \cdot \text{m}^2/\text{C}}$

(c) The bottom and the two triangular sides all lie parallel to E, so $\Phi_E = 0$ for each of these. Thus,
 $\Phi_{E, \text{total}} = -2.34 \text{ kN} \cdot \text{m}^2/\text{C} + 2.34 \text{ kN} \cdot \text{m}^2/\text{C} + 0 + 0 + 0 = \boxed{0}$.

P24.7 (a)

$$E = \frac{k_e Q}{r^2}$$

$$8.90 \times 10^2 = \frac{(8.99 \times 10^9) Q}{(0.750)^2}$$

But Q is negative since E points inward. $Q = -5.56 \times 10^{-8} \text{ C} = \boxed{-55.6 \text{ nC}}$

(b) The **negative** charge has a **spherically symmetric** charge distribution.

P24.9 $\Phi_E = \frac{q_{\text{in}}}{\epsilon_0}$

Through S_1 $\Phi_E = \frac{-2Q + Q}{\epsilon_0} = \boxed{-\frac{Q}{\epsilon_0}}$

Through S_2 $\Phi_E = \frac{+Q - Q}{\epsilon_0} = \boxed{0}$

Through S_3 $\Phi_E = \frac{-2Q + Q - Q}{\epsilon_0} = \boxed{-\frac{2Q}{\epsilon_0}}$

Through S_4 $\Phi_E = \boxed{0}$

P24.19

If $R \leq d$, the sphere encloses no charge and $\Phi_E = \frac{q_{in}}{\epsilon_0} = \boxed{0}$.

If $R > d$, the length of line falling within the sphere is $2\sqrt{R^2 - d^2}$

$$\text{so } \Phi_E = \frac{2\lambda\sqrt{R^2 - d^2}}{\epsilon_0}$$

P24.29

The charge distributed through the nucleus creates a field at the surface equal to that of a point charge at its center: $E = \frac{k_e q}{r^2}$

$$E = \frac{(8.99 \times 10^9 \text{ Nm}^2/\text{C}^2)(82 \times 1.60 \times 10^{-19} \text{ C})}{[(208)^{1/3} 1.20 \times 10^{-15} \text{ m}]^2}$$

$$E = \boxed{2.33 \times 10^{21} \text{ N/C}} \text{ away from the nucleus}$$

$$\text{P24.26 } \sigma = (8.60 \times 10^{-6} \text{ C/cm}^2) \left(\frac{100 \text{ cm}}{\text{m}} \right)^2 = 8.60 \times 10^{-2} \text{ C/m}^2$$

$$E = \frac{\sigma}{2\epsilon_0} = \frac{8.60 \times 10^{-2}}{2(8.85 \times 10^{-12})} = \boxed{4.86 \times 10^9 \text{ N/C}} \text{ away from the wall}$$

The field is essentially uniform as long as the distance from the center of the wall to the field point is much less than the dimensions of the wall.

P 24.29 a) $E = 0$ inside thin spherical shell

$$\text{b) } E = \frac{kQ}{r^2} = \frac{(9 \times 10^9)(32 \times 10^{-6})}{(0.2 \text{ m})^2} = \boxed{7.19 \times 10^6 \text{ N/C}}$$

or 7.19 MN/C
away from the center

P24.34

$$\text{(a) } E = \frac{2k_e \lambda}{r} = \frac{2(8.99 \times 10^9 \text{ N} \cdot \text{m}^2/\text{C}^2)[(2.00 \times 10^{-6} \text{ C})/7.00 \text{ m}]}{0.100 \text{ m}}$$

$$E = \boxed{51.4 \text{ kN/C, radially outward}}$$

$$\text{(b) } \Phi_E = EA \cos \theta = E(2\pi r l) \cos 0^\circ$$

$$\Phi_E = (51.4 \times 10^4 \text{ N/C}) 2\pi(0.100 \text{ m})(0.0200 \text{ m})(1.00) = \boxed{646 \text{ N} \cdot \text{m}^2/\text{C}}$$