Data:______ Horário:______ Turma:______ Turno:______ Grupo:______
Aluno N°: 54149 Nome: Américo Tomás
Aluno N°: ______ Nome: ______
Aluno N°: ______ Nome: ______

3. DIMENSIONAMENTO

Esta secção visa preparar os alunos para as experiências que irão realizar no laboratório. Todos os grupos terão de no início da sessão de laboratório entregar ao docente uma cópia desta secção.

A água destilada apresenta uma condutividade aproximadamente de $\sigma=1.9\times10^{-2}$(S/m) (20ºC). Estime qual a resistência entre dois eléctrodos paralelos com w=11(cm) de largura, separados por d=10(cm) e imergidos em água com h=1(cm) de altura.

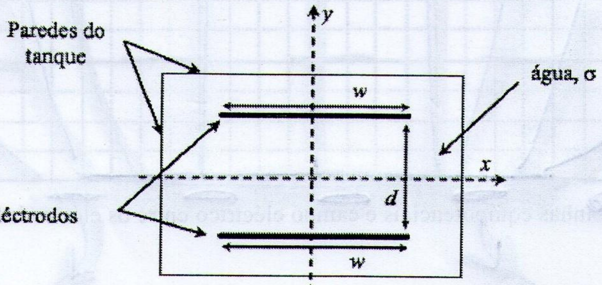


Figura 3 – Eléctrodos paralelepipédicos colocados no tanque.

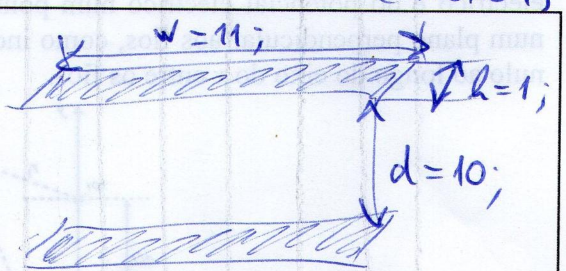
(ANEXO 1)

Valor estimado da resistência:

$\boxed{R = \rho \cdot \frac{l}{A}}$

$A_{\square} = l \times l = w \times h$;

$\rho = \frac{1}{\sigma}$;



$R = \left(\frac{1}{1.9\times10^{-2}}\right) \cdot \frac{(10)}{(11\times1)} = 47{,}847$; [Ω]

Uma diferença de potencial de 3(V) é aplicada entre os eléctrodos da configuração anterior. Considere que o eléctrodo inferior é ligado a terra, desenhe na figura seguinte, as linhas equipotenciais de 2.5(V), 2(V), 1.5(V), 1(V) e 0.5(V) entre os eléctrodos. Represente também na figura o campo eléctrico.

Legenda:

- - - - : Linhas equipotenciais (V);
⟶ : Linhas campo $\vec{E}$;
⊕ : positivo
⊖ : negativo

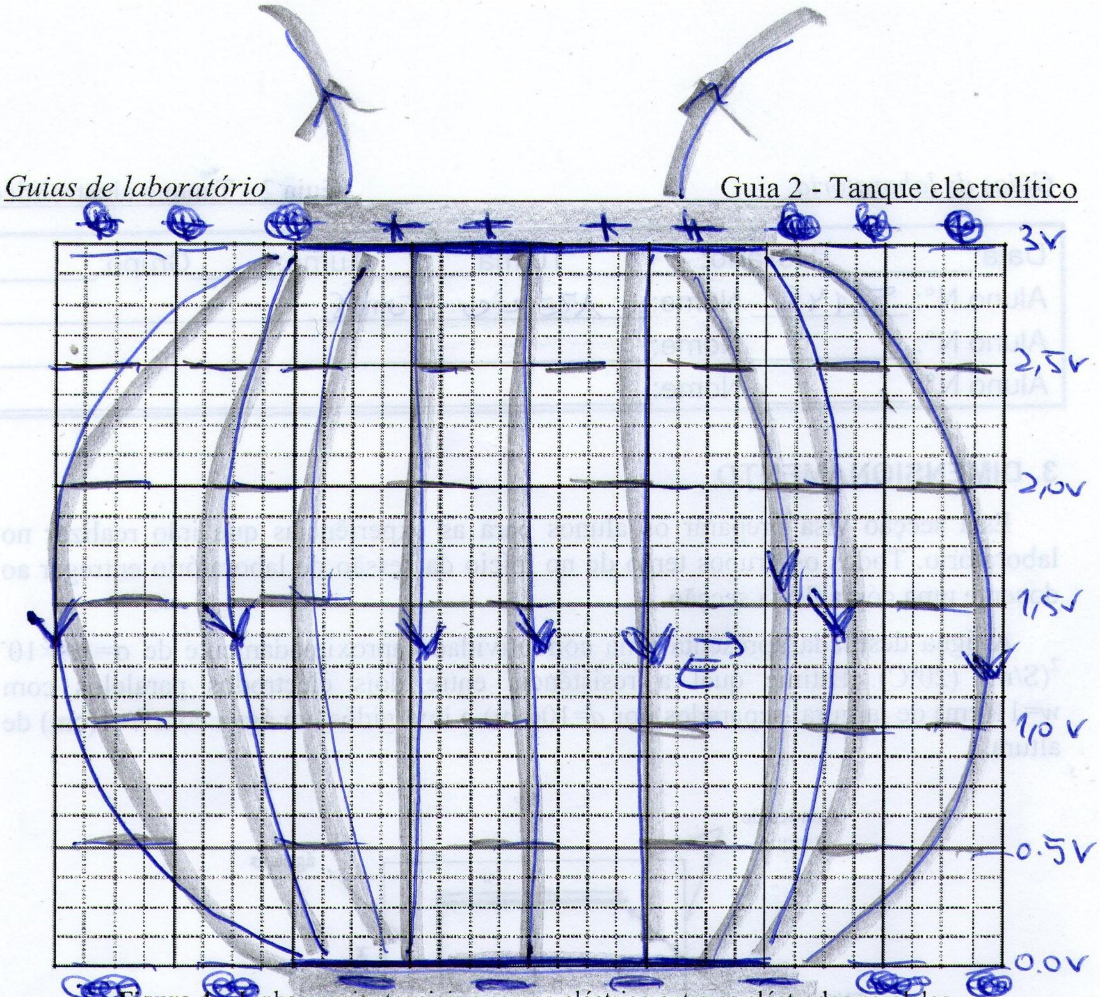


Figura 4 – Linhas equipotenciais e campo eléctrico entre os eléctrodos paralelos.

Considere dois fios filiformes no ar com comprimentos infinitos e densidades de carga por unidade de comprimento simétricas, ρ_l e $-\rho_l$. Os fios encontram-se paralelos e separados por uma distância *d*. Determine as expressões do campo eléctrico e do potencial eléctrico num ponto genérico *P* na posição (x_0, y_0) contido num plano perpendicular aos fios, como indicado na Figura 5. Considere o potencial nulo ao longo do eixo do *x* entre os fios.

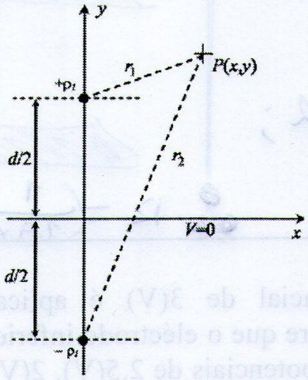
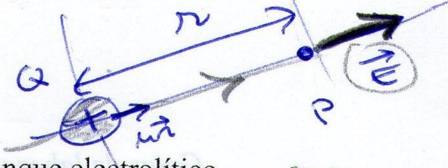


Figura 5 – Dois fios filiformes infinitos.

Campo eléctrico

$$\vec{E} = k_e \frac{Q}{r^2}\vec{u_r} \Rightarrow E = k_e \int \frac{dq}{r^2}\vec{u_r}$$

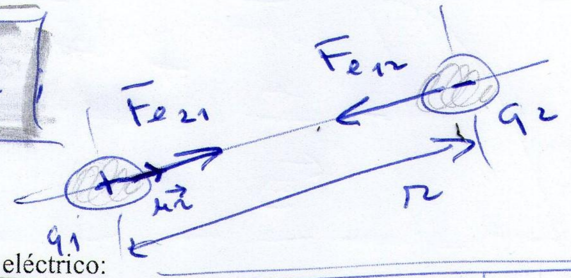


Força eléctrica

Dedução da expressão do campo eléctrico:

$$\boxed{\vec{F}_E = K_e \frac{|q_1 q_2|}{r^2}\vec{u_r}}$$

$[N/C]$; $k_e = \frac{1}{4\pi\varepsilon_0}$;



$$\boxed{E = k_e \frac{q}{r^2}}$$

$$\boxed{F_e = q \cdot E}$$

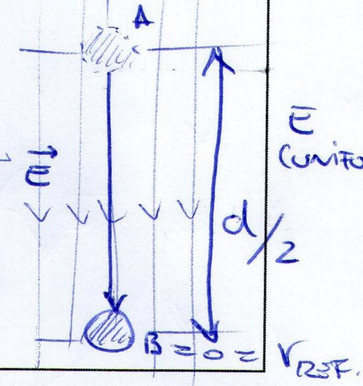
Potencial eléctrico

Dedução da expressão do potencial eléctrico:

$$\begin{cases} \Delta U = -q_0 \int_B^A E \cdot ds \\ V = \frac{U}{q_0} \end{cases} \Rightarrow \Delta V = \frac{\Delta U}{q_0}$$

$$\boxed{\Delta V = -\int_B^A E\,ds};$$

$$\boxed{V_A - V_B} = -E\int_{B=0}^{A} ds = \boxed{-E \cdot d/2}; \ [V]$$



Desenhe na figura seguinte, as linhas equipotenciais e o campo eléctrico num plano perpendicular aos dois fios filiformes infinitos e paralelos. Considere d=10(cm).

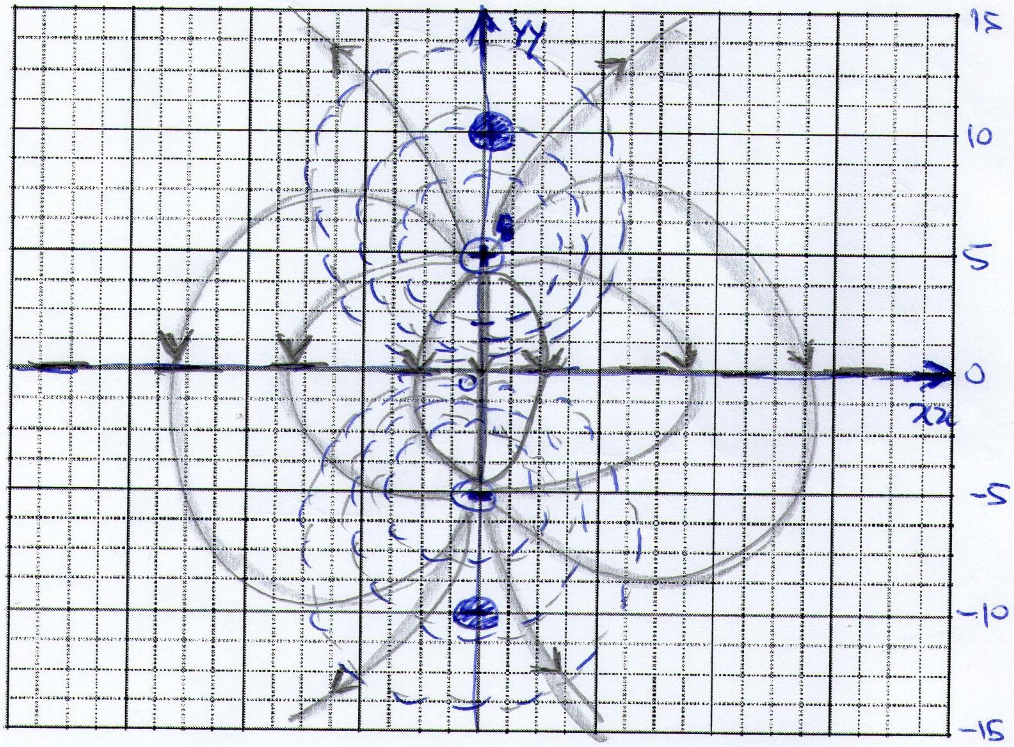


Figura 6 – Linhas equipotenciais e campo eléctrico entre dois fios filiformes infinitos e paralelos. [cm]

- - - : Linhas equipotenciais (V);

⟶ : Linhas campo (E);

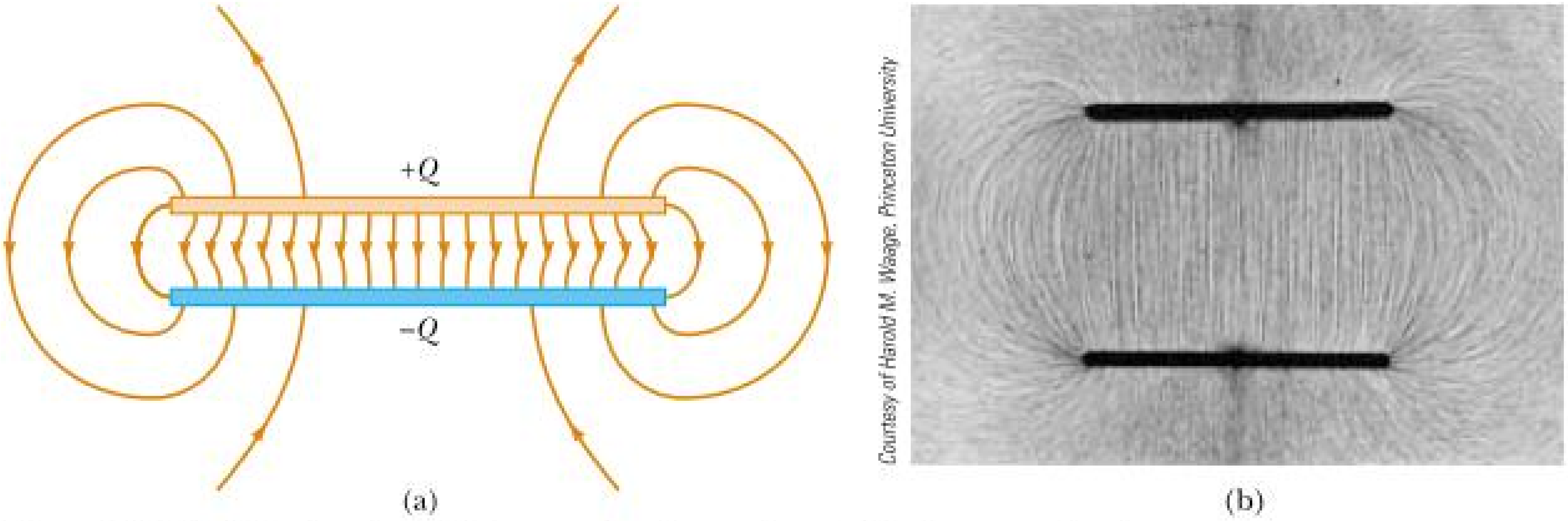


Figure 26.3 (a) The electric field between the plates of a parallel-plate capacitor is uniform near the center but nonuniform near the edges. (b) Electric field pattern of two oppositely charged conducting parallel plates. Small pieces of thread on an oil surface align with the electric field.

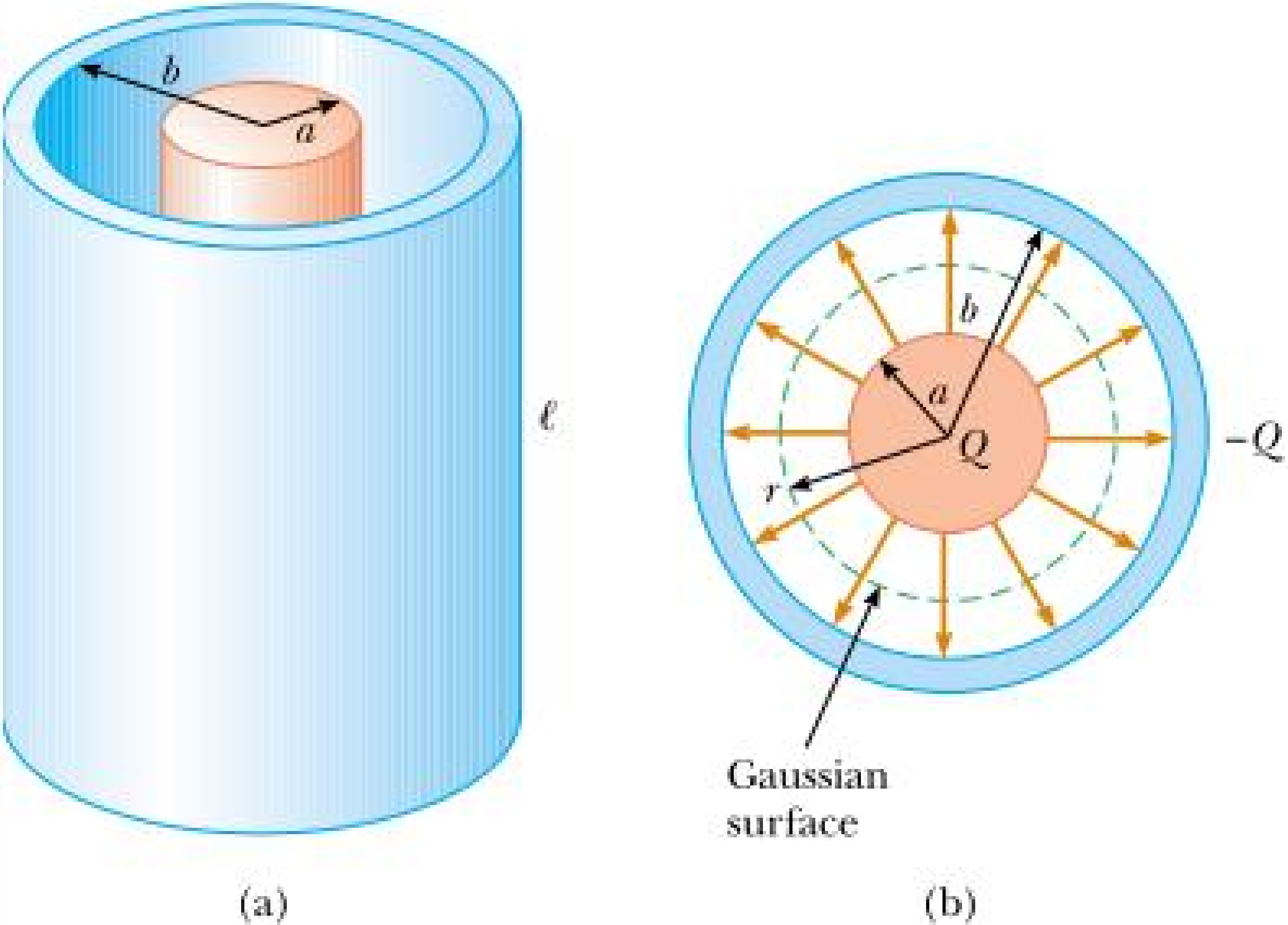


Figure 26.6 (Example 26.2) (a) A cylindrical capacitor consists of a solid cylindrical conductor of radius a and length ℓ surrounded by a coaxial cylindrical shell of radius b. (b) End view. The electric field lines are radial. The dashed line represents the end of the cylindrical gaussian surface of radius r and length ℓ.

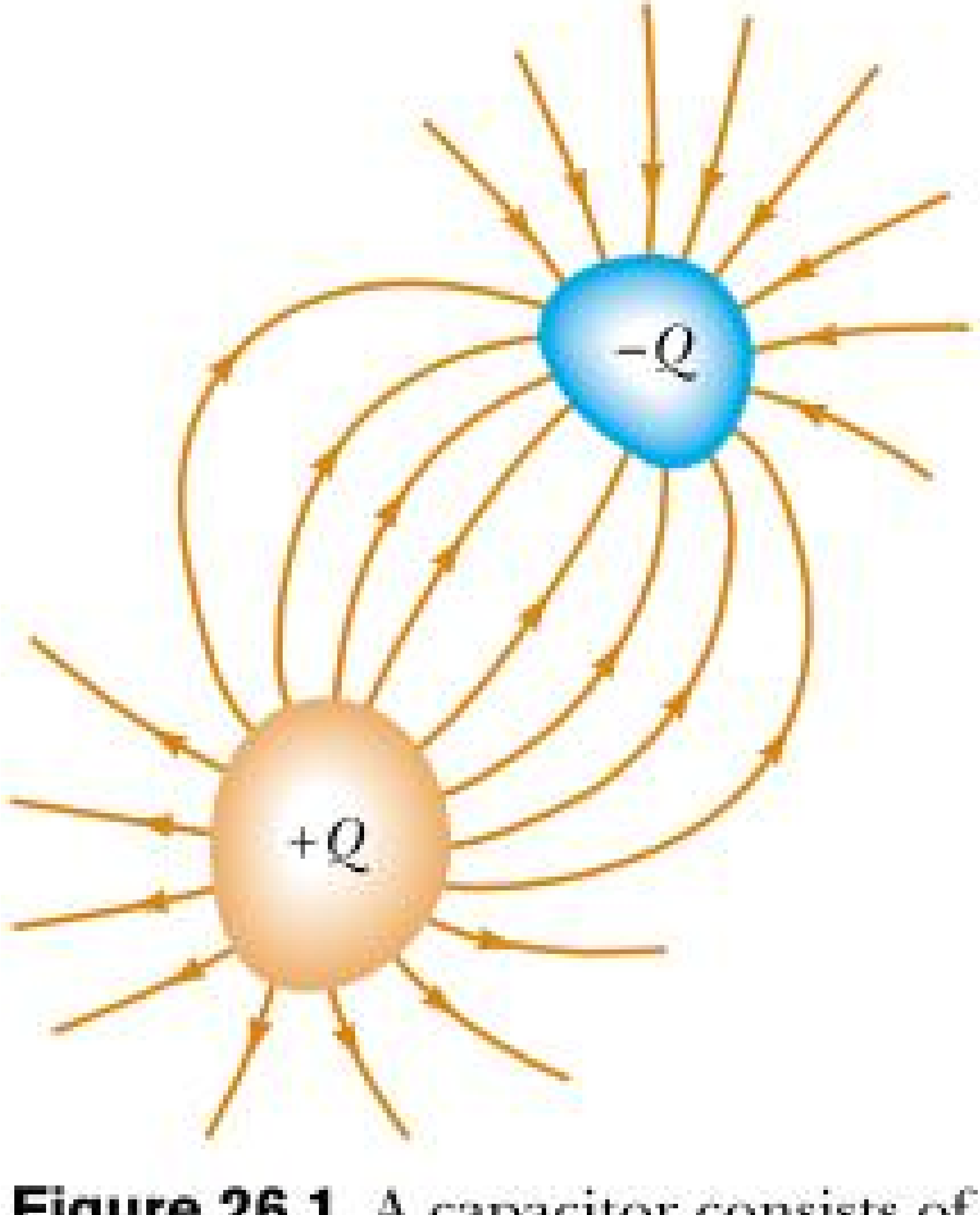


Figure 26.1 A capacitor consists of two conductors. When the capacitor is charged, the conductors carry charges of equal magnitude and opposite sign.

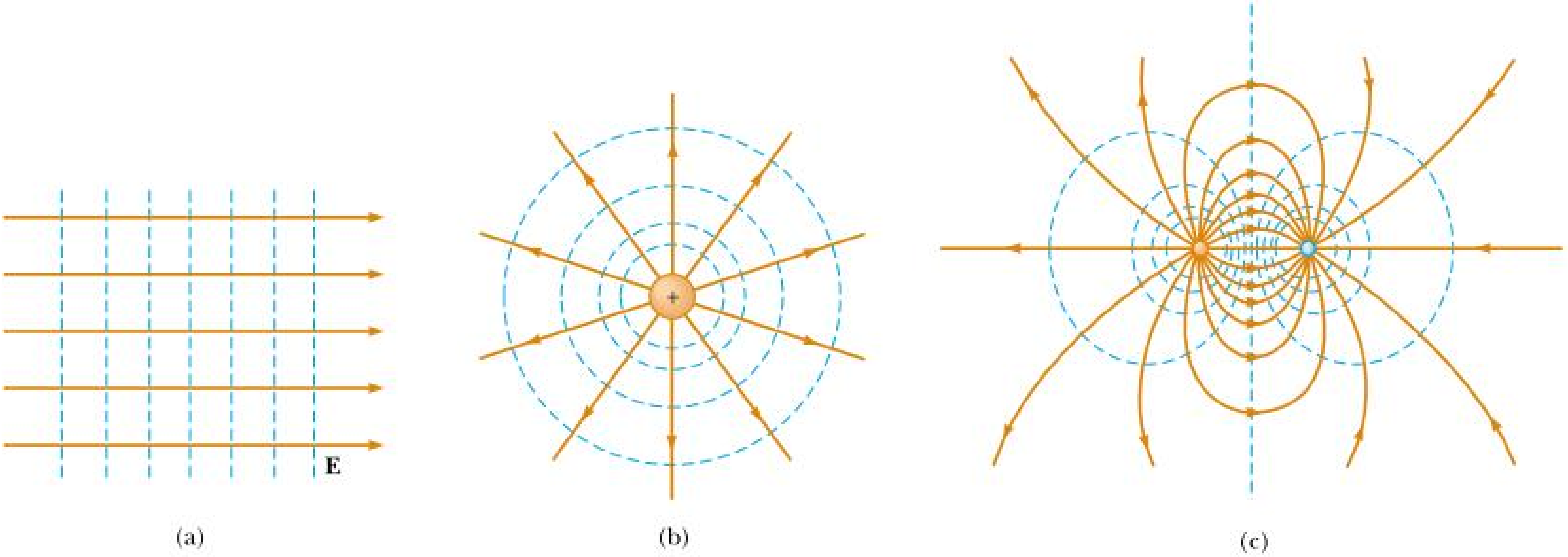


Figure 25.13 Equipotential surfaces (the dashed blue lines are intersections of these surfaces with the page) and electric field lines (red-brown lines) for (a) a uniform electric field produced by an infinite sheet of charge, (b) a point charge, and (c) an electric dipole. In all cases, the equipotential surfaces are *perpendicular* to the electric field lines at every point.

where on the surface of a charged conductor in equilibrium. That is,

the surface of any charged conductor in electrostatic equilibrium is an equipotential surface. Furthermore, because the electric field is zero inside the conductor, we conclude that the electric potential is constant everywhere inside the conductor and equal to its value at the surface.

Because this is true, no work is required to move a test charge from the interior of a charged conductor to its surface.

Consider a solid metal conducting sphere of radius R and total positive charge Q, as shown in Figure 25.22a. The electric field outside the sphere is k_eQ/r^2 and points radially outward. From Example 25.8, we know that the electric potential at the interior and surface of the sphere must be k_eQ/R relative to infinity. The potential outside the sphere is k_eQ/r. Figure 25.22b is a plot of the electric potential as a function of r, and Figure 25.22c shows how the electric field varies with r.

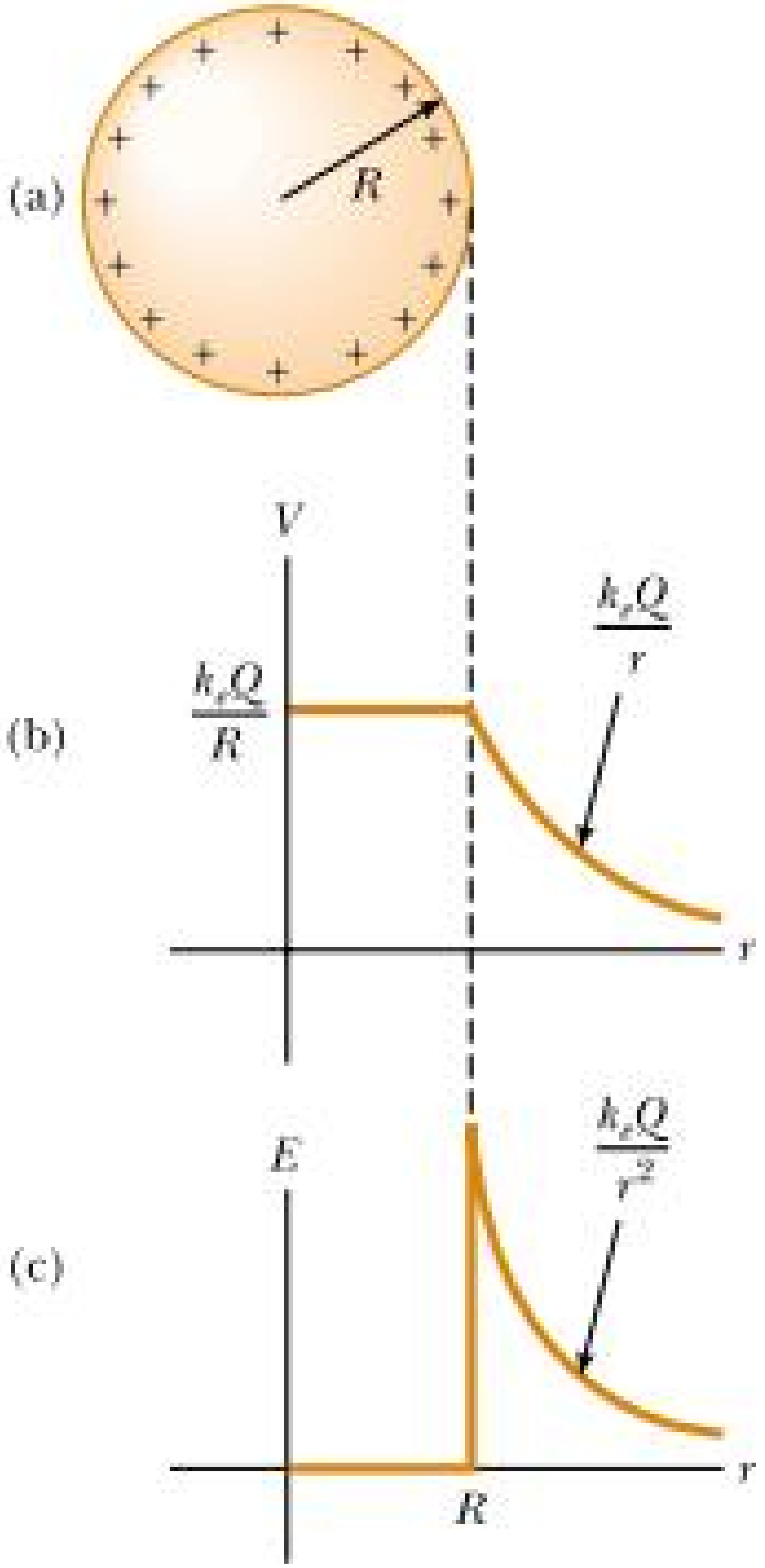


Figure 25.22 (a) The excess charge on a conducting sphere of radius R is uniformly distributed on its surface. (b) Electric potential versus distance r from the center of the charged conducting sphere. (c) Electric field magnitude versus distance r from the center of the charged conducting sphere.

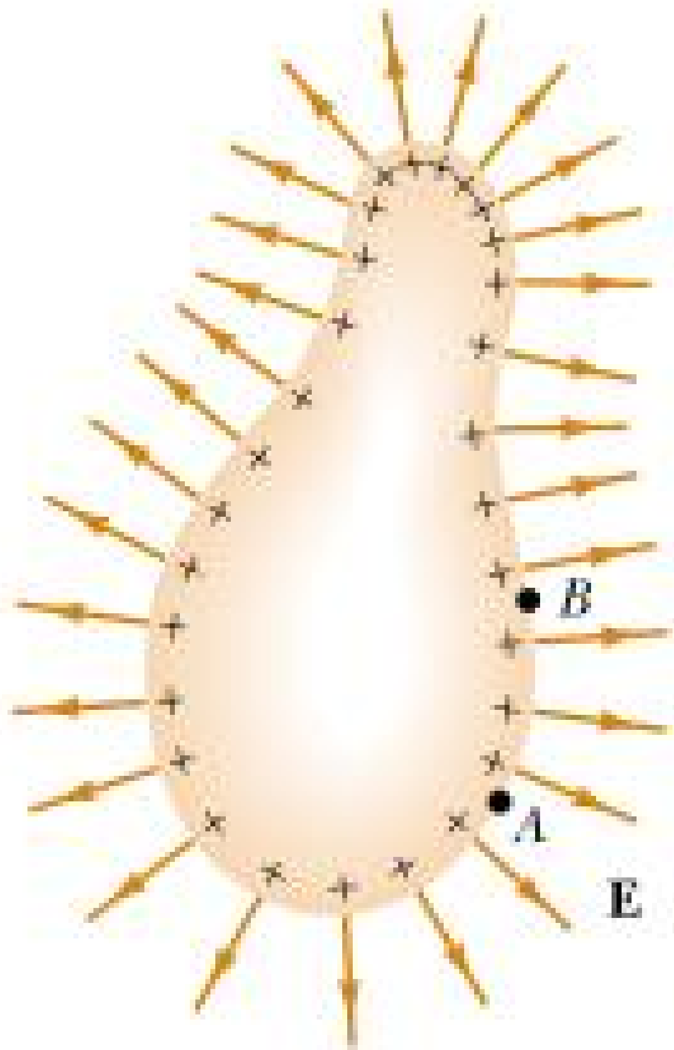
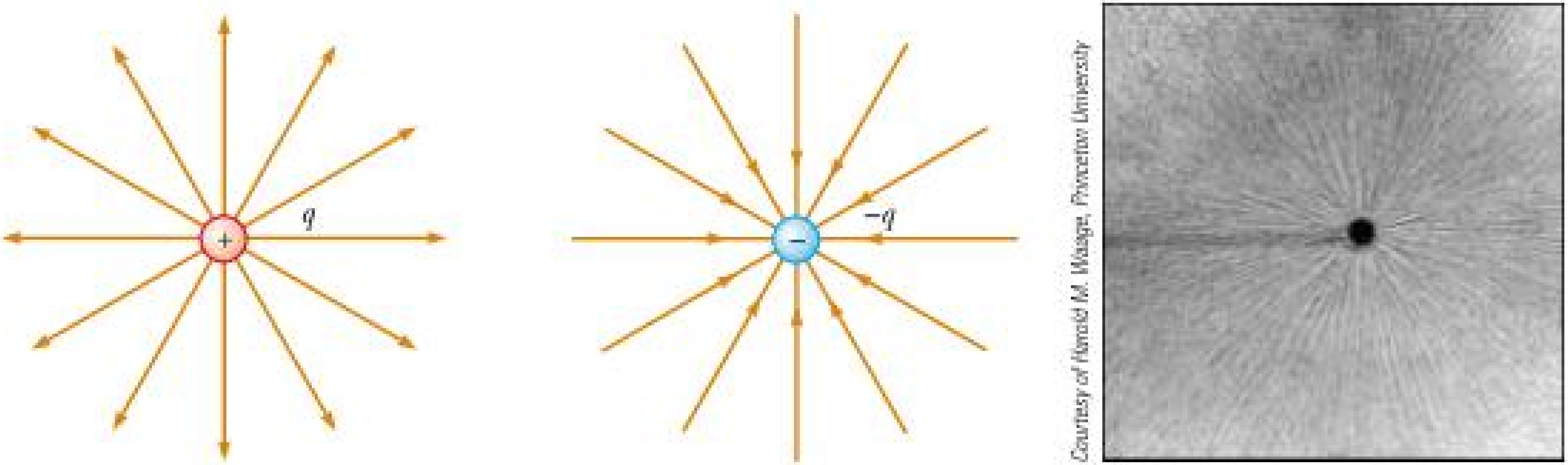


Figure 25.21 An arbitrarily shaped conductor carrying a positive charge. When the conductor is in electrostatic equilibrium, all of the charge resides at the surface, $\mathbf{E} = 0$ inside the conductor, and the direction of $\mathbf{E}$ just outside the conductor is perpendicular to the surface. The electric potential is constant inside the conductor and is equal to the potential at the surface. Note from the spacing of the positive signs that the surface charge density is nonuniform.

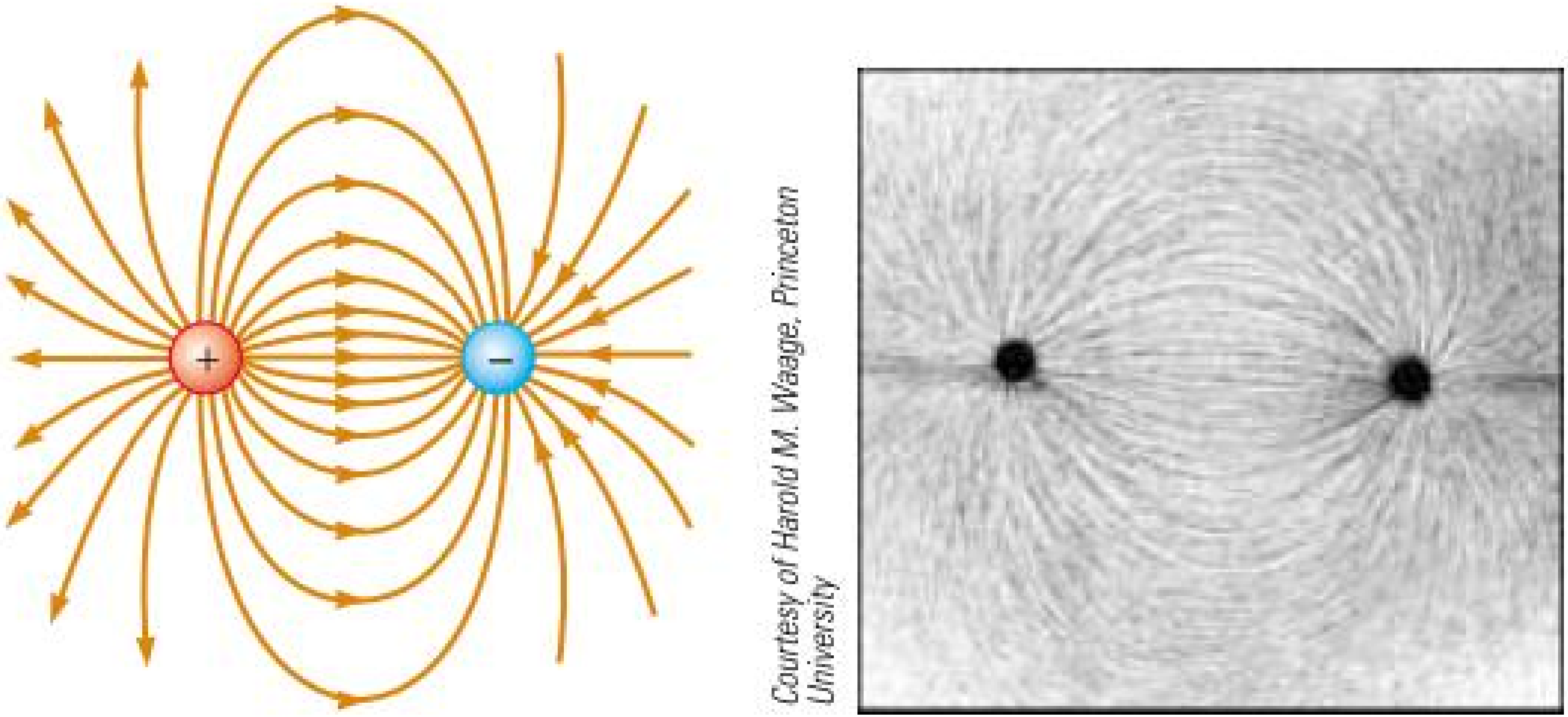


(a) (b) (c)

Figure 23.21 The electric field lines for a point charge. (a) For a positive point charge, the lines are directed radially outward. (b) For a negative point charge, the lines are directed radially inward. Note that the figures show only those field lines that lie in the plane of the page. (c) The dark areas are small pieces of thread suspended in oil, which align with the electric field produced by a small charged conductor at the center.

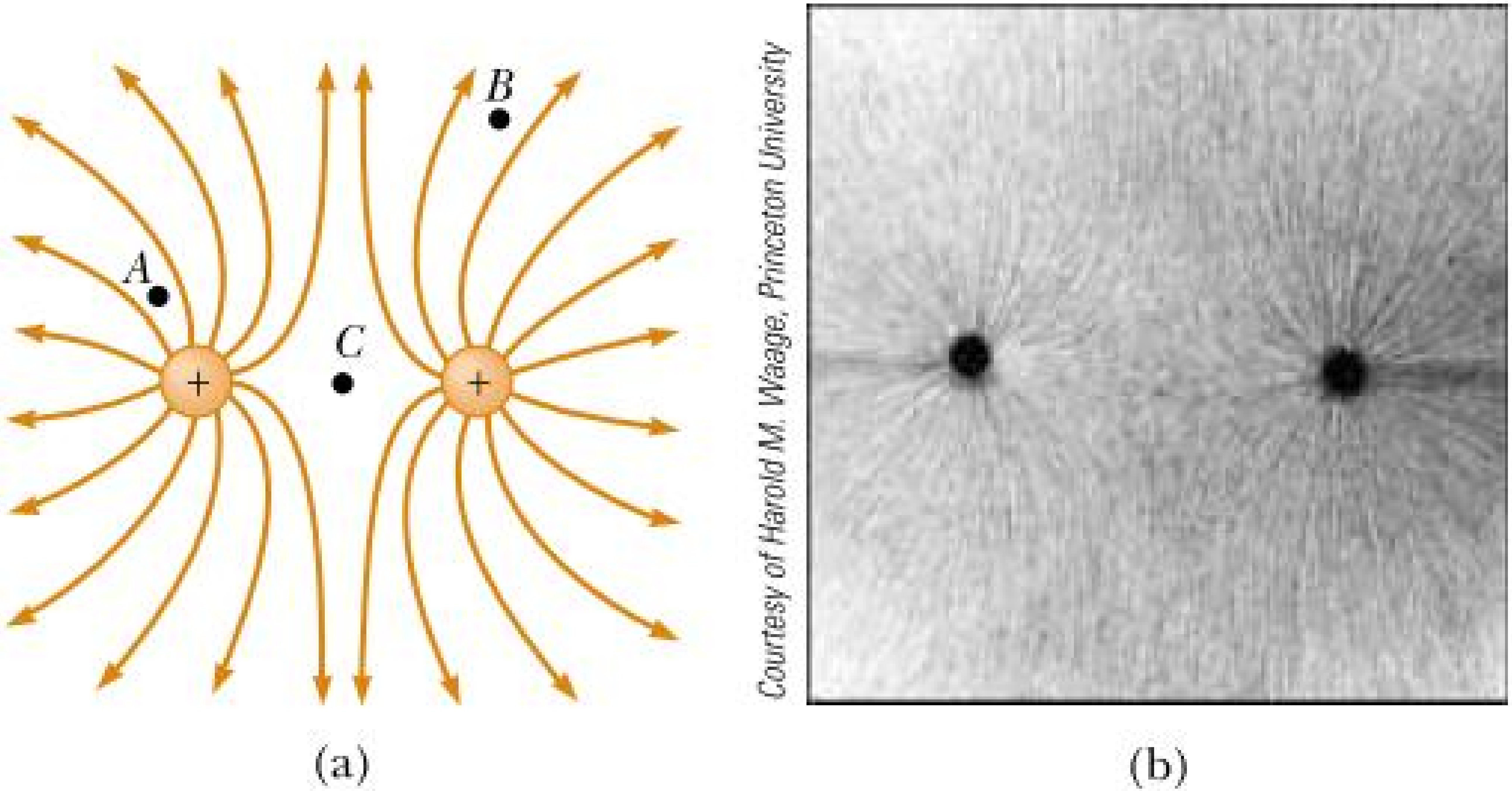
The rules for drawing electric field lines are as follows:

- The lines must begin on a positive charge and terminate on a negative charge. In the case of an excess of one type of charge, some lines will begin or end infinitely far away.
- The number of lines drawn leaving a positive charge or approaching a negative charge is proportional to the magnitude of the charge.
- No two field lines can cross.



(a) (b)

Figure 23.22 (a) The electric field lines for two point charges of equal magnitude and opposite sign (an electric dipole). The number of lines leaving the positive charge equals the number terminating at the negative charge. (b) The dark lines are small pieces of thread suspended in oil, which align with the electric field of a dipole.



Courtesy of Harold M. Waage, Princeton University

Figure 23.23 (a) The electric field lines for two positive point charges. (The locations *A*, *B*, and *C* are discussed in Quick Quiz 23.7.) (b) Pieces of thread suspended in oil, which align with the electric field created by two equal-magnitude positive charges.