

ate potential of 5 V and
20 V, we can draw circles
contours. Also drawing
the contour map of Fig.
always intersect at right

function of radius. In this
a measure of the electric
hill," the greater the field
mm, $V = 10$ V so that the

$V m^{-1}$

e, we can obtain the mag-

(6)

dient of the potential which
the line integral of the field.

potential contour or surface
unit distance is performed
coincides with the direction

osed path in a static field is
the upper and lower
ne result is zero. A property
of this field around any closed

(7)

closed path. A field for which
it follows that the potential
e field is independent of the

ositive test charge introduced
ates in the direction of a field

In a uniform field the E lines are parallel and the equipotential lines form a parallel orthogonal set of lines as in Fig. 2-17a. Actually the equipotentials are plane surfaces perpendicular to E and for a fixed voltage increment ΔV ($= 10$ V in the figure) are spaced uniformly.

In a nonuniform field the E lines diverge in going from a stronger to a weaker field region, as in Fig. 2-17b. Furthermore, for a fixed voltage increment, such as 10 V, the equipotential surfaces become more widely spaced in the weaker field region. The uniform and nonuniform fields are shown in three dimensions in Figs. 2-17c and d.

Note that a potential rise is always opposite to the direction of E .

As another example of a nonuniform field, let us consider the field in the vicinity of a long straight wire shown in Fig. 2-18. The wire perpendicular to the page carries a uniform positive charge.

From (2-7-8) the electric field at a distance r from a long (ideally infinite) wire is

$$E_r = \frac{\rho_L}{2\pi\epsilon_0 r} \quad (V m^{-1}) \quad (1)$$

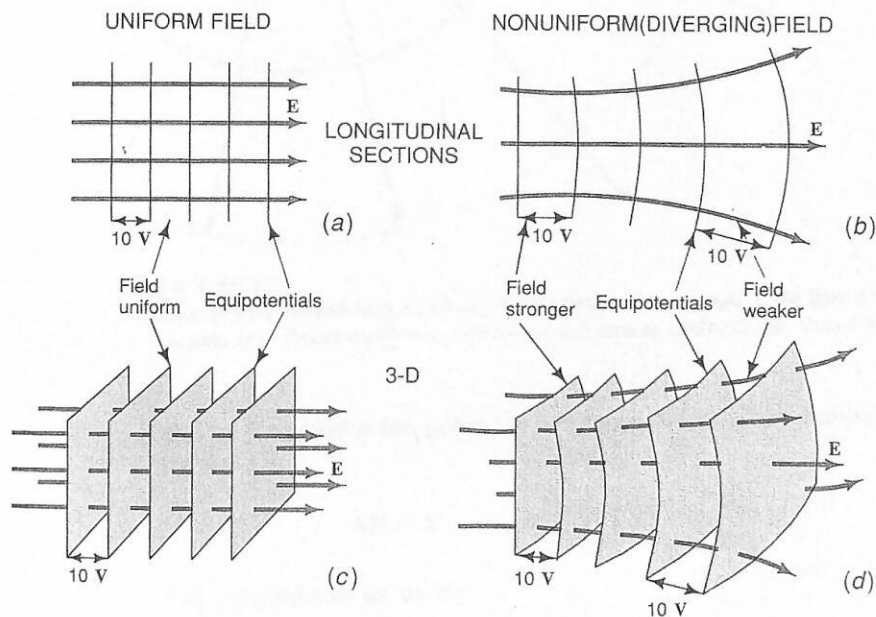


FIGURE 2-17

(a) Uniform electric field. (b) Nonuniform electric field. Equipotential surfaces are planar in (a) and curved in (b) as seen in three dimensions in (c) and (d). For a given potential difference or increment (10 V), the equipotential surfaces are equally spaced in a uniform field (c), but in the nonuniform field (d) the spacing increases as the field becomes weaker.