21.4 Calculating the Electric Potential (continued)

Review: Point Charge: $V = \frac{Kq}{r}$ (set $V=0$ as $r \to \infty$)

$\vec{E} = |Kq/r^2|$, {away from +, towards −}

Multiple Charges: Superposition

$V = V_1 + V_2 + \cdots$

$\vec{E} = \vec{E}_1 + \vec{E}_2 + \cdots$

Parallel Plates:

$|\Delta V| = |Ed|$

$E = \frac{Q/A}{\epsilon_0}$, points from high V to low V.

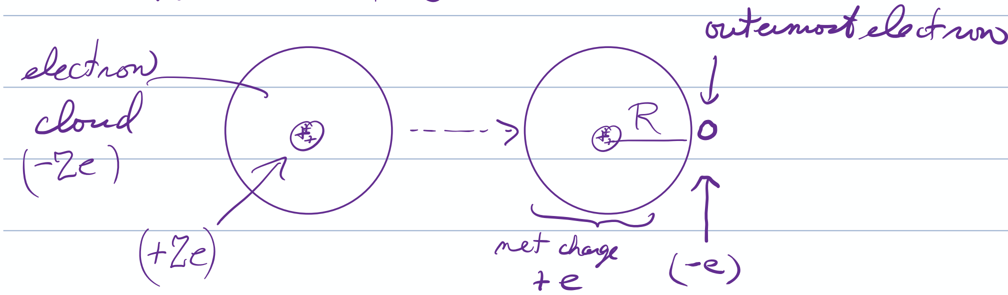
In all cases, $\Delta U = q_0 \Delta V$

$\vec{F} = q_0 \vec{E}$.

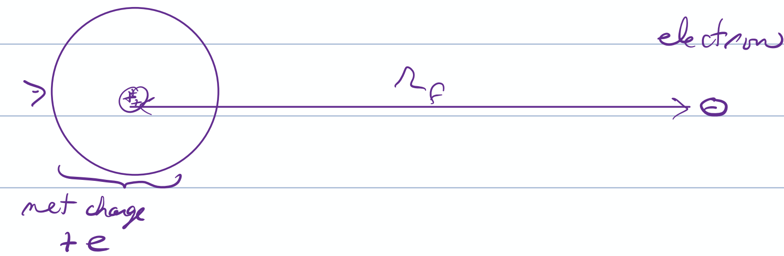
Applications $\vec{F} = m\vec{a}$, Energy conservation

e.g. Ionization: See example 21.10.

Neutral atom



Ionized



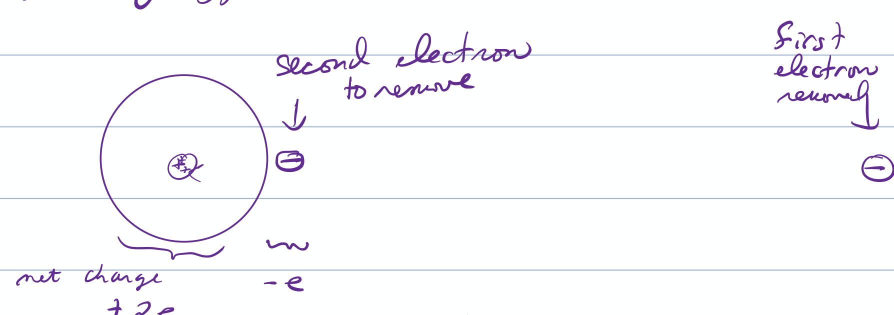
Apply minimal work/energy to separate the electron

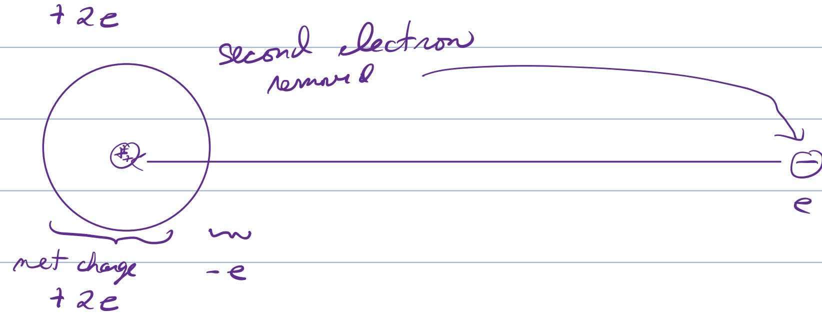
$$U_i + K_i + W = U_f + K_f$$

$$\frac{K(e)(-e)}{R} + 0 + W = 0 + 0$$

$$W = +\frac{Ke^2}{R}.$$

How about pulling off the second electron?



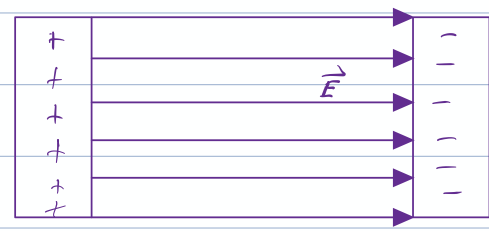


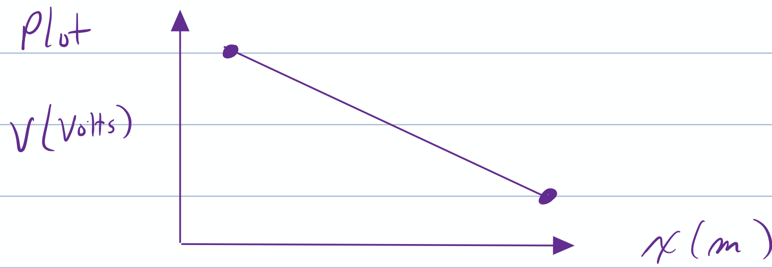
$$\frac{K(2e)(-e)}{R} + 0 + W = 0 + 0$$

$$W = \frac{2Ke^2}{R}$$ = work to remove a second electron.

21.5 Connecting Potential and Field

Back to the parallel plate



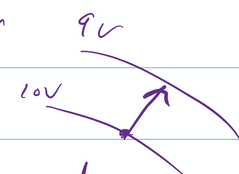


$\vec{E}$ points "downhill."

Recall for parallel plates:

$$E = \frac{-\Delta V}{d} \qquad \text{Units: } \frac{\text{Volts}}{\text{meter}}$$

$$\text{Units: } \frac{J/C}{m} = \frac{(N\cdot m)/C}{m} = \frac{N}{C} \quad \checkmark$$



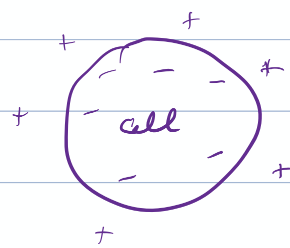
Generalize: If you know V at two nearby spots, $E = -\frac{\Delta V}{d}$.

Equipotential curves: set of points all at the same potential (e.g. contour lines in a contour plot.)

See figures in text.

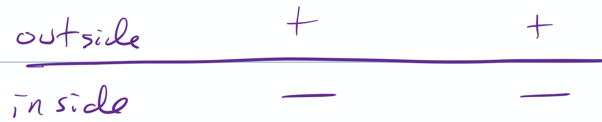
21.6 Electrocardiogram

Normal cells typically have a net − charge compared to the environment



positive charges in solution will tend to be attracted to the membrane.

Zoom in:



Say it is "polarized".

Various processes involve "depolarization". This means the inside becomes less negative (e.g. by letting calcium ions in). Confusing: "depolarized" ≠ "not polarized"!

Upshot: Changes in dipole moment ⇒ changes in ΔV, which can be measured.
(No further detail on test.)