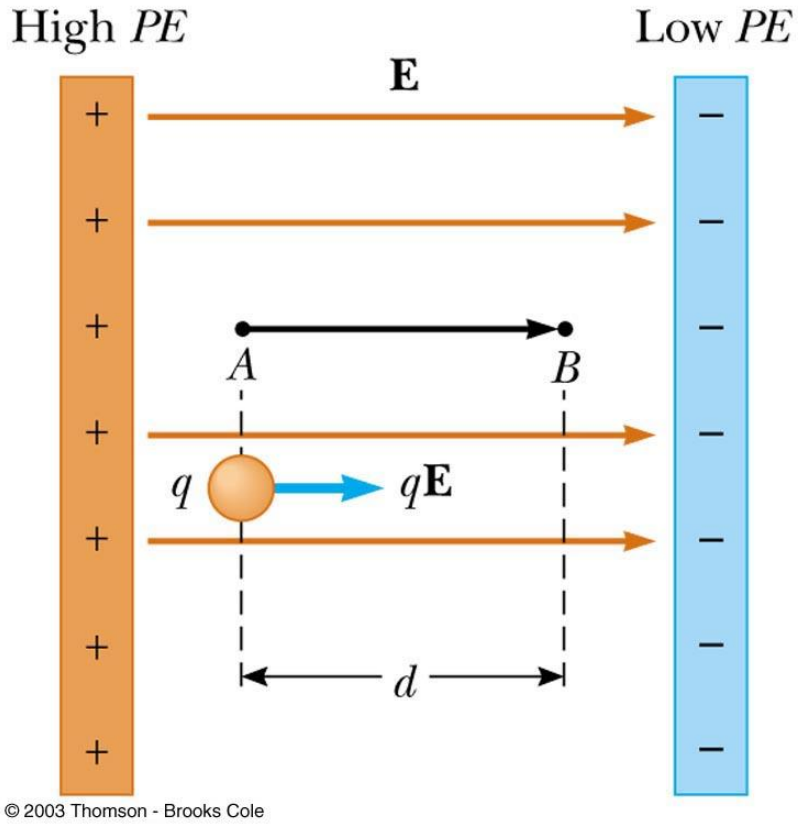
Electric Potential Energy

- The electrostatic force is a conservative (="path independent") force
- It is possible to define an electrical potential energy function with this force
- Work done by a conservative force is equal to the negative of the change in potential energy

Work and Potential Energy

- There is a uniform field between the two plates
- As the positive charge moves from A to B, work is done
- $W_{AB}=F\,d=q\,E\,d$
- $\Delta PE=-W_{AB}=-q\,E\,d$
  - only for a uniform field



Potential Difference (="Voltage Drop")

- The potential difference between points A and B is defined as the change in the potential energy (final value minus initial value) of a charge *q* moved from A to B divided by the size of the charge

  $-\Delta V = V_B - V_A = \Delta PE / q$

- Potential difference is not the same as potential energy

Potential Difference, cont.

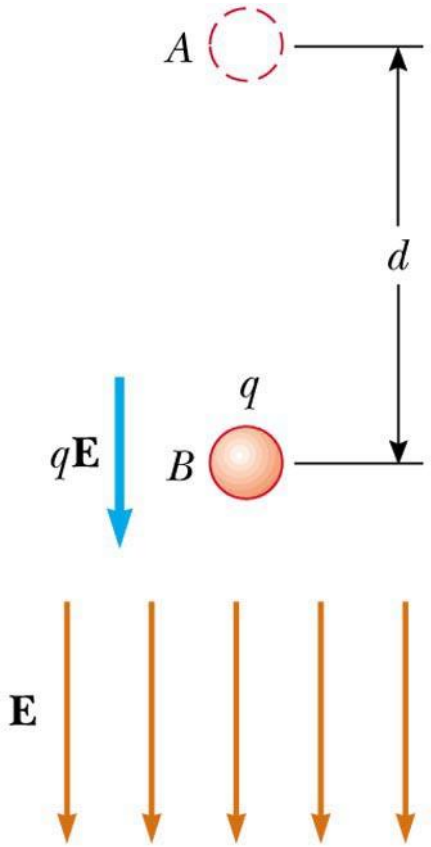
- Another way to relate the energy and the potential difference: $\Delta PE = q\,\Delta V$
- Both electric potential energy and potential difference are *scalar* quantities
- Units of potential difference
  - V = J/C
- A special case occurs when there is a *uniform electric field*
  - $V_B - V_A = -Ed$
    - Gives more information about units: N/C = V/m

Energy and Charge Movements

- A positive charge gains electrical potential energy when it is moved in a direction opposite the electric field
- If a charge is released in the electric field, it experiences a force and accelerates, gaining kinetic energy
  - As it gains kinetic energy, it loses an equal amount of electrical potential energy
- A negative charge loses electrical potential energy when it moves in the direction opposite the electric field

Energy and Charge Movements, cont

- When the electric field is directed downward, point B is at a lower potential than point A
- A positive test charge that moves from A to B loses electric potential energy
- It will gain the same amount of kinetic



Summary of Positive Charge Movements and Energy

- When a positive charge is placed in an electric field
  - It moves in the direction of the field
  - It moves from a point of higher potential to a point of lower potential
  - Its electrical potential energy decreases
  - Its kinetic energy increases