PHYSICS II

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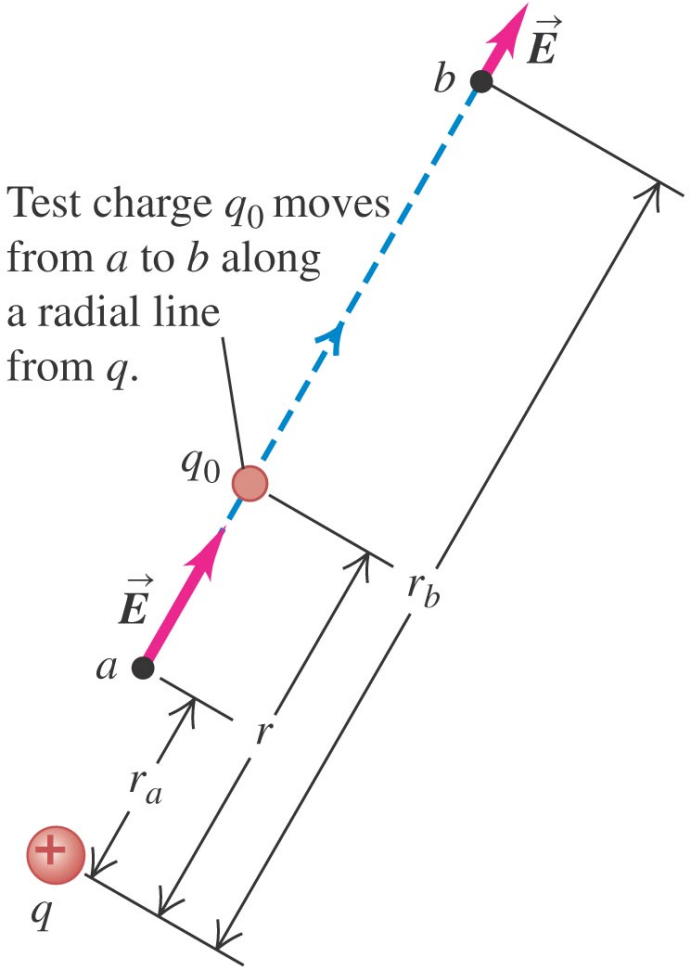
Electric Potential

- Electrical potential is sometimes modeled as a river. The width of the river defines how much water will be able to flow through its banks.
- The arc welder in the picture at right is taking advantage of a potential between the welding rod and material to be joined. The arc of electrical flow is so hot that the metals and the rod actually melt into one material.

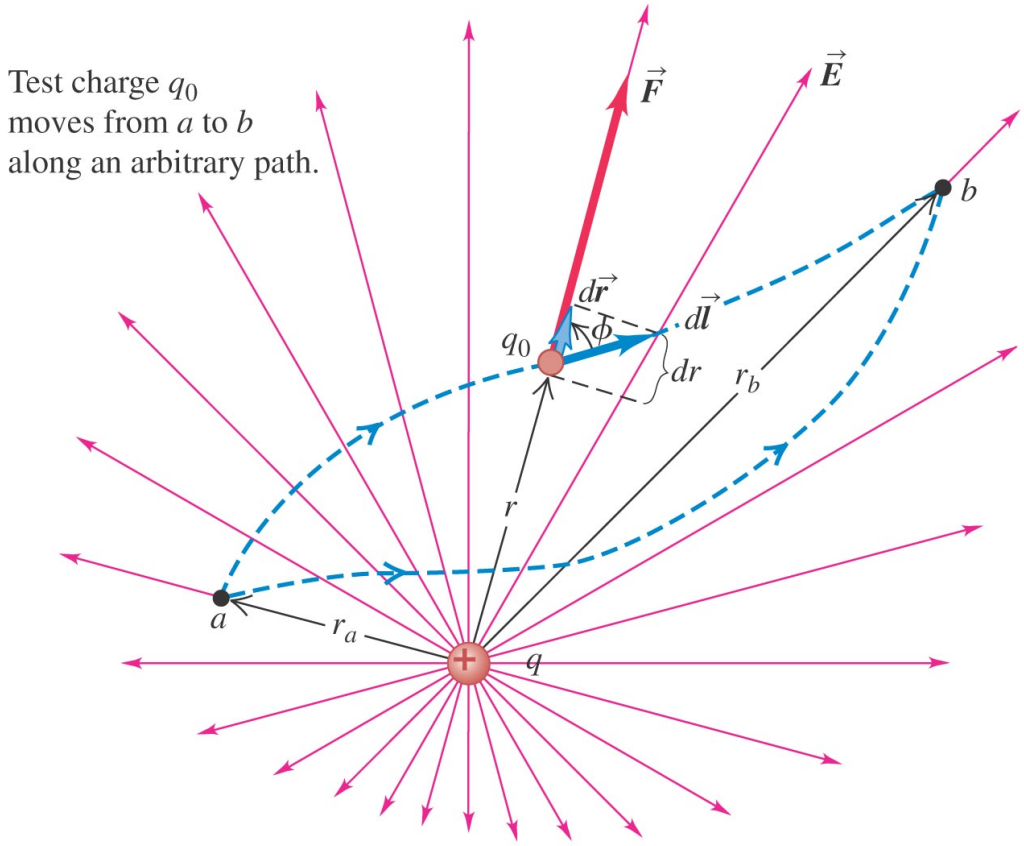
A test charge will move with respect to other charges

A test charge will move directly away from a like charge q.



The work done moving a test charge

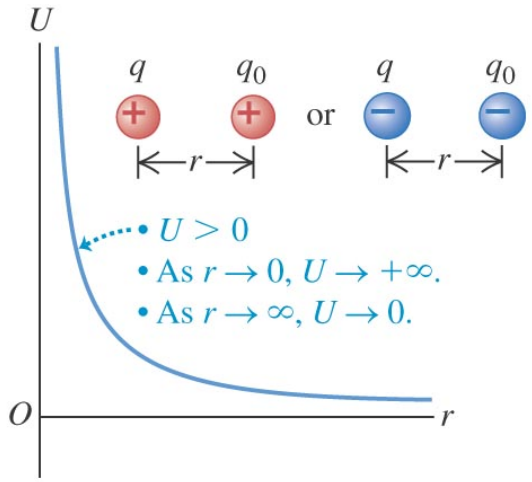
– As a test charge moves away from a charge of like sign, the path does not matter (with respect to work or energy), only the distance between the charges.



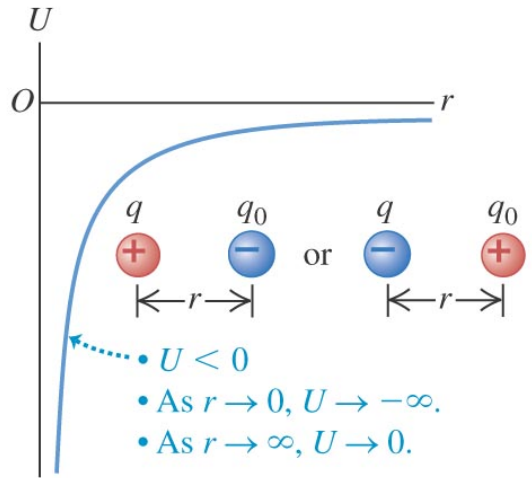
Potential energy curves

- Graphically, the potential energy between like charges increases sharply to positive (repulsive) values as the charges become close.
- Unlike charges have potential energy becoming sharply negative as they become close (attractive).

(a) q and q_0 have the same sign.

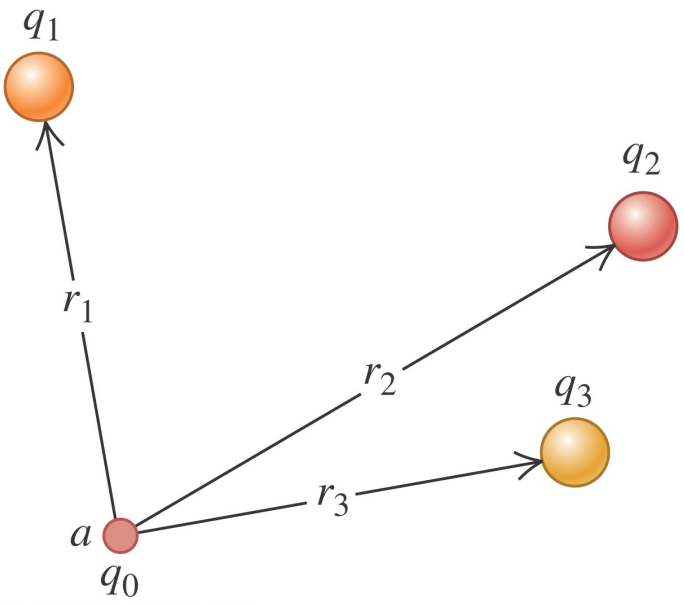


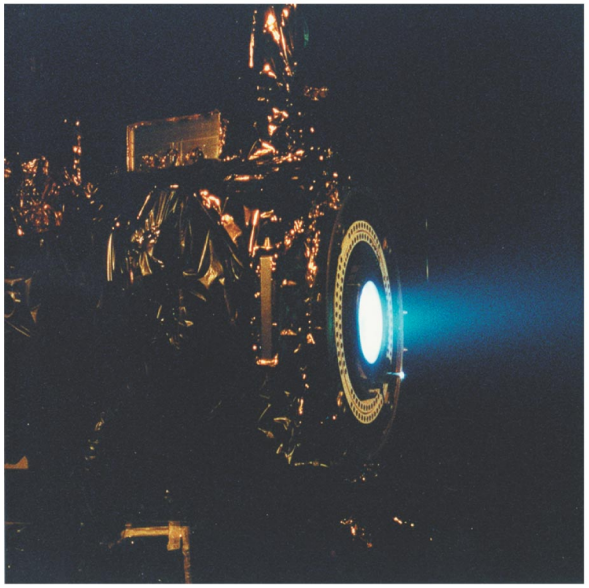
(b) q and q_0 have opposite signs.



Electrical potential and multiple point charges

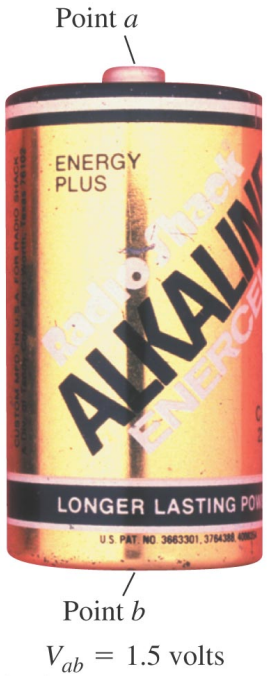
- The potential between multiple charges is done by vector addition of the individual energies as shown in Figure (left).
- Figure (right) shows this principle is applied to an ion engine for spaceflight.

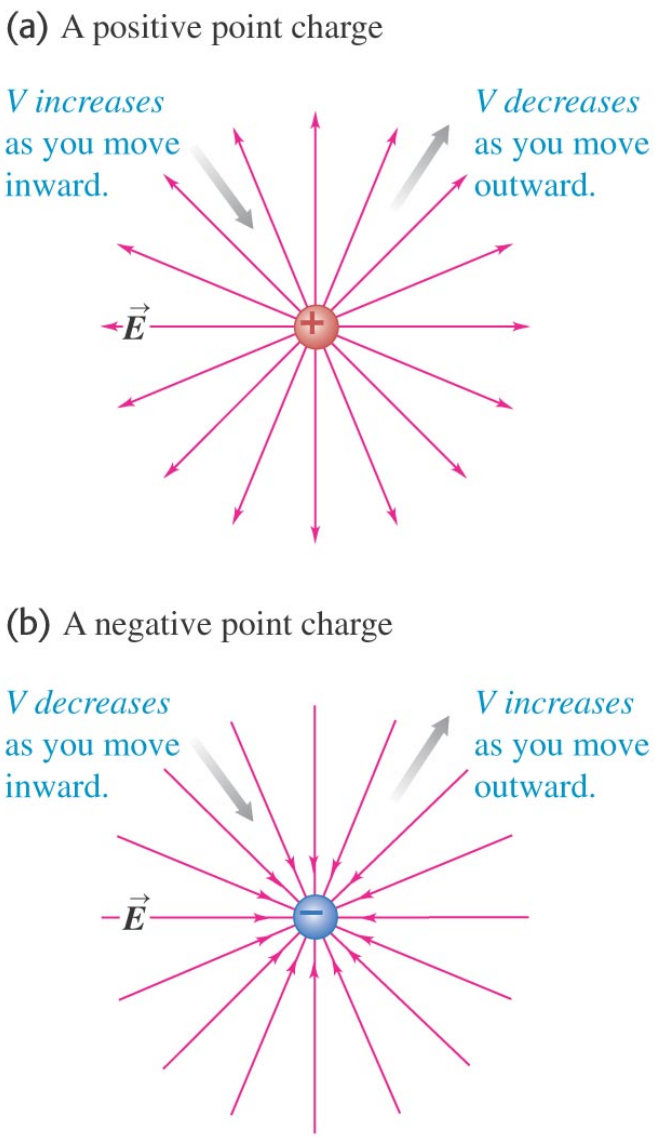




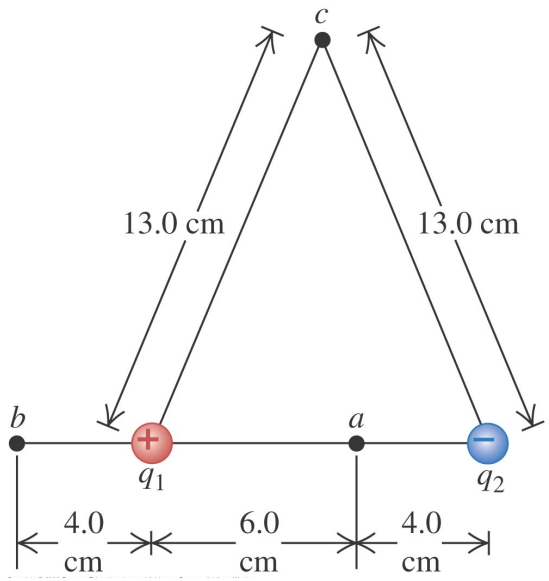
The electrical potential

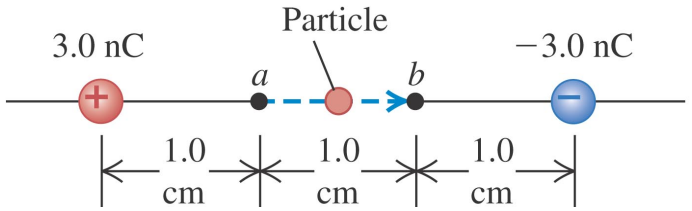
- The potential of a battery can be measured between point *a* and point *b* (the positive and negative terminals).
- Moving with the electrical field decreases the electrical potential. Moving against the field lowers it.

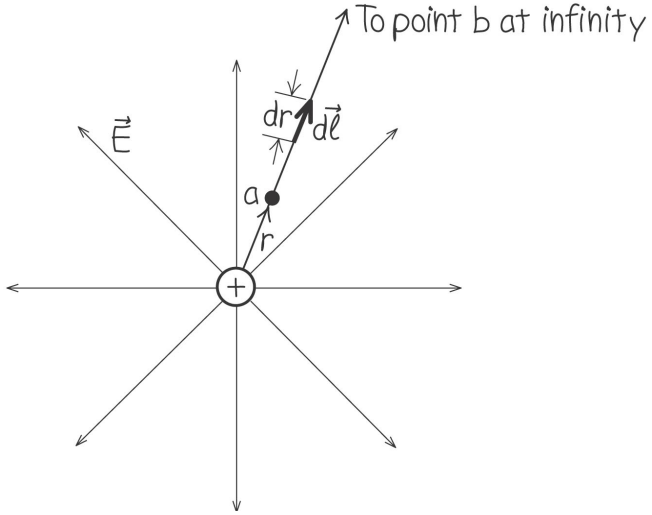




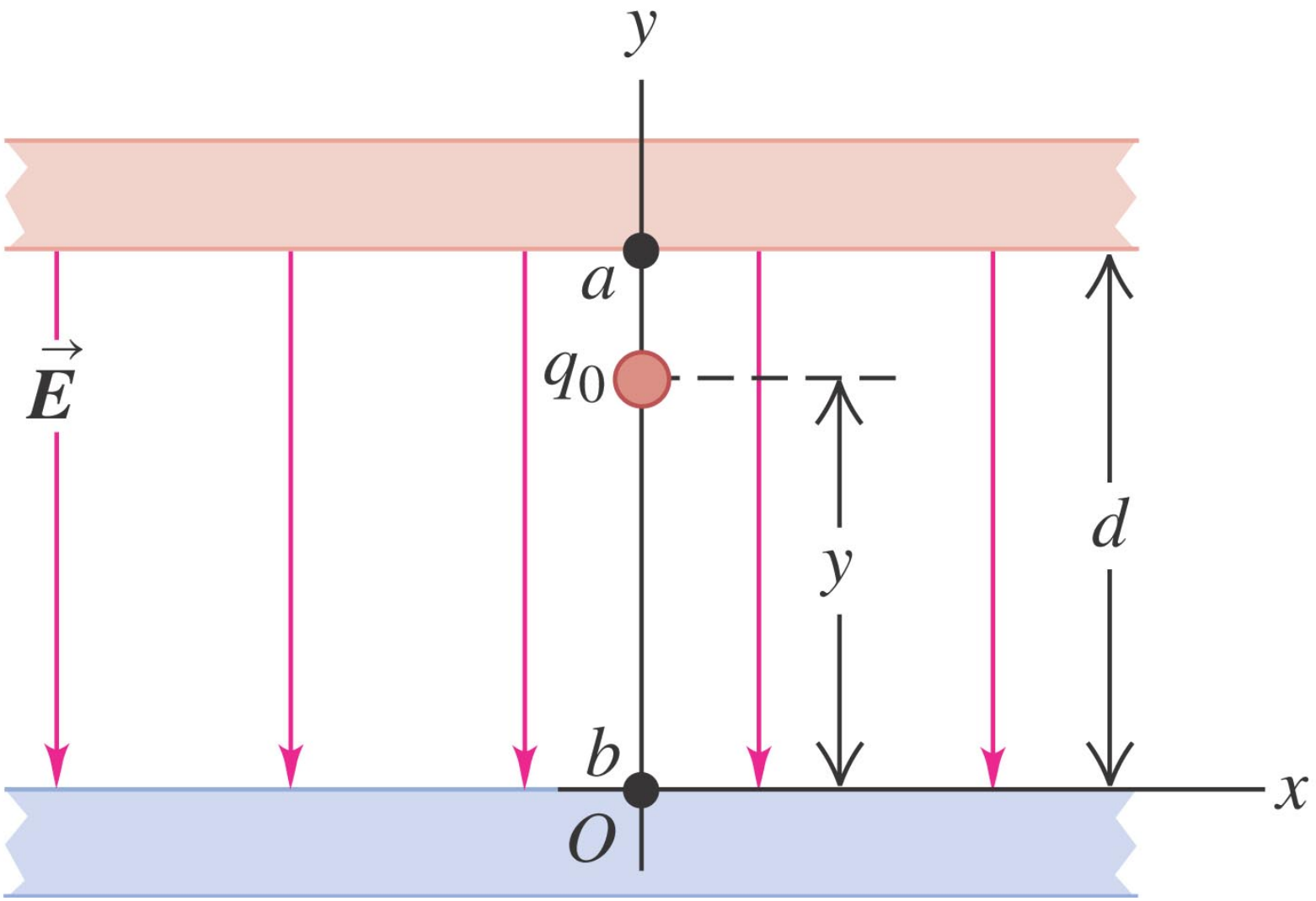
Finding the potential



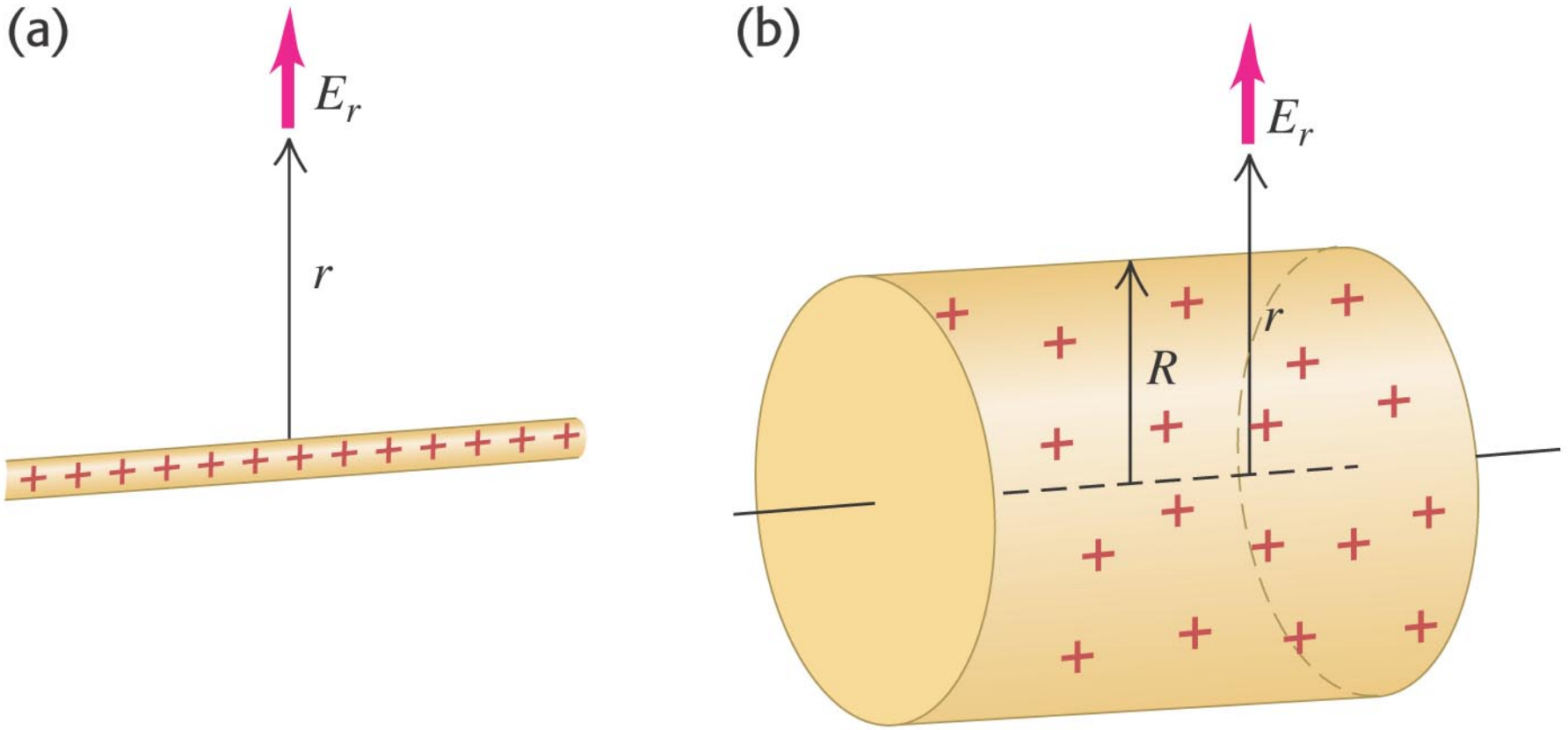




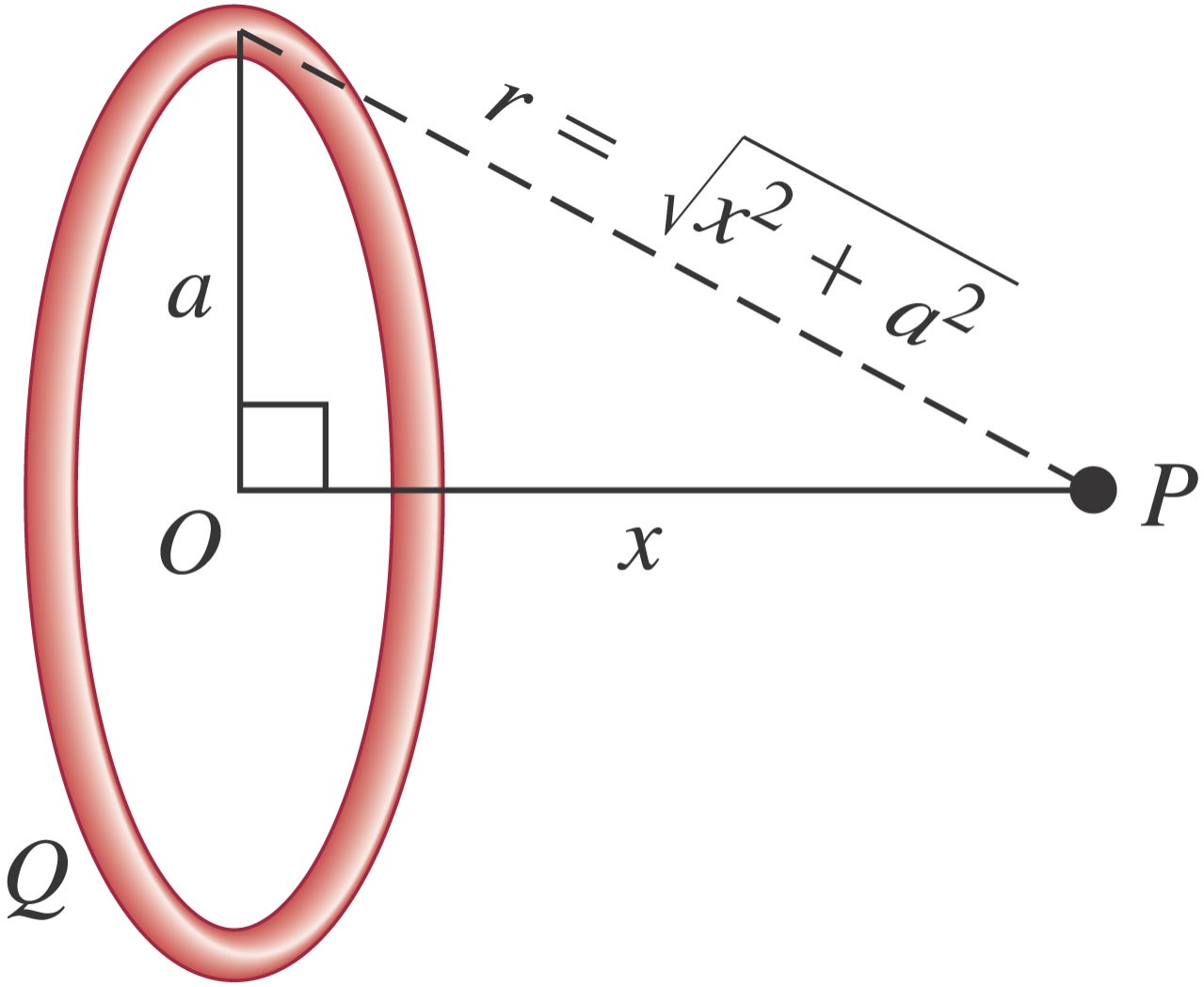
Ex: oppositely charged parallel plates



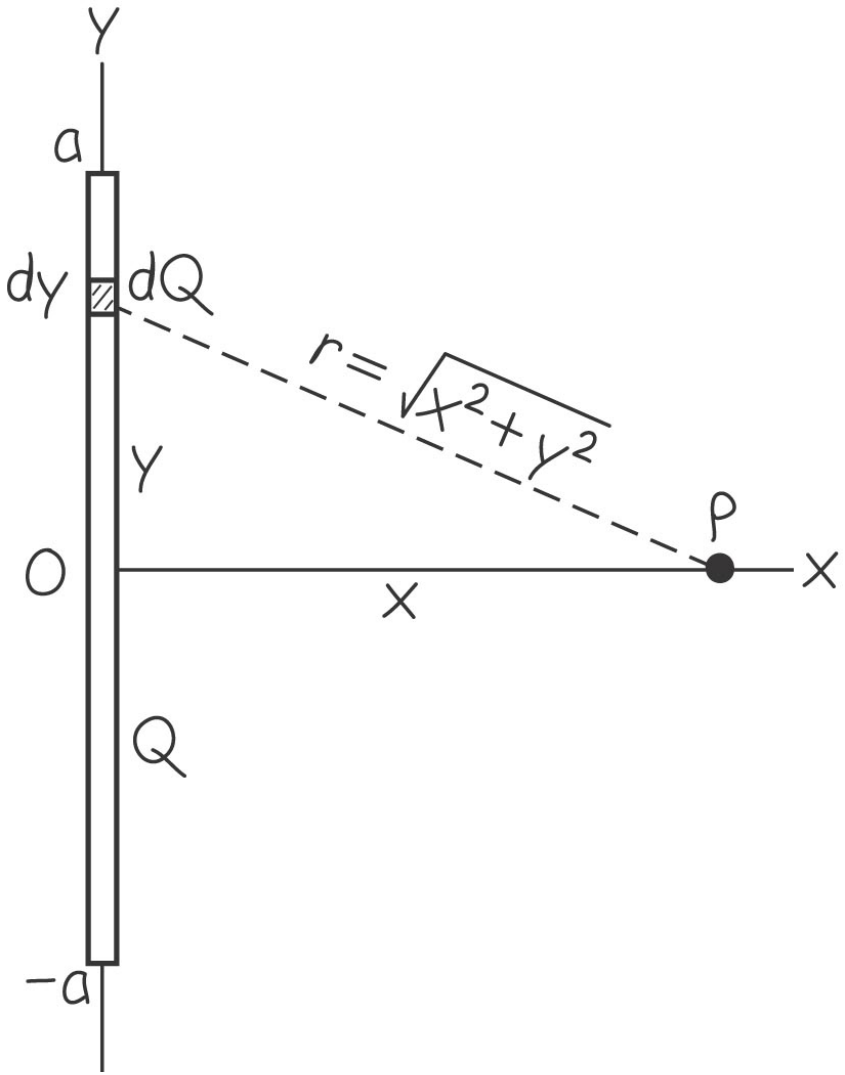
Example: a charged, conducting cylinder



Example: a ring of charge

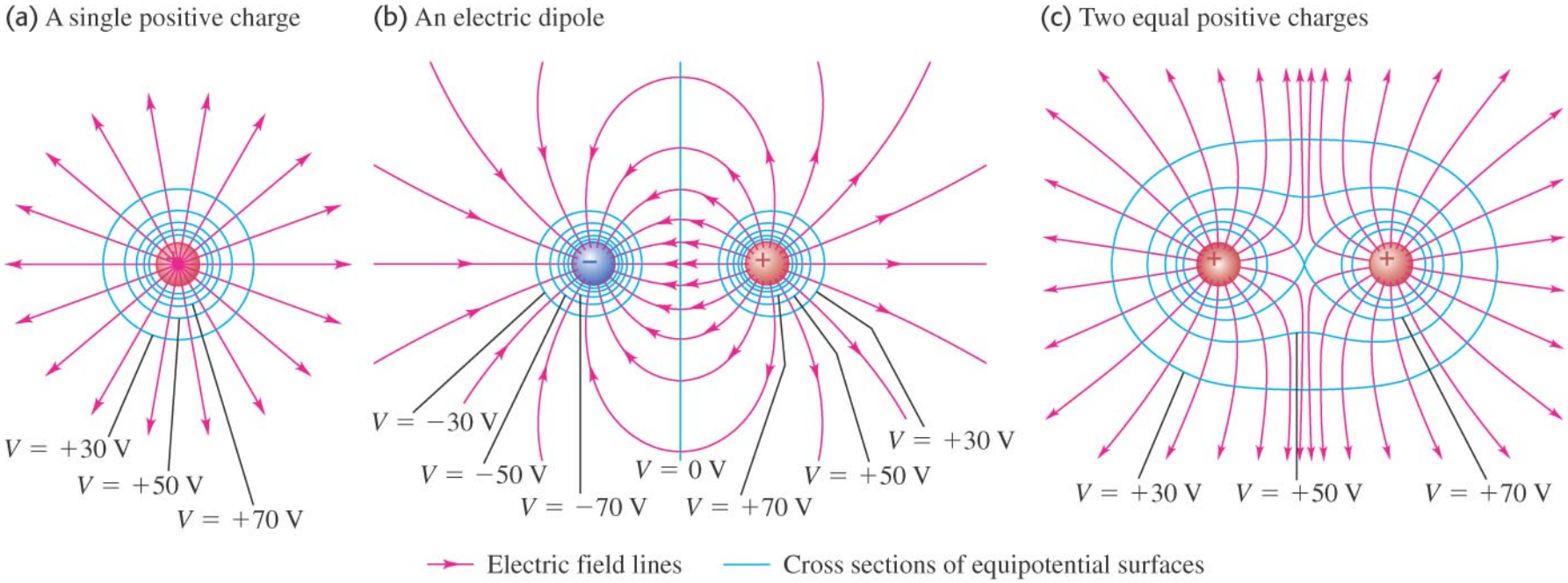


Example: a line of charge

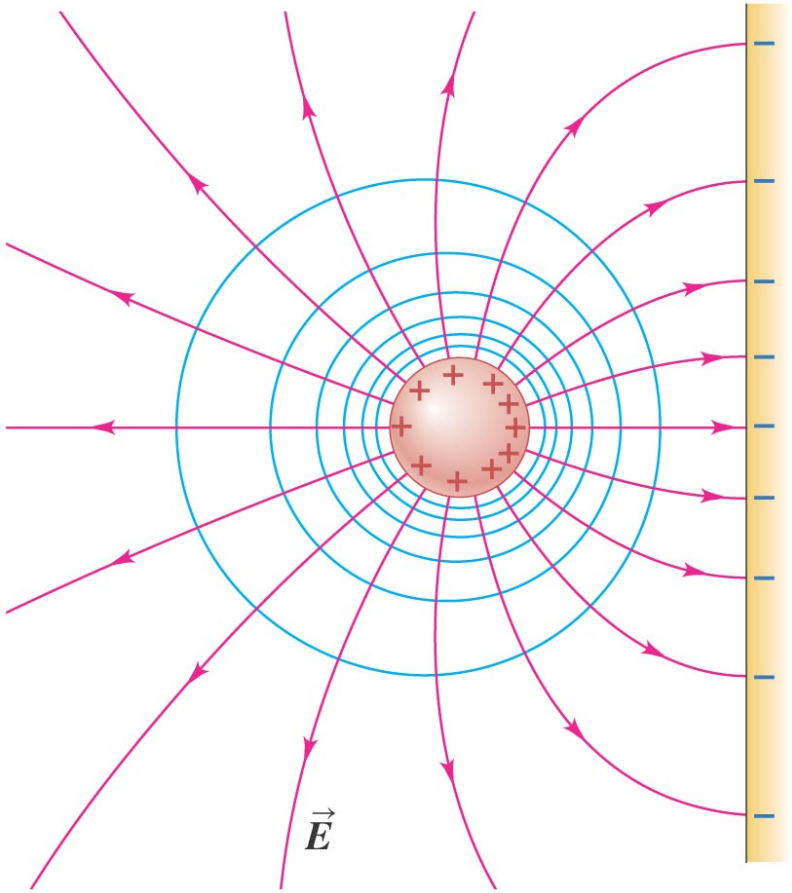


Equipotential surfaces and field lines

- Surfaces of equal potential may be drawn any charge or charges and the field lines they create.



Field lines and a conducting surface



The surface and interior of a conductor

An impossible electric field

If the electric field just outside a conductor had a tangential component $E_{\parallel}$, a charge could move in a loop with net work done.