Physics 07-05 Potential and E-Field **Name: _____**

Electric Potential and E-field

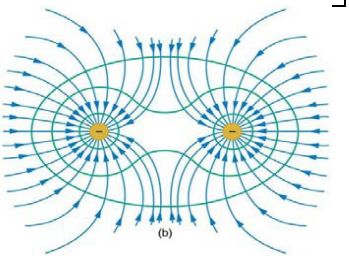
- $E = \frac{\Delta V}{x_f - x_0}$
- E-field units: _____ or _____
- It is easy to measure _____. To find E-field, divide ΔV and the _____ between two points

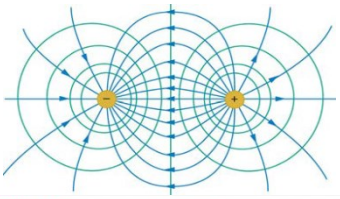
What is the voltage difference between the positions, x = 11 m and x = 5.0 m in an electric field of 2.0 N/C?

X-ray tubes that generate X-rays contain an electron source separated by about 10 cm from a metallic target. The electrons are accelerated from the source to the target by a uniform electric field with a magnitude of about 100 kN/C. When the electrons hit the target, X-rays are produced. (a) What is the potential difference between the electron source and the metallic target? (b) What is the kinetic energy of the electrons when they reach the target, assuming that the electrons start at rest?

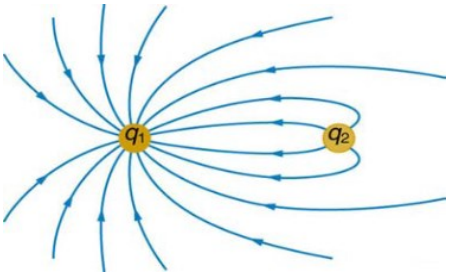
Equipotential Lines

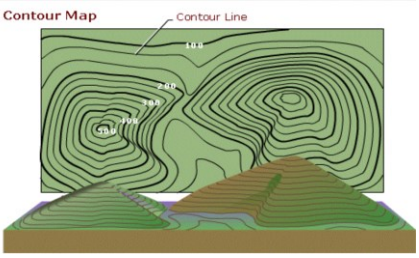
- Lines where the electric _____ is the _____
- Perpendicular to _____
- No _____ is required to move charge along _____ line since $q\Delta V = 0$





Sketch the equipotential lines in the vicinity of two opposite charges, where the negative charge is three times as great in magnitude as the positive.





Practice Work

1. What is an equipotential line? What is an equipotential surface?
2. Explain in your own words why equipotential lines and surfaces must be perpendicular to electric field lines.
3. Can different equipotential lines cross? Explain.
4. What is the strength of the electric field between two parallel conducting plates separated by 1.00 cm and having a potential difference (voltage) between them of 1.50×10^4 V? (OpenStax 19.14) **1.50×10^6 V/m**
5. The electric field strength between two parallel conducting plates separated by 4.00 cm is 7.50×10^4 V/m. (a) What is the potential difference between the plates? (b) The plate with the lowest potential is taken to be at zero volts. What is the potential 1.00 cm from that plate (and 3.00 cm from the other)? (OpenStax 19.15) **3.00 kV, 750 V**

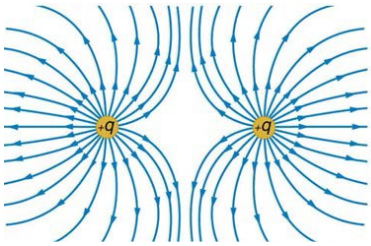
6. How far apart are two conducting plates that have an electric field strength of 4.50×10^3 V/m between them, if their potential difference is 15.0 kV? (OpenStax 19.16) **3.33 m**

7. The voltage across a membrane forming a cell wall is 80.0 mV and the membrane is 9.00 nm thick. What is the electric field strength? (The value is surprisingly large, but correct.) You may assume a uniform electric field. (OpenStax 19.18) $\mathbf{8.89 \times 10^6\ V/m}$

8. Membrane walls of living cells have surprisingly large electric fields across them due to separation of ions. What is the voltage across an 8.00 nm–thick membrane if the electric field strength across it is 5.50 MV/m? You may assume a uniform electric field. (OpenStax 19.19) **44.0 mV**

9. (a) Sketch the equipotential lines near a point charge $+q$. Indicate the direction of increasing potential. (b) Do the same for a point charge $-3q$. (OpenStax 19.36)

10. Sketch the equipotential lines for the two equal positive charges shown in the figure. Indicate the direction of increasing potential. (OpenStax 19.37)



11. The figure below shows the electric field lines near two charges q_1 and q_2, the first having a magnitude four times that of the second. Sketch the equipotential lines for these two charges, and indicate the direction of increasing potential. (OpenStax 19.38)