

Relation between E and V

Both electric _____ and electric _____ can be used to describe _____

- E
 - deals with _____
 - _____
- V
 - deals with _____
 - _____

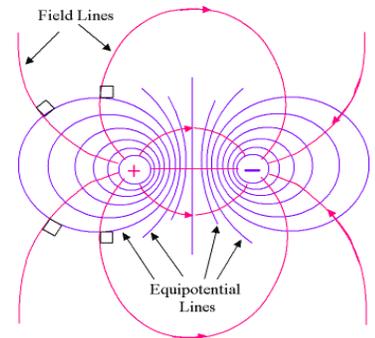
Uniform Electric Field

$$V_{AB} = Ed \text{ or } E = \frac{V_{AB}}{d}$$

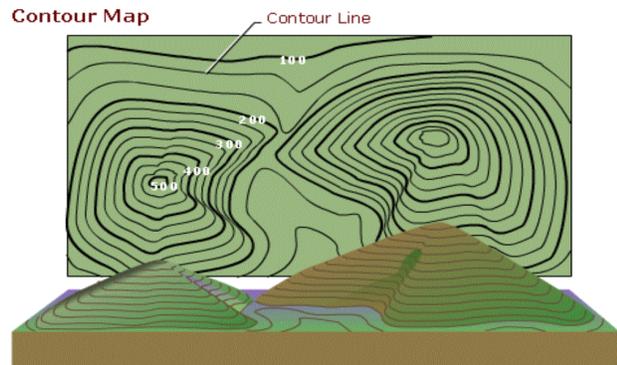
In general

$$E = -\frac{\Delta V}{\Delta s}$$

- E is gradient (_____) of V vs. s (_____)
- On picture, E -field lines show _____. V lines are where V are _____
- The closer V _____ are, the _____ E is.



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?



A doubly charged ion is accelerated to an energy of 15.0 keV by the electric field between two parallel conducting plates separated by 3.00 mm. What is the electric field strength between the plates?

Homework

1. Discuss how potential difference and electric field strength are related. Give an example.
2. What is the strength of the electric field in a region where the electric potential is constant?
3. Will a negative charge, initially at rest, move toward higher or lower potential? Explain why.
4. Show that units of V/m and N/C for electric field strength are indeed equivalent. (OpenStax 19.13)
5. 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**
6. 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**
7. 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**
8. 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) **8.89×10^6 V/m**
9. 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**
10. A doubly charged ion is accelerated to an energy of 32.0 keV by the electric field between two parallel conducting plates separated by 2.00 cm. What is the electric field strength between the plates? (OpenStax 19.22) **8.00×10^5 V/m**
11. An electron is to be accelerated in a uniform electric field having a strength of 2.00×10^6 V/m. (a) What energy in keV is given to the electron if it is accelerated through 0.400 m? (b) Over what distance would it have to be accelerated to increase its energy by 50.0 GeV? (OpenStax 19.23) **800 keV, 25.0 km**