Week 9

Detailed learning goals

By completing this topic, you should be able to:

- Define electric potential and electric potential energy
- Describe the relationship between potential difference and electrical potential energy
- Determine electric potential energy given potential difference and amount of charge
- Use the law of conservation of energy to understand the change of energy in a charge
- Explain point charges and express the equation for electric potential and electrical potential energy of point charges
- Explain the electron volt unit.

Prescribed readings for SLE123 content

Please read the following sections from Giambattista Physics (5th ed.). New York: McGraw-Hill:

- Section 17.1 Electric Potential Energy.
- Section 17.2 Electric Potential.
- Section 26.7 Mass and Energy.
- focus on the electron volt.

Problem solving :

9.1 A proton is moved at a constant velocity from a position at which the electrical potential is 100 V to one at which the electrical potential is −50 V.
(a) How much work was done on the proton by the electric field?
(b) How much work was done on the proton by the external force?

Answer: (a)$W_{elec} = +2.4\times10^{-17}$ J (b)$W_{ext} = -2.4\times10^{-17}$ J

9.2 In a region of space there is a uniform 6000NC^{-1} electric field like that shown in Figure below.

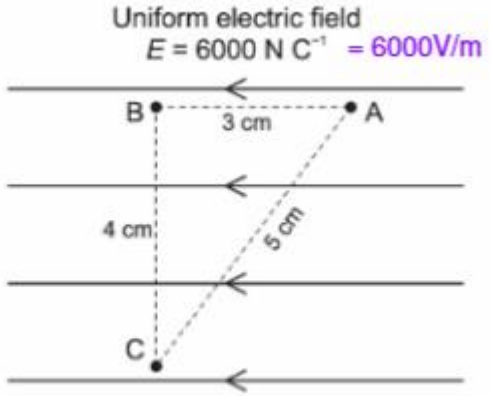
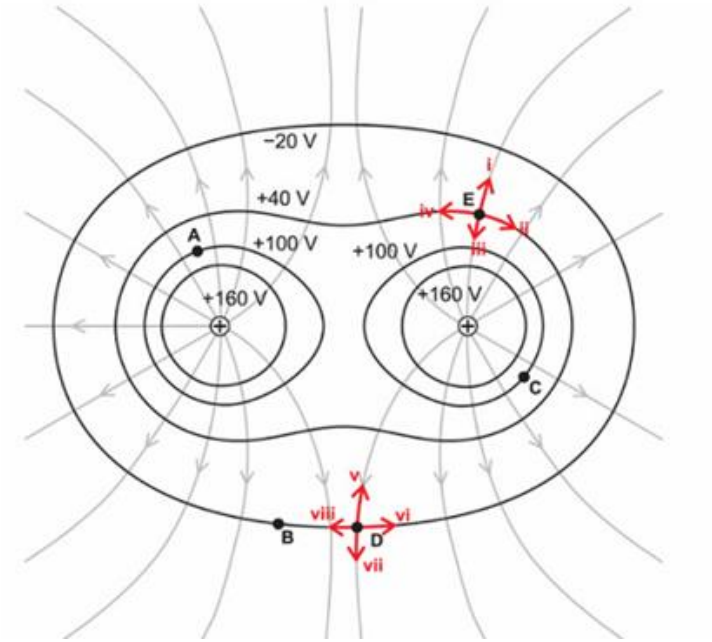


Figure 25.21
Three points in a region of uniform electric field.

(a) What is the potential difference between points A and B? Which point is at the lower electrical potential?
(b) What is the potential difference between points A and C? Which point is at the lower electrical potential?
(c) What is the potential difference between points B and C? Which point is at the lower electrical potential?

Answer: (a) V_{AB} = 180 V, B is at the lower electrical potential (b) V_{AC} = 180 V, C is at the lower electrical potential
(c) V_{BC} = 0 V, both points are at the same electrical potential

9.3 Use Figure below to answer the following questions.



The electric field and some equipotential in the region around two positive charges

(a) What is the potential difference between points A and B?
(b) How much work does the electric field do on a −0.5 C charge that is moved from A to C?
(c) If a −5 C charge is released from point D which path would it take?
(d) If a +6 C charge is released from point E which path would it take?

Answer: (a) V_{AB} = 120 V (B is at the lower potential) (b)W_{elec} = 0 J (c) v (d) i

9.4 At rest, the potential inside a nerve cell is lower than that of the extracellular fluid. The membrane potential, the potential difference between the inside and outside of the cell membrane, is 70mV.
(a) What is the change in electrical potential energy of the sodium ion when moving from inside the cell to outside the cell?
(b) How much work must be done on a sodium ion (Na+) to move it from inside the cell to outside the cell
Answer: (a) ¢PE = $+1.12\times10^{-20}$ J (b)W = $+1.12\times10^{-20}$ J