Answer on Question 59025, Physics, Electric Circuits

Question:

The following are true about electric field lines except that they

a) are drawn such that the magnitude of the field is proportional to the number of lines crossing a unit area perpendicular to the lines

b) do not intersect one another

c) are discontinuous and may terminate in a vacuum

d) give the direction of motion of a unit positive test-charge under the action of the electrostatic force

Solution:

There are variety of rules to drawing the patterns of electric fields lines. One common rule is to surround more charged objects by more lines. Objects with greater charge create stronger electric fields. By surrounding a highly charged object with more lines, one can communicate the strength of an electric field in the space surrounding a charged object by the line density. Line density in an electric field line pattern reveals information about the strength or magnitude of an electric field. Thus, a) is true

Another rule for drawing electric field lines involves the intersection of lines. Electric field lines should never cross. So, c) is true.

The electric fields lines give the direction of motion of a unit positive test-charge under the action of the electrostatic force, so d) is true.

But, the electric field lines can't terminate. Thus the wrong answer is c).

Answer:

c) are discontinuous and may terminate in a vacuum

7. What are the dimensions of the constant k in Coulomb's law of electrostatics?

a) $ML^2T^{-4}T^{-2}A^{-1}$

b) $ML^2T^3A^{-2}$

c) $M^{-2}L^3T^2A^{-1}$

d) $ML^3T^{-4}A^{-2}$

Solution:

Let's write the Coulomb's law of electrostatics:

$$F_e = k\frac{q_1 q_2}{r^2},$$

here, F_e is the electric force between two point charges, q_1, q_2 are the charges and r is the distance between the charges, k is the Coulomb constant.

Then, from this equation we can find k:

$$k = F_e\frac{r^2}{q_1 q_2},$$

here, the dimension of the electric force is newton (N), the dimension of the distance is meter (m) and the dimension of the charge is coulomb (C).

Let's write the dimension of newton. By the definition of the Newton's second law of motion we have:

$$F = ma,$$

$$[N] = \left[kg \cdot \frac{m}{s^2}\right] = \left[M \cdot \frac{L}{T^2}\right].$$

Also, if we recall the definition of the electric current ($I = \frac{\Delta Q}{\Delta t}$), we can write the dimension of coulomb:

$$\Delta Q = I\Delta t,$$

$$[C] = [A] \cdot [s] = [A] \cdot [T].$$

Finally, we get:

$$k = F_e\frac{r^2}{q_1 q_2} = [M] \cdot \left[\frac{L}{T^2}\right] \cdot \frac{[L^2]}{[A^2] \cdot [T^2]} = [M] \cdot [L^3] \cdot [T^{-4}] \cdot [A^{-2}].$$

Thus, the correct answer is d) $ML^3T^{-4}A^{-2}$.

Answer:

d) $ML^3T^{-4}A^{-2}$.