

Answer on Question #45978– Physics – Electromagnetism

Question: what are the dimensions of the constant k in Coulomb's law of electrostatics?

Solution: Coulomb's law of electrostatics yields:

$$F = k \cdot \frac{q_1 q_2}{r},$$

where q_1, q_2 are the signed magnitudes of the charges and r is the distance between them. To find the dimensions of the constant k , we express it through quantities F, q_1, q_2, r :

$$k = \frac{F \cdot r}{q_1 q_2}$$

Therefore

$$[k] = \frac{[F] \cdot [r]}{[q_1] \cdot [q_2]}.$$

In SI electrical charge has the dimensions

$$[Q] = [A] \cdot [T]$$

and force has the dimensions

$$[F] = [N] = [M] \cdot \frac{[L]}{[T]^2}.$$

Thus the constant k has the dimensions

$$[k] = \frac{[M] \cdot [L] \cdot [L]}{[T]^2 \cdot [A]^2 \cdot [T]^2} = \frac{[M] \cdot [L]^2}{[A]^2 \cdot [T]^4}.$$

Answer:

$$[k] = \frac{[M] \cdot [L]^2}{[A]^2 \cdot [T]^4}.$$