

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

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

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

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

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

Coulomb's law of electrostatics:

$$F = \frac{k(q_1q_2)}{r^2}$$

where F – force, q – charge, r – distance.

Therefore k equals:

$$k = \frac{Fr^2}{q_1q_2}$$

dimension of force is N, dimension of distance is meter, dimension of charge is C.

Newton's second law of motion: $F = m * a$, therefore dimension of N:

$$[N] = \left[kg * \frac{m}{s^2} \right]$$

And, by definition: $I = \frac{dq}{dt}$, therefore dimension of C: $C = A * s$

Finally, for k we have:

$$[k] = \left[kg * \frac{m}{s^2} * \frac{m^2}{(A * s)^2} \right] = \left[\frac{kg m^3}{s^4 A^2} \right]$$

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

Answer: d.