Answer on Question #51632-Physics-Electromagnetism

1. A uniform electric field of 2000 N/C is in the x-direction. A point charge of 3μC is released from rest at the origin. What is the kinetic energy of the charge when it is at x = 4 m?

a. $2.4 \cdot 10^{-2}$J. b. $1.6 \cdot 10^{-2}$J. c. $3.6 \cdot 10^{-2}$J. J d. $4.8 \cdot 10^{-2}$J.

Solution

By the law of conservation of energy the work, done by the electric field:

$$W = Eqx$$

is equal to the kinetic energy. Thus, kinetic energy of a charge is:

$$K = W = Eqx$$

$$K = 2000\frac{\text{N}}{\text{C}} \cdot 3 \cdot 10^{-6}\text{C} \cdot 4\text{ m} = 2.4 \cdot 10^{-2}\text{J}.$$

Answer: a. $\mathbf{2.4 \cdot 10^{-2}J}$.

2. Two large horizontal metal plates are separated by 4 mm. The lower plate is at a potential of −6V. What potential should be applied to the upper plate to create electric field strength of 4000 V/m upwards in the space between the plates?

a. +22V b. +10V c. −10V d. −22V

Solution

By definition the electric field is equal to:

$$E = \frac{\Delta\varphi}{l}.$$

Electric field is defined by potential difference $\Delta\varphi = |\varphi_1 - \varphi_2|$. We know that electric field is directed from a higher potential to lower. In our case, electric field is directed upwards, from lower plate to upper plate. So, the potential of lower plate is bigger. That's why:

Therefore, we can find the potential of upper plate:

$$\varphi_2 = \varphi_1 - El = -6V - 4000\frac{\text{V}}{\text{m}} \cdot 4 \cdot 10^{-3}m = -22\ V.$$

Answer: d. −22V.

3. An ac circuit consists of a voltage source v=200sin120πt and a 6μF capacitor in series. Calculate the current established in the circuit

a. 0.32A b. 1.24A c. 0.64A d. 2.13A

Solution

Reactance of a capacitor equals:

$$X_c = \frac{1}{\omega C} = \frac{1}{120\pi\frac{1}{s} \cdot 6\mu F} = 442.1\ \Omega.$$

Therefore amplitude of current equals:

$$I_{max} = \frac{U}{X_c} = 0.45\ A.$$

The root mean square value of the current is

$$I = \frac{I_{max}}{\sqrt{2}} = 0.32\ A.$$

Answer: a. 0.32A.

4. Gauss's law says that the net flux passing through a Gaussian sphere is equal to the charge enclosed divided by?

a.1 b. $\frac{1}{\varepsilon_0}$ c. 0 d. ε_0

Solution

Gauss's law:

$$\Phi_{net} = \frac{Q_{enclosed}}{\varepsilon_0}.$$

Answer: d. $\boldsymbol{\varepsilon_0}$.