

Cp physics web review ch 18 Electric Fields and Capacitors**Please do not write on my tests****Multiple Choice***Identify the choice that best completes the statement or answers the question.*

- _____ 1. Two point charges, initially 1 cm apart, are moved to a distance of 3 cm apart. By what factor do the resulting electric and gravitational forces between them change?
- | | |
|------|------------------|
| a. 9 | c. $\frac{1}{3}$ |
| b. 3 | d. $\frac{1}{9}$ |
- _____ 2. A conductor that is in electrostatic equilibrium has an electric field inside the conductor that
- depends on the radius of the conductor.
 - is zero.
 - is greatest near the conductor's surface.
 - is parallel to the surface of the conductor.
- _____ 3. The electric field just outside a charged conductor in electrostatic equilibrium is
- zero.
 - at its minimum level.
 - the same as it is in the center of the conductor.
 - perpendicular to the conductor's surface.
- _____ 4. Electric field strength depends on
- | | |
|-------------------------|----------------------------------|
| a. charge and distance. | c. Coulomb constant and mass. |
| b. charge and mass. | d. elementary charge and radius. |
- _____ 5. When a capacitor discharges,
- it must be attached to a battery.
 - charges move through the circuit from one plate to the other until both plates are uncharged.
 - charges move from one plate to the other until equal and opposite charges accumulate on the two plates.
 - it cannot be connected to a material that conducts.
- _____ 6. A capacitor consists of two metal plates; _____ is stored on one plate, and _____ is stored on the other.
- | | |
|-------------------------------------|--|
| a. negative charge, positive charge | c. potential difference, internal resistance |
| b. potential energy, kinetic energy | d. residual charge, induced charge |
- _____ 7. What effect will be produced on a capacitor if the separation between the plates is increased?
- | | |
|---------------------------------|--------------------------------------|
| a. It will increase the charge. | c. It will increase the capacitance. |
| b. It will decrease the charge. | d. It will decrease the capacitance. |
- _____ 8. Increasing the potential difference between the plates of a capacitor will produce what effect on the capacitor?
- It will increase the charge on each plate.
 - It will decrease the charge on each plate.
 - It will increase the capacitance.
 - It will decrease the capacitance.

**Cp physics web review ch 18 Electric Fields and Capacitors
Answer Section**

MULTIPLE CHOICE

1. D
2. B
3. D
4. A
5. B
6. A
7. D
8. A
9. B
10. D
11. B

PROBLEM

12. $1.3 \times 10^9 \text{ N/C}$

Given

$$r_1 = r_2 = 2.0 \text{ cm} = 2.0 \times 10^{-2} \text{ m}$$

$$\theta_1 = 0^\circ$$

$$\theta_2 = 180^\circ$$

$$q_1 = 30 \text{ } \mu\text{C} = 3.0 \times 10^{-5} \text{ C}$$

$$q_2 = -30 \text{ } \mu\text{C} = -3.0 \times 10^{-5} \text{ C}$$

$$k_c = 8.99 \times 10^9 \text{ Nm}^2/\text{C}^2$$

Solution

$$E_1 = k_c \frac{q_1}{r_1^2} = \left(8.99 \times 10^9 \text{ Nm}^2/\text{C}^2 \right) \left(\frac{3.0 \times 10^{-5} \text{ C}}{\left(2.0 \times 10^{-2} \text{ m} \right)^2} \right) = 6.7 \times 10^8 \text{ N/C}$$

$$E_2 = k_c \frac{q_2}{r_2^2} = \left(8.99 \times 10^9 \text{ Nm}^2/\text{C}^2 \right) \left(\frac{-3.0 \times 10^{-5} \text{ C}}{\left(2.0 \times 10^{-2} \text{ m} \right)^2} \right) = -6.7 \times 10^8 \text{ N/C}$$

$$\text{For } E_1 : E_{x,1} = (E_1)(\cos 0^\circ) = (6.7 \times 10^8 \text{ N/C})(\cos 0^\circ) = 6.7 \times 10^8 \text{ N/C}$$

$$E_{y,1} = 0 \text{ N/C}$$

$$\text{For } E_2 : E_{x,2} = (E_2)(\cos 180^\circ) = (-6.7 \times 10^8 \text{ N/C})(\cos 180^\circ) = 6.7 \times 10^8 \text{ N/C}$$

$$E_{y,2} = 0 \text{ N/C}$$

$$E_{x,tot} = E_{x,1} + E_{x,2} = 6.7 \times 10^8 \text{ N/C} + 6.7 \times 10^8 \text{ N/C} = 1.3 \times 10^9 \text{ N/C}$$

$$E_{y,tot} = E_{y,1} + E_{y,2} = 0 \text{ N/C} + 0 \text{ N/C} = 0 \text{ N/C}$$

$$E_{tot} = \sqrt{\left(E_{x,tot} \right)^2 + \left(E_{y,tot} \right)^2} = \sqrt{\left(1.3 \times 10^9 \text{ N/C} \right)^2 + 0} = 1.3 \times 10^9 \text{ N/C}$$

$$E_{tot} = 1.3 \times 10^9 \text{ N/C}$$

13. $4.8 \times 10^6 \text{ N/C}$ *Given*

$$q_1 = 4.0 \times 10^{-6} \text{ C}$$

$$q_2 = -6.0 \times 10^{-6} \text{ C}$$

$$\theta = 60^\circ$$

$$r_1 = 1.0 \times 10^{-1} \text{ m}$$

$$r_2 = 1.0 \times 10^{-1} \text{ m}$$

$$k_C = 8.99 \times 10^9 \text{ Nm}^2/\text{C}^2$$

Solution

$$E_1 = k_C \frac{q_1}{r_1^2} = \left(8.99 \times 10^9 \text{ Nm}^2/\text{C}^2 \right) \left(\frac{4.0 \times 10^{-6} \text{ C}}{\left(1.0 \times 10^{-1} \text{ m} \right)^2} \right) = 3.6 \times 10^6 \text{ N/C}$$

$$E_2 = k_C \frac{q_2}{r_2^2} = \left(8.99 \times 10^9 \text{ Nm}^2/\text{C}^2 \right) \left(\frac{-6.0 \times 10^{-6} \text{ C}}{\left(1.0 \times 10^{-1} \text{ m} \right)^2} \right) = -5.4 \times 10^6 \text{ N/C}$$

$$\text{For } E_1 : E_{x,1} = (E_1)(\cos 60^\circ) = (3.6 \times 10^6 \text{ N/C})(\cos 60^\circ) = 1.8 \times 10^6 \text{ N/C}$$

$$E_{y,1} = (E_1)(\sin 60^\circ) = (3.6 \times 10^6 \text{ N/C})(\sin 60^\circ) = 3.1 \times 10^6 \text{ N/C}$$

$$\text{For } E_2 : E_{x,2} = -(E_2)(\cos 60^\circ) = -(-5.4 \times 10^6 \text{ N/C})(\cos 60^\circ) = 2.7 \times 10^6 \text{ N/C}$$

$$E_{y,2} = (E_2)(\sin 60^\circ) = (-5.4 \times 10^6 \text{ N/C})(\sin 60^\circ) = -4.7 \times 10^6 \text{ N/C}$$

$$E_{x,tot} = E_{x,1} + E_{x,2} = 1.8 \times 10^6 \text{ N/C} + 2.7 \times 10^6 \text{ N/C} = 4.5 \times 10^6 \text{ N/C}$$

$$E_{y,tot} = E_{y,1} + E_{y,2} = 3.1 \times 10^6 \text{ N/C} + (-4.7 \times 10^6 \text{ N/C}) = -1.6 \times 10^6 \text{ N/C}$$

$$E_{tot} = \sqrt{\left(E_{x,tot} \right)^2 + \left(E_{y,tot} \right)^2} = \sqrt{\left(4.5 \times 10^6 \text{ N/C} \right)^2 + \left(-1.6 \times 10^6 \text{ N/C} \right)^2} = 4.8 \times 10^6 \text{ N/C}$$

$$E_{tot} = 4.8 \times 10^6 \text{ N/C}$$

14. $1.25 \times 10^{-2} \text{ m}$

Given

$E = 3279 \text{ N/C}$

$q = 5.72 \times 10^{-11} \text{ C}$

$k_c = 8.99 \times 10^9 \text{ Nm}^2/\text{C}^2$

Solution

$$E = k_c \frac{q}{r^2}$$

Rearrange to solve for r .

$$r = \sqrt{k_c \frac{q}{E}} = \sqrt{\left(8.99 \times 10^9 \text{ Nm}^2/\text{C}^2\right) \left(\frac{5.72 \times 10^{-11} \text{ C}}{3279 \text{ N/C}}\right)}$$

$r = 1.25 \times 10^{-2} \text{ m}$

15. $3.3 \times 10^{-6} \text{ C}$

Given

$q_1 = q_2$

$r_{\text{total}} = 1.0 \text{ m}$

$r_1 = r_2 = 0.50 \text{ m}$

$E_{\text{total}} = 2.4 \times 10^5 \text{ N/C}$

$k_c = 8.99 \times 10^9 \text{ Nm}^2/\text{C}^2$

Solution

$$E_1 = E_2 = \frac{E_{\text{total}}}{2} = \frac{2.4 \times 10^5 \text{ N/C}}{2} = 1.2 \times 10^5 \text{ N/C}$$

$$E_1 = k_c \frac{q_1}{r_1^2}$$

Rearrange to solve for q_1 .

$$q_1 = \frac{E_1 r_1^2}{k_c} = \frac{\left(1.2 \times 10^5 \text{ N/C}\right) (0.50 \text{ m})^2}{8.99 \times 10^9 \text{ Nm}^2/\text{C}^2} = 3.3 \times 10^{-6} \text{ C}$$

$q_1 = q_2 = 3.3 \times 10^{-6} \text{ C}$

16. $2.8 \times 10^{-12} \text{ F}$

Given

$$l = 4.0 \text{ cm} = 4.0 \times 10^{-2} \text{ m}$$

$$d = 5.0 \text{ mm} = 5.0 \times 10^{-3} \text{ m}$$

$$\epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2/\text{N}\cdot\text{m}^2$$

Solution

$$A = l^2 = (4.0 \times 10^{-2} \text{ m})^2 = 1.6 \times 10^{-3} \text{ m}^2$$

$$C = \epsilon_0 \frac{A}{d} = (8.85 \times 10^{-12} \text{ C}^2/\text{Nm}^2) \left(\frac{1.6 \times 10^{-3} \text{ m}^2}{5.0 \times 10^{-3} \text{ m}} \right)$$

$$C = 2.8 \times 10^{-12} \text{ F}$$

17. $2.4 \times 10^{-5} \text{ J}$

Given

$$C = 0.75 \text{ }\mu\text{F} = 7.5 \times 10^{-7} \text{ F}$$

$$Q = 6.0 \text{ }\mu\text{C} = 6.0 \times 10^{-6} \text{ C}$$

Solution

Find the voltage across the capacitor, using the equation for capacitance.

$$C = \frac{Q}{\Delta V}$$

Rearrange to solve for ΔV .

$$\Delta V = \frac{Q}{C} = \frac{6.0 \times 10^{-6} \text{ C}}{7.5 \times 10^{-7} \text{ F}} = 8.0 \text{ V}$$

Find the potential energy.

$$PE_{\text{electric}} = \frac{1}{2} C (\Delta V)^2 = \frac{1}{2} (7.5 \times 10^{-7} \text{ F})(8 \text{ V})^2$$

$$PE_{\text{electric}} = 2.4 \times 10^{-5} \text{ J}$$