Classroom Response System Questions

Chapter 23 Gauss’ Law

Reading Quiz Questions
23.2.1. At one point during a rain storm, the rain is falling at a constant rate of \( n \) drops per square meter at an angle of 60° with respect to the horizontal direction. Unfortunately Ted has left three windows open: (1) the sunroof on his car that measures 0.6 m by 0.3 m, (2) his bathroom window that measures 0.6 m by 0.2 m; and (3) his bedroom window that measures 0.6 m by 0.3 m. The bedroom and bathroom windows are perpendicular to the ground and the sunroof is parallel to the ground. Which of the window openings has the greatest flux?

a) 1

b) 2

c) 3

d) 1 and 3 have the same flux

e) 2 and 3 have the same flux
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23.3.1. In each of the four cases below a Gaussian circle is represented by the dashed line circle and the arrows represent electric field lines. In which of the four cases is the flux through the Gaussian circle not equal to zero?

a) A and B only

b) C and D only

c) A only

d) D only

e) A, B, C, and D
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a) A and B only

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c) A only

d) D only

e) A, B, C, and D
23.3.2. Imagine a closed Gaussian surface and a particle that has a net charge $q$. Consider the following two statements: (1) “If the particle is enclosed by the surface the net electric flux through the surface cannot be equal to zero N/C.” and (2) “If the particle is near the closed Gaussian surface, but outside of it, the net electric flux through the surface must be equal to zero N/C.” Which of these two statements is true, if either?

a) 1 only

b) 2 only

c) 1 and 2

d) Neither statement is true.
23.3.2. Imagine a closed Gaussian surface and a particle that has a net charge \( q \). Consider the following two statements: (1) “If the particle is enclosed by the surface the net electric flux through the surface cannot be equal to zero N/C.” and (2) “If the particle is near the closed Gaussian surface, but outside of it, the net electric flux through the surface must be equal to zero N/C.” Which of these two statements is true, if either?

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d) Neither statement is true.
23.4.1. Which of the following laws, principles, or definitions describes the electric flux through a surface that encloses a charge?

a)  Amonton’s law

b)  Gauss’ law

c)  Carnot’s principle

d)  definition of a fluxon

e)  electric flux principle
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23.4.2. A conducting sphere (shown in grey in the drawing) of radius $R$ has a charge $q$ distributed uniformly over its surface. A spherically-shaped Gaussian surface with a radius $r < R$ is represented in the drawing by the dashed circle. Applying Gauss’ law, what is the magnitude of the electric field inside the Gaussian sphere?

a) \( \frac{q}{4\pi\varepsilon_0 r} \)

b) \( \frac{q}{4\pi\varepsilon_0 r^2} \)

c) zero N/C

d) \( \frac{q}{r} \)

e) \( \frac{4\pi\varepsilon_0 r^2}{q} \)
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c) zero N/C

d) $\frac{q}{r}$

e) $\frac{4\pi \varepsilon_0 r^2}{q}$
23.4.3. To what does Gauss’ law relate the electric field at points on a Gaussian surface?

a) charges near the surface

b) electric field flux leaving the volume enclosed by the surface

c) electric field flux entering the volume enclosed by the surface

d) net charge enclosed by the surface

e) velocity of charges entering or leaving the surface
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23.4.4. Consider the three charges shown in drawings A and B. The values of the charges are 
\[ q_1 = +4 \times 10^{-7} \text{ C}; \quad q_2 = +2 \times 10^{-7} \text{ C}; \quad q_3 = -2 \times 10^{-7} \text{ C}. \] In drawing A, a Gaussian surface surrounds charge \( q_1 \); and in drawing B, the Gaussian surface surrounds all three charges. Which one of the following statements concerning the electric flux through the two Gaussian surfaces is true?

a) The flux through the Gaussian surface in drawing A is greater than the flux through the Gaussian surface in drawing B.

b) The flux through the Gaussian surface in drawing A is the same as the flux through the Gaussian surface in drawing B.

c) The flux through the Gaussian surface in drawing A is less than the flux through the Gaussian surface in drawing B.
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23.5.1. Which of the following laws or principles can be derived from Gauss’ law?

a) Amonton’s law

b) Coulomb’s law

c) Carnot’s principle

d) definition of a fluxon

e) electric flux principle
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23.6.1. Which of the following statements concerning the electric field inside a conductor is true?

a) The electric field inside a conductor is never zero N/C.

b) The electric field inside a conductor is always zero N/C.

c) The electric field inside a conductor can only be non-zero if charges inside the conductor are moving.

d) The electric field inside a conductor is always zero N/C, unless there are excess charges inside the conductor.

e) Two or more of the above answers are correct.
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e) Two or more of the above answers are correct.
23.6.2. Gauss’ law can be used to prove that all excess charge in a conductor distributes itself on the surface of the conductor. Which one of the following choices is a consequence of this proof?

a) There would be a non-zero electric field if any net charge was not on the surface.

b) Charges can never be inside the conductor.

c) A Gaussian surface around the whole conductor encloses all of the charge.

d) The flux through a Gaussian surface inside the sphere is zero.

e) The electric field inside a conductor is always equal to zero N/C.
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e) The electric field inside a conductor is always equal to zero N/C.
23.6.3. Why must the electric field at the surface of a conductor be perpendicular to the surface?

a) Excess charge in a conductor always moves to the surface of the conductor.

b) Flux is always perpendicular to the surface.

c) If it was not perpendicular, then charges on the surface would be moving.

d) The electric field lines from a single charge extend radially outward or inward.

e) None of the above choices are correct.
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e) None of the above choices are correct.
23.6.4. A positively charged particle is located inside a thin conducting shell that has a radius $R$. As shown, the charge $Q$ is located at a distance $R/2$ from the center of the spherical shell. Which of the following is the electric field at a distance $3R$ from the particle?

a) $E = \frac{1}{4\pi\varepsilon_0} \frac{Q}{9R^2}$

b) $E = \frac{1}{4\pi\varepsilon_0} \frac{Q}{\frac{5}{2}R^2}$

c) $E = \frac{1}{4\pi\varepsilon_0} \frac{Q}{\frac{5}{2}R^2}$

d) $E = \frac{1}{4\pi\varepsilon_0} \frac{Q}{\frac{7}{2}R^2}$

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23.6.5. A spherical conductor has a radius $R$ and a tiny spherical cavity at its center that has a radius $R/10$. The conductor is otherwise solid. Inside the cavity is a positive charge $Q$. What is the electric field at a distance $R/2$ from the center?

a) zero N/C

b) $E = \frac{1}{4\pi\varepsilon_0} \frac{Q}{R^2}$

c) $E = \frac{1}{4\pi\varepsilon_0} \frac{Q}{\frac{1}{2}R^2}$

d) $E = \frac{1}{4\pi\varepsilon_0} \frac{Q}{\frac{1}{10}R^2}$

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e) $E = \frac{1}{4\pi \varepsilon_0} \frac{Q}{\frac{1}{2} R}$
23.7.1. What is the best choice for the shape of a Gaussian surface?

a) spherical

b) cylindrical

c) cubic

d) It should be one that encloses the smallest volume.

e) It should be one that matches the symmetry of the charge distribution.
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a) spherical

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23.7.2. The image shown is taken from the text. Why was this woman in danger according to the text?

a) The electric field could have broken down and her hair would have caught fire.

b) The electric field was about to cause a breakdown in the air surrounding her and she would have suffocated.

c) The electric field surrounding her would soon attract a downward lightning bolt from a passing cloud.

d) The electric field was about to cause a breakdown in the surrounding air and an upward streamer would have resulted.
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23.8.1. Consider the situation shown to the left below. There are two parallel non-conducting plates. The plate on the left is positively charged with \((3/2)\) the surface charge density to that of the right plate, which is negatively charged. Which one of the drawings shows the correct net electric field that results from this situation?

a) A

b) B

c) C

d) D

e) None of these drawings is correct.
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e) None of these drawings is correct.
23.9.1. A spherical conductor has a radius \( R \) and a tiny spherical cavity at its center that has a radius \( R/10 \). The conductor is otherwise solid. Inside the cavity is a positive charge \( Q \). What is the electric field at a distance \( 2R \) from the center?

a) zero N/C

b) \( E = \frac{1}{4\pi\varepsilon_0} \frac{Q}{R^2} \)

c) \( E = \frac{1}{4\pi\varepsilon_0} \frac{Q}{\frac{1}{2}R^2} \)

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