Physics II
Exam 1 Review

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Outline

Must Knows!!

Constants:

$$k = \frac{1}{4\pi\varepsilon_0} = 8.99 \times 10^9 Nm^2/C^2$$

$$\varepsilon_0 = 8.85 \times 10^{-12} C^2/Nm^2$$

$$e = 1.692 \times 10^{-19} C$$

Volumes:

$$V_{Sphere} = \frac{4}{3}\pi r^3$$

$$V_{Cylinder} = \pi r^2 h$$

Multiple Choice

Chapter 21: Electric Charge

Question 1

The charge on a glass rod that has been rubbed with silk is called positive:

A by arbitrary convention

B so that the proton charge will be positive

C to conform to the conventions adopted for G and m in Newton's law of gravitation

D because like charges repel

E because glass is an insulator

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Answer: A

Question 2

A conductor is distinguished from an insulator with the same number of atoms by the number of:

A nearly free atoms

B electrons

C nearly free electrons

D protons

E molecules

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E molecules

Answer: C

Question 3

A positively charged metal sphere A is brought into contact with an uncharged metal sphere B. As a result:

A both spheres are positively charged

B A is positively charged and B is neutral

C A is positively charged and B is negatively charged

D A is neutral and B is positively charged

E A is neutral and B is negatively charged

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Answer: A

Question 4

A small object has charge Q. Charge q is removed from it and placed on a second small object. The two objects are placed 1 m apart. For the force that each object exerts on the other to be a maximum, q should be:

A $2Q$

B Q

C $\frac{Q}{2}$

D $\frac{Q}{4}$

E 0

Question 4

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B Q

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E 0

Answer: C

Question 5

Two identical conducting spheres A and B carry equal charge. They are separated by a distance much larger than their diameters. A third identical conducting sphere C is uncharged. Sphere C is first touched to A, then to B, and finally removed. As a result, the electrostatic force between A and B, which was originally F , becomes:

A $\frac{F}{2}$

B $\frac{F}{4}$

C $\frac{3F}{8}$

D $\frac{F}{16}$

E 0

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E 0

Answer: C

Chapter 22: Electric fields

Question 1

An electric field is most directly related to:

A the momentum of a test charge

B the kinetic energy of a test charge

C the potential energy of a test charge

D the force acting on a test charge

E the charge carried by a test charge

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Answer: D

Question 2

Experimenter A uses a test charge q_0 and experimenter B uses a test charge $2q_0$ to measure an electric field produced by stationary charges. A finds a field that is:

- A the same in both magnitude and direction as the field found by B
- B greater in magnitude than the field found by B
- C less in magnitude than the field found by B
- D opposite in direction to the field found by B
- E either greater or less than the field found by B, depending on the accelerations of the test charges

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Answer: A

Question 3

Two thin spherical shells, one with radius R and the other with radius $2R$, surround an isolated charged point particle. The ratio of the number of field lines through the larger sphere to the number through the smaller is:

A 1

B 2

C 4

D $\frac{1}{2}$

E $\frac{1}{4}$

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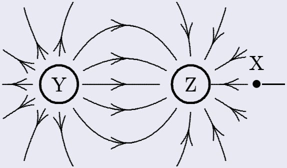
Answer: A

Question 4

The diagram shows the electric eld lines in a region of space containing two small charged spheres (Y and Z). Then:



A Y is negative and Z is positive

B the magnitude of the electric field is the same everywhere

C the electric field is strongest midway between Y and Z

D the electric field is not zero anywhere (except infinitely far from the spheres)

E Y and Z must have the same sign

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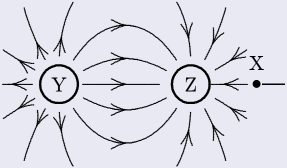

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Answer: D

Question 5

An isolated charged point particle produces an electric field with magnitude E at a point 2 m away from the charge. A point at which the field magnitude is $\frac{E}{4}$ is:

A 1 m away from the particle

B 0.5 m away from the particle

C 2 m away from the particle

D 4 m away from the particle

E 8 m away from the particle

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E 8 m away from the particle

Answer: D

Question 6

An electron traveling north enters a region where the electric field is uniform and points north. The electron:

A speeds up

B slows down

C veers east

D veers west

E continues with the same speed in the same direction

Question 6

An electron traveling north enters a region where the electric field is uniform and points north. The electron:

- A speeds up
- B slows down
- C veers east
- D veers west
- E continues with the same speed in the same direction

Answer: B

Question 7

An electric field exerts a torque on a dipole only if:

A the field is parallel to the dipole moment

B the field is not parallel to the dipole moment

C the field is perpendicular to the dipole moment

D the field is not perpendicular to the dipole moment

E the field is uniform

Question 7

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E the field is uniform

Answer: B

Chapter 23: Gauss' Law

Question 1

A charged point particle is placed at the center of a spherical Gaussian surface. The electric flux Φ_E is changed if:

A the sphere is replaced by a cube of the same volume

B the sphere is replaced by a cube of one-tenth the volume

C the point charge is moved off center (but still inside the original sphere)

D the point charge is moved to just outside the sphere

E a second point charge is placed just outside the sphere

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Answer: D

Question 2

The outer surface of the cardboard center of a paper towel roll:

A is a possible Gaussian surface

B cannot be a Gaussian surface because it encloses no charge

C cannot be a Gaussian surface since it is an insulator

D cannot be a Gaussian surface because it is not a closed surface

E none of the above

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Answer: D

Question 3

A point particle with charge q is placed inside the cube but not at its center. The electric flux through any one side of the cube:

A is zero

B is $\frac{q}{\varepsilon_0}$

C is $\frac{q}{4\varepsilon_0}$

D is $\frac{q}{6\varepsilon_0}$

E cannot be computed using Gauss law

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Answer: E

Question 4

A conducting sphere of radius $0.01m$ has a charge of $1.0 \times 10^{-9} C$ deposited on it. The magnitude of the electric field in $\frac{N}{C}$ just inside the surface of the sphere is:

A 0

B 450

C 900

D 4500

E $90,000$

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A 0

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C 900

D 4500

E $90,000$

Answer: A

Question 5

Charge is distributed uniformly along a long straight wire. The electric field $2cm$ from the wire is $20\frac{N}{C}$. The electric field $4cm$ from the wire is:

A $120\frac{N}{C}$

B $80\frac{N}{C}$

C $40\frac{N}{C}$

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Answer: D

Question 6

Positive charge Q is placed on a conducting spherical shell with inner radius R_1 and outer radius R_2 . A particle with charge q is placed at the center of the cavity. The magnitude of the electric field at a point in the cavity, a distance r from the center, is:

A zero

B $\frac{Q}{4\pi\varepsilon_0 R_1^2}$

C $\frac{q}{4\pi\varepsilon_0 r^2}$

D $\frac{q+Q}{4\pi\varepsilon_0 r^2}$

E $\frac{q+Q}{4\pi\varepsilon_0 \left(R_1^2 - r^2\right)}$

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Answer: C

Question 7

Positive charge Q is placed on a conducting spherical shell with inner radius R_1 and outer radius R_2 . A point charge q is placed at the center of the cavity. The magnitude of the electric field at a point outside the shell, a distance r from the center, is:

A zero

B $\frac{Q}{4\pi\varepsilon_0 r^2}$

C $\frac{q}{4\pi\varepsilon_0 r^2}$

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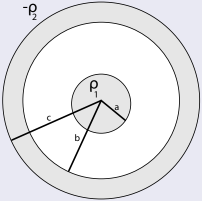
Answer: D

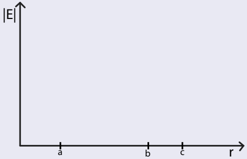
Problems

Problem 1

Problem 2

Consider a nonconducting solid of positive charge surrounded by a thin nonconducting spherical thick shell of charge. The solid sphere has radius a and a uniform volume charge density $+\rho$, while the spherical shell has an inner radius b and an outer radius c and an uniform charge density $-\rho$. The spheres are concentric.





Use Gauss' Law to find an expression for the magnitude of the electric filed.

A E_I in region $r < a$

B E_{II} in region $a < r < b$

C E_{III} in region $b < r < c$

D For $r > c$ $E = 0$, find $\frac{\rho_1}{\rho_2}$

E plot the magnitude of E. label the magnitude at $r = 0$, a, b, c.