Engineer Physics 1220_03 (EPCHIEN09080)

Bonus HW 2 [Edit]

Bonus HW 2

Due: 11:00am on Wednesday, October 29, 2014

You will receive no credit for items you complete after the assignment is due. Grading Policy

Conceptual Question 21.13

Description: (a) Two very large parallel sheets a distance d apart have their centers directly opposite each other. The sheets carry equal but opposite uniform surface charge densities. A point charge that is placed near the middle of the sheets a distance d/2...

Part A

Two very large parallel sheets a distance *d* apart have their centers directly opposite each other. The sheets carry equal but opposite uniform surface charge densities. A point charge that is placed near the middle of the sheets a distance *d*/2 from each of them feels an electrical force *F* due to the sheets. If this charge is now moved closer to one of the sheets so that it is a distance *d*/4 from that sheet, what force will feel?

ANSWER:

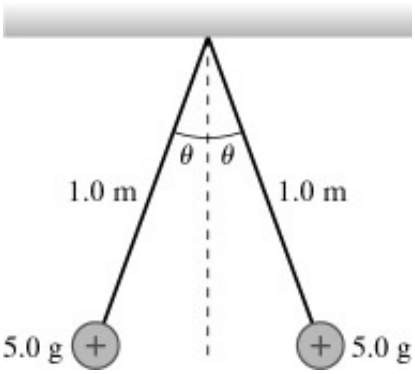
- (•) *F*
- ( ) 4*F*
- ( ) *F*/2
- ( ) *F*/4
- ( ) 2*F*

Problem 21.11

Description: (a) The figure shows two tiny 5.0-g spheres suspended from two very thin 1.0-m-long threads. The spheres repel each other after being charged to +v1 nC and hang at rest as shown. What is the angle θ? (k = 1/4πε = 8.99 × 109 N · m2/C2)...

Part A

The figure shows two tiny 5.0-g spheres suspended from two very thin 1.0-m-long threads. The spheres repel each other after being charged to +53 nC and hang at rest as shown. What is the angle θ? ($k = 1/4\pi\varepsilon_0 = 8.99 \times 10^9$ N · m^2/C^2)



ANSWER:

- 5.7°
- 8.5°
- 2.9°
- 11°

Problem 22.41

Description: A very long conducting tube (hollow cylinder) has inner radius a and outer radius b. It carries charge per unit length - alpha where alpha is a positive constant with units of C/m. A line of charge lies along the axis of the tube. The line of...

A very long conducting tube (hollow cylinder) has inner radius a and outer radius b. It carries charge per unit length $-\alpha$ where α is a positive constant with units of $\mathrm{C/m}$. A line of charge lies along the axis of the tube. The line of charge has charge per unit length $+\alpha$.

Part A

Calculate the magnitude the electric field in terms of α and the distance r from the axis of the tube for $r < a$.

Express your answer in terms of the variables α, r, and constants π and ϵ_0.

ANSWER:

$$E = \frac{\alpha}{2\pi\epsilon_0 r}$$

Part B

Find the direction of the electric field in terms of α and the distance r from the axis of the tube for $r < a$.

ANSWER:

- parallel to tube's axis
- radially outward
- radially inward
- the field is zero

Part C

Calculate the magnitude the electric field in terms of α and the distance r from the axis of the tube for $a < r < b$.

Express your answer in terms of the variables α, r, and constants π and ϵ_0.

ANSWER:

E = 0

Part D

Find the direction of the electric field in terms of α and the distance r from the axis of the tube for $a < r < b$.

ANSWER:

- parallel to tube's axis
- radially outward
- radially inward
- the field is zero

Part E

Calculate the magnitude the electric field in terms of α and the distance r from the axis of the tube for $r > b$.

Express your answer in terms of the variables α, r, and constants π and ϵ_0.

ANSWER:

E = 0

Part F

Find the direction of the electric field in terms of α and the distance r from the axis of the tube for $r > b$

ANSWER:

- parallel to tube's axis
- radially outward
- radially inward
- the field is zero

Part G

What is the charge per unit length on the inner surface of the tube?

Express your answer in terms of the given quantities and appropriate constants.

ANSWER:

$\alpha_{\text{inner}} = -\alpha$

Part H

What is the charge per unit length on the outer surface of the tube?

Express your answer in terms of the given quantities and appropriate constants.

ANSWER:

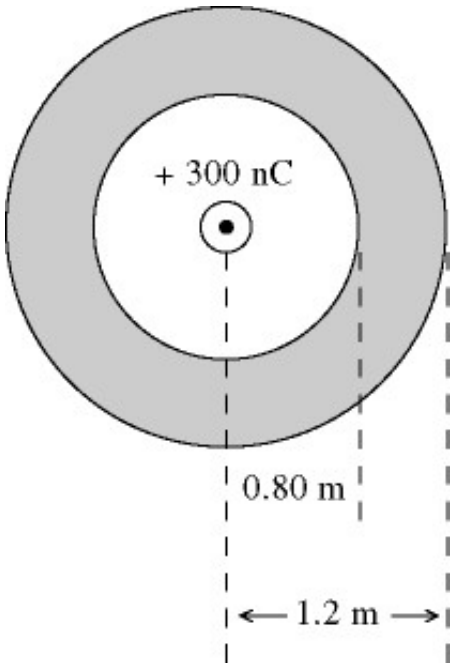
$\alpha_{\text{outer}} = 0$

Problem 22.29

Description: (a) A hollow conducting spherical shell has radii of 0.80 m and 1.20 m, as shown in the figure. The sphere carries a net excess charge of -500 nC. A point charge of +300 nC is present at the center. (k = 1/4π varepsilon_0 = 8.99 × 109 N · m2/C)...

Part A

A hollow conducting spherical shell has radii of 0.80 m and 1.20 m, as shown in the figure. The sphere carries a net excess charge of -500 nC. A point charge of +300 nC is present at the center. (k = 1/4$\pi\ \varepsilon_0$ = 8.99 × 10^9 N · m^2/C) The radial component of the electric field at a point that is 0.60 m from the center is closest to



ANSWER:

- zero.
- -5000 N/C.
- -7500 N/C.
- +5000 N/C.
- +7500 N/C.

Problem 23.70

Description: A thin insulating rod is bent into a semicircular arc of radius a, and a total electric charge Q is distributed uniformly along the rod. (a) Calculate the potential at the center of curvature of the arc if the potential is assumed to be zero at...

A thin insulating rod is bent into a semicircular arc of radius a, and a total electric charge Q is distributed uniformly along the rod.

Part A

Calculate the potential at the center of curvature of the arc if the potential is assumed to be zero at infinity.

Express your answer in terms of the given quantities and appropriate constants.

ANSWER:

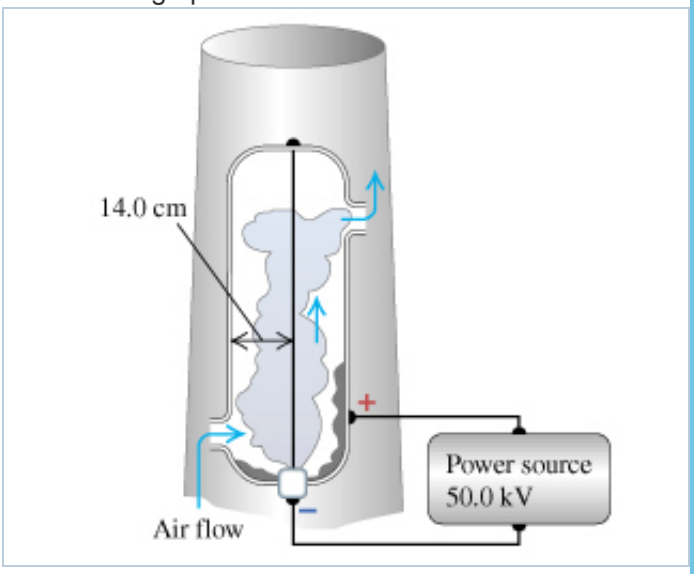
$V = \frac{kQ}{a}$

Also accepted: $\frac{Q}{4\pi\epsilon_0 a}$, $\frac{KQ}{a}$

Problem 23.67

Description: Electrostatic precipitators use electric forces to remove pollutant particles from smoke, in particular in the smokestacks of coal-burning power plants. One form of precipitator consists of a vertical, hollow, metal cylinder with a thin wire,...

Electrostatic precipitators use electric forces to remove pollutant particles from smoke, in particular in the smokestacks of coal-burning power plants. One form of precipitator consists of a vertical, hollow, metal cylinder with a thin wire, insulated from the cylinder, running along its axis . A large potential difference is established between the wire and the outer cylinder, with the wire at lower potential. This sets up a strong radial electric field directed inward. The field produces a region of ionized air near the wire. Smoke enters the precipitator at the bottom, ash and dust in it pick up electrons, and the charged pollutants are accelerated toward the outer cylinder wall by the electric field. Suppose the radius of the central wire is $93.0\mu\text{m}$, the radius of the cylinder is $14.0\ \text{cm}$, and a potential difference of $50.0\ \text{kV}$ is established between the wire and the cylinder. Also assume that the wire and cylinder are both very long in comparison to the cylinder radius.



Part A

What is the magnitude of the electric field midway between the wire and the cylinder wall?

ANSWER:

$$E = \frac{50000}{\ln\left(\frac{0.140}{a}\right)\cdot 0.070} = 9.76\times10^{4}\ \ \text{V/m}$$

Part B

What magnitude of charge must a $32.0\mu\text{g}$ ash particle have if the electric field computed in part (a) is to exert a force ten times the weight of the particle?

ANSWER:

$$q = \frac{10m\cdot 9.80}{\frac{50000}{\ln\left(\frac{0.140}{a}\right)\cdot 0.070}} = 3.21\times10^{-11}\ \ \text{C}$$

Problem 25.30

Description: (a) A cylindrical wire of radius r mm carries a current of I A. The potential difference between

points on the wire that are l m apart is V V.(a) What is the electric field in the wire?(b) What is the resistivity of the material of which the wire is ...

Part A

A cylindrical wire of radius 5 mm carries a current of 2.3 A. The potential difference between points on the wire that are 48 m apart is 4.0 V.
(a) What is the electric field in the wire?
(b) What is the resistivity of the material of which the wire is made?

ANSWER:

- (a) 192 V/m; (b) 7.11×10^{-7} Ω · m
- (a) 8.33×10^{-2} V/m; (b) 7.11×10^{-7} Ω · m
- (a) 192 V/m; (b) 2.85×10^{-6} Ω · m
- (a) 8.33×10^{-2} V/m; (b) 2.85×10^{-6} Ω · m

Problem 25.57

Description: On your first day at work as an electrical technician, you are asked to determine the resistance per meter of a long piece of wire. The company you work for is poorly equipped. You find a battery, a voltmeter, and an ammeter, but no meter for directly ...

On your first day at work as an electrical technician, you are asked to determine the resistance per meter of a long piece of wire. The company you work for is poorly equipped. You find a battery, a voltmeter, and an ammeter, but no meter for directly measuring resistance (an ohmmeter). You put the leads from the voltmeter across the terminals of the battery, and the meter reads 13.0V . You cut off a 20.0-m length of wire and connect it to the battery, with an ammeter in series with it to measure the current in the wire. The ammeter reads 6.50A . You then cut off a 40.0-m length of wire and connect it to the battery, again with the ammeter in series to measure the current. The ammeter reads 4.10A . Even though the equipment you have available to you is limited, your boss assures you of its high quality: The ammeter has very small resistance, and the voltmeter has very large resistance.

Part A

What is the resistance of 1 meter of wire?

ANSWER:

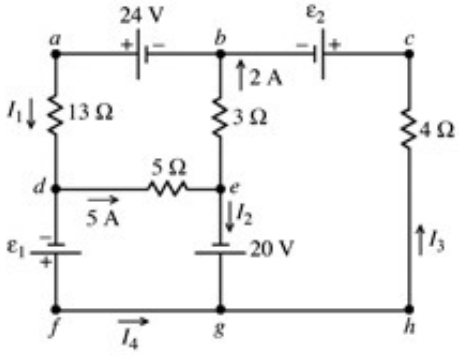
$$R = \frac{V}{20}\left(\frac{1}{I_2}-\frac{1}{I_1}\right) = 5.85\times10^{-2}\ \Omega$$

Problem 26.24

Description: (a) A multiloop circuit is shown in the figure. It is not necessary to solve the entire circuit. Compared to the polarity shown in the figure, the emf varepsilon_1 is closest to...

Part A

A multiloop circuit is shown in the figure. It is not necessary to solve the entire circuit. Compared to the polarity shown in the figure, the emf ε_1 is closest to



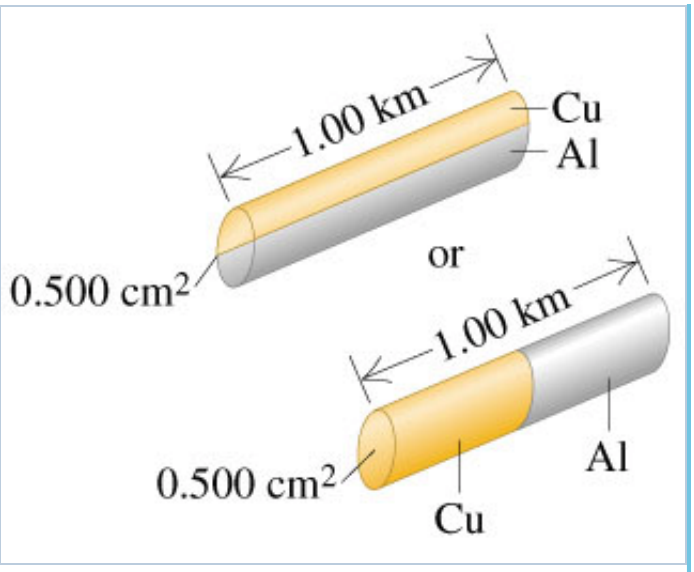
ANSWER:

- -51 V.
- 5 V.
- 45 V.
- 51 V.
- -5 V.

Problem 26.69

Description: A ## km cable having a cross-sectional area of ## cm^2 is to be constructed out of equal lengths of copper and aluminum. This could be accomplished either by making a ## km cable of each one and welding them together end to end or by making two...

A 1.00km cable having a cross-sectional area of 0.500cm^2 is to be constructed out of equal lengths of copper and aluminum. This could be accomplished either by making a 0.500km cable of each one and welding them together end to end or by making two parallel 1.00km cables, one of each metal. (See the figure .) (Resistivities of copper and aluminum are $1.72 \times 10^{-8}\ \Omega \cdot \text{m}$, $2.63 \times 10^{-8}\ \Omega \cdot \text{m}$ respectively.)



Part A

Calculate the resistance of the 1.00km cable for the connection in series.

ANSWER:

R = 0.435 Ω

Part B

Calculate the resistance of the 1.00km cable for the connection in parallel.

ANSWER:

R = 0.416 Ω