Assignment-3

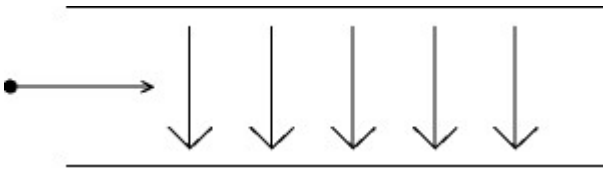
Due: 3:00pm on Friday, March 9, 2012

Note: You will receive no credit for late submissions. To learn more, read your instructor's Grading Policy

[Switch to Standard Assignment View]

Short Answer Question - 21.3

Part A



In the figure, a proton, mass 1.67×10^{-27} kg, is projected horizontally midway between two parallel plates that are separated by 0.60 cm, with an electrical field with magnitude 8×10^{5} N/C between the plates. If the plates are 4.00 cm long, find the minimum speed of the proton that just misses the lower plate as it emerges from the field.

ANSWER: **4.52×10⁶** *Correct* m/s

Exercise 21.66

The dipole moment of the water molecule (H_2O) is 6.17×10^{-30} C · m. Consider a water molecule located at the origin whose dipole moment $\vec{p}$ points in the +*x*-direction. A chlorine ion (Cl^-), of charge -1.60×10^{-19} C, is located at $x = 3.00 \times 10^{-9}$ m. Assume that x is much larger than the separation d between the charges in the dipole, so that the approximate expression for the electric field along the dipole axis can be used.

Part A

Find the magnitude of the electric force that the water molecule exerts on the chlorine ion.

ANSWER: F = **6.58×10⁻¹³** *Correct* N

Part B

What is the direction of the electric force.

ANSWER:

- **-*x*-direction**
- **+*x*-direction**

Correct

Part C

Is this force attractive or repulsive?

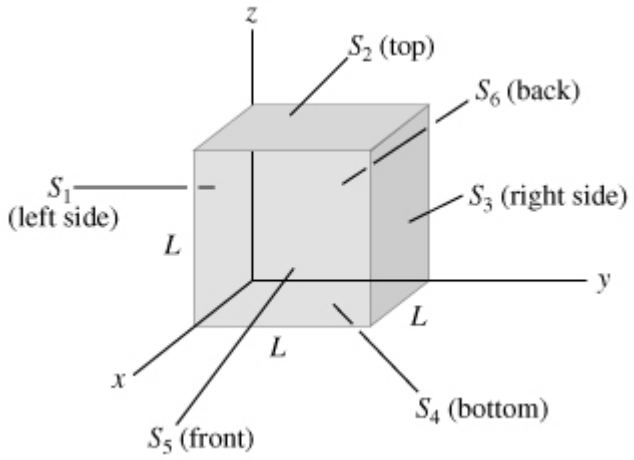
ANSWER:

- **attractive**
- **repulsive**

Correct

Problem 22.32

A cube has sides of length L. It is placed with one corner at the origin as shown in the figure . The electric field is uniform, and given by $\vec{E} = -B\hat{i} + C\hat{j} - D\hat{k}$ where B, C, D are positive constants.



Part A

Find the electric flux through the cube face S_1.

Express your answer in terms of the given quantities.

ANSWER:

$\Phi_1 = -CL^2$

Correct

Part B

Find the electric flux through the cube face S_2.

Express your answer in terms of the given quantities.

ANSWER:

$\Phi_2 = -DL^2$

Correct

Part C

Find the electric flux through the cube face S_3.

Express your answer in terms of the given quantities.

ANSWER: $\Phi_3 = +CL^2$

Correct

Part D

Find the electric flux through the cube face S_4.

Express your answer in terms of the given quantities.

ANSWER: $\Phi_4 = DL^2$

Correct

Part E

Find the electric flux through the cube face S_5.

Express your answer in terms of the given quantities.

ANSWER: $\Phi_5 = -BL^2$

Correct

Part F

Find the electric flux through the cube face S_6.

Express your answer in terms of the given quantities.

ANSWER: $\Phi_6 = BL^2$

Correct

Part G

Find the electric flux through the entire cube.

Express your answer in terms of the given quantities.

ANSWER: $\Phi_{\text{cube}} = 0$

Correct

Problem 22.48

A solid conducting sphere with radius R carries a positive total charge Q. The sphere is surrounded by an insulating shell with inner radius R and outer radius $2R$. The insulating shell has a uniform charge density ρ.

Part A

Find the value of ρ so that the net charge of the entire system is zero.

Express your answer in terms of the variables Q, R, and appropriate constants.

ANSWER:

$$\rho = -\frac{3Q}{28 \cdot pi \cdot R^3}$$

Correct

Part B

If ρ has the value found in part A, find the magnitude of the electric field in the region $0 < r < R$.

Express your answer in terms of the variables Q, R, r, and appropriate constants.

ANSWER:

$$E_1 = 0$$

Correct

Part C

If ρ has the value found in part A, find the magnitude of the electric field in the region $R < r < 2R$.

Express your answer in terms of the variables Q, R, r, and appropriate constants.

ANSWER:

$$E_2 = \frac{2}{7 \cdot pi \cdot \epsilon_0} \frac{Q}{r^2} - \frac{Q \cdot r}{28 \cdot pi \cdot \epsilon_0 \cdot R^3}$$

Correct

Part D

If ρ has the value found in part A, find the direction of the electric field in the region $R < r < 2R$.

ANSWER:

- **radially inward**
- **radially outward**

Correct

Part E

If ρ has the value found in part A, find the magnitude of the electric field in the region $r > 2R$.

Express your answer in terms of the variables Q, R, r, and appropriate constants.

ANSWER: E_3 = **0**
Correct

Part F

As a general rule, the electric field is discontinuous only at locations where there is a thin sheet of charge. Explain how your results in previous parts agree with this rule.

Essay answers are limited to about 500 words (3800 characters maximum, including spaces).

ANSWER:
My Answer:
Because we see a smooth transition from the uniform insulator to the surrounding space

Problem 22.50

Part A

How many excess electrons must be distributed uniformly within the volume of an isolated plastic sphere 30.0 cm in diameter to produce an electric field of 1300 $\mathrm{N/C}$ just outside the surface of the sphere?

ANSWER: N = **2.03×10^{10}** electrons
Correct

Part B

What is the electric field at a point 13.0 cm outside the surface of the sphere?

ANSWER: E = **373** $\mathrm{N/C}$
Correct

Exercise 23.44

The electric field at the surface of a charged, solid, copper sphere with radius 0.160 m is 3500 $\mathrm{N/C}$, directed toward the center of the sphere. .

Part A

What is the potential at the center of the sphere, if we take the potential to be zero infinitely far from the sphere?

ANSWER: V = **-560** V
Correct

Exercise 23.36

A very long insulating cylinder of charge of radius 2.80 cm carries a uniform linear density of 13.0 $\mathrm{nC/m}$.

Part A

If you put one probe of a voltmeter at the surface, how far from the surface must the other probe be placed so that the voltmeter reads 185 V?

ANSWER: d = **3.37** ***Correct*** cm

Problem 23.76

Two plastic spheres, each carrying charge uniformly distributed throughout its interior, are initially placed in contact and then released. One sphere has a diameter of 56.0 cm, a mass of m_1 = 54.0 g, and contains -12.0 $\mu\mathrm{C}$ of charge. The other sphere has a diameter of 39.0 cm, a mass of m_2 = 140.0 g and contains -29.0 $\mu\mathrm{C}$ of charge. Assume that no other forces are acting on them.

Part A

Find the maximum speed achieved by the sphere of mass 54.0 g.

ANSWER: v = ***Answer not displayed*** $\mathrm{m/s}$

Part B

Find the maximum speed achieved by sphere of mass 140.0 g.

ANSWER: v = ***Answer not displayed*** $\mathrm{m/s}$

Part C

Find the maximum acceleration achieved by the sphere of mass 54.0 g.

ANSWER: a = ***Answer not displayed*** $\mathrm{m/s^2}$

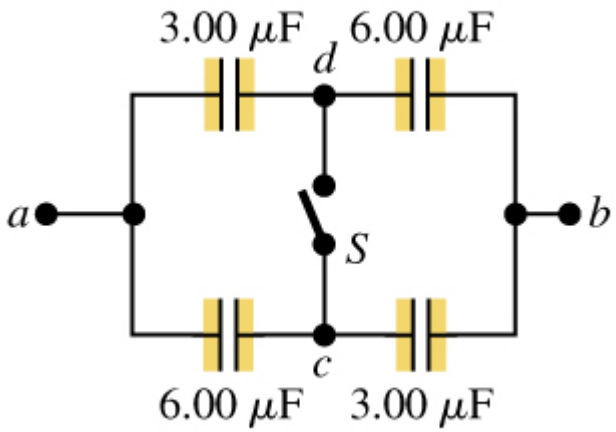
Part D

Find the maximum acceleration achieved by the sphere of mass 140.0 g.

ANSWER: a = ***Answer not displayed*** $\mathrm{m/s^2}$

Problem 24.60

The capacitors in the Figure are initially uncharged and are connected, as in the diagram, with switch S open. The applied potential difference is V_{ab} = + 210 V.



Part A

What is the potential difference V_{cd}?

Express your answer using two significant figures.

ANSWER: V_{cd} = **70** V
Correct

Part B

What is the potential difference V_{ad} after switch S is closed?

ANSWER: V_{ad} = **105** V
Correct

Part C

What is the potential difference V_{db} after switch S is closed?

ANSWER: V_{db} = **105** V
Correct

Part D

What is the potential difference V_{ac} after switch S is closed?

ANSWER: V_{ac} = **105** *Correct* V

Part E

What is the potential difference V_{cb} after switch S is closed?

ANSWER: V_{cb} = **105** *Correct* V

Part F

How much charge flowed through the switch when it was closed?

ANSWER: Q = **3.15×10^{-4}** *Correct* C

Exercise 24.44

A constant potential difference of 12 V is maintained between the terminals of a 0.25-μF parallel-plate air capacitor.

Part A

A sheet of Mylar is inserted between the plates of the capacitor, completely filling the space between the plates. When this is done, how much additional charge flows onto the positive plate of the capacitor? (Dielectric constant K of Mylar is 3.1)

Express your answer using two significant figures.

ANSWER: ΔQ = **6.3×10^{-6}** *Correct* C

Part B

What is the total induced charge on either face of the Mylar sheet?

Express your answer using two significant figures.

ANSWER: $|Q_i|$ = **6.3×10^{-6}** *Correct* C

Part C

What effect does the Mylar sheet have on the electric field between the plates? Explain how you can reconcile this with the increase in charge on the plates, which acts to *increase* the electric

field.

Essay answers are limited to about 500 words (3800 characters maximum, including spaces).

ANSWER:

My Answer:
when you add the mylar it doesn't affect the electric field because the induced charge cancels the additional charge drawn to the plate.

Score Summary:

Your score on this assignment is 89%.
You received 89.02 out of a possible total of 100 points.