PHYS 2B(A) QUIZ 3

FORM A:
BEEBCA

FORM B:
CEEACB

FORMC:
BBDBAB

FORMD:
BBCDAB

Physics 2B-Section A
Electricity and Magnetism
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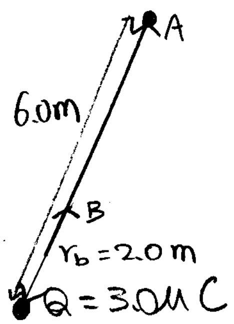
Winter 2006

TEST 3

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

A sphere with radius 2.0 mm carries a 3.0-μC charge. What is the potential difference, $V_B - V_A$, between point B 2.0 m from the center of the sphere and point A 6.0 m from the center of the sphere? (The value of k is $9.0 \times 10^9\ N \cdot m^2/C^2$.)



from Ch 23, we know

$$\vec{E}(\vec{r}) = \frac{kq}{r}\hat{r}$$

$$\therefore V_B - V_A = -\int_A^B \frac{kq}{r^2}\hat{r}$$

$$= +9\times10^9 \times 3.0\times10^{-6}\left(+\frac{1}{r}\right)_A^B$$

$$= 27\times10^3\left(\frac{1}{r_B} - \frac{1}{r_A}\right) = 9000\ J$$

When there is a net static charge present on a perfect conductor, and no other charges are present

A) the electric field inside the conductor need not be zero if the conductor is hollow.

B) the charge will be uniformly distributed over the outside of the conductor (i.e., the surface charge density will be constant).

C) the surface charge density will be greatest where the conductor is flat and smallest where there are sharp protuberances or points.

D) every point throughout the entire conductor will be at zero potential.

E) every point throughout the entire conductor will be at a constant potential, but not necessarily at zero potential.

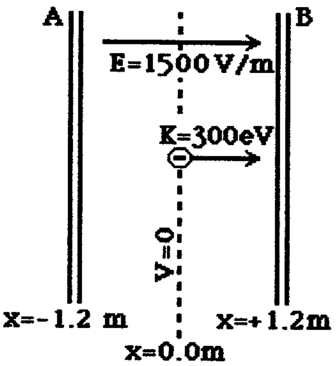
A) Wrong. electric field is ALWAYS zero inside the conductor regardless of the sphere while in equilibrium

B). wrong, the surface charge density is greatest where there is a sharp protuberace or point to make the potential constant through the surface

C) wrong, explaination as in (B)

D) wrong, the potential in the conductor is constant but could be non-zero values

E) Correct



Two large conducting parallel plates A and B are separated by 2.4 m. A uniform field of 1500 V/m, in the positive x-direction, is produced by charges on the plates. The center plane at x = 0.0 m is an equipotential surface on which V = 0. An electron is projected from x= 0.0 m, with an initial kinetic energy K = 300 eV, in the positive x-direction, as shown. In this figure, the electric potential difference $V_A - V_B$ is closest to:

$$V_A - V_B = -\int_B^A \vec{E}\cdot d\vec{l} = -\int_{+1.2}^{-1.2} 1500\,\frac{V}{m}\,\hat{i}\cdot dx\,\hat{i}\ m$$

$$= +1500 \times 2.4\ V = +3600\ V$$

A dipole with a moment of 2.0 C•nm is centered about the origin and is oriented along the x-axis with the positive charge to the right of the origin. What is the potential at a point 11.0 m from the origin $\pi/6$ radians below the axis? (The value of k is $9.0 \times 10^9\ N \cdot m^2/C^2$.)

$$V(r,\theta) = \frac{kP\cos\theta}{r^2} \quad \text{(from example 25-5 in the textbook)}$$

$$= 9\times10^9 \times \frac{2.0\times10^{-9} \times \cos\frac{\pi}{6}}{(11.0)^2} \approx 0.13\ V$$

A proton with speed 1.5×10^5 m/s falls through a potential difference of 100 volts, gaining speed. What is the speed reached?

Energy Conservation : $PE_A + KE_A = PE_B + KE_B$

$$\Rightarrow (PE_A - PE_B) = (KE_B - KE_A)$$

$$PE_A - PE_B = q\,(V_A - V_B) = (1.6\times10^{-19}\ C)(100V) = 1.6\times10^{-17}\ J$$

$$KE_B = KE_A + (PE_A - PE_B) = \frac{1}{2} m_p V_0^2 + 1.6\times10^{-17}\ J$$

$$= \frac{1}{2} \times 1.6\times10^{-27} \times (1.5\times10^5)^2 + 1.6\times10^{-17}$$

$$\Rightarrow \frac{1}{2} \times (1.6\times10^{-27}) \times v^2 = \frac{1}{2} \times 1.6\times10^{-27}\,(1.5\times10^5)^2 + 1.6\times10^{-17}$$

$$\Rightarrow v = 2.04\times10^5\ m/s$$

Two conductors are joined by a long copper wire. Thus

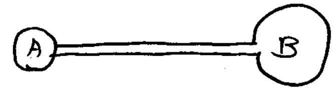
A) each conductor must be at the same potential.

B) each carries the same free charge.

C) the electric field at the surface of each conductor is the same.

D) no free charge can be present on either conductor.

E) the potential on the wire is the average of the potential of each conductor.



A) Correct. Equil potential throug out the conductors and wire

B). $\because V_A = V_B = V$, $\frac{k q_A}{r_A} = \frac{k q_B}{r_B}$

$\therefore \frac{q_A}{r_A} = \frac{q_B}{r_B}$, $\Rightarrow q_A \neq q_B$ when $r_A \neq r_B$

C). $E_A = \frac{k q_A}{r_A^2} = \frac{V_A}{r_A} = \frac{V}{r_A}$

similarly $E_B = \frac{V}{r_B}$

$\therefore E_A \neq E_B$ if $r_A \neq r_B$

D). $\because$ Charge is conserved

$\therefore$ Once there is a net free charge on the conductor, the net total charge is always remain the same.

E). $V_A = V_B = V_{wire}$