Smith's Key

A.P. Physics – C

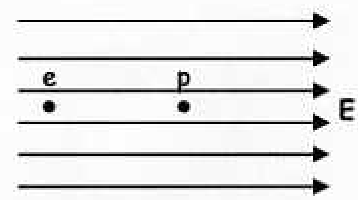
UNIT 7 TEST REVIEW

Electric Forces and Fields: Chapters 21-23

*** In studying for your test, make sure to study this review sheet <u>along with your quizzes and homework assignments.</u>**

Multiple Choice Review: **On this portion of the test, you will not be allowed to use your calculator or AP formula sheet. (You may, however, use your AP table of information.) Approximate $g=10m/s^2$ for simplicity of calculations. No partial credit will be given.**

1. An electron e and proton p are simultaneously released from rest in a uniform electric field E, as shown. Assume that the particles are sufficiently far apart so that the only force acting on each particle is that due to the electric field. At a later time when the particles are still in the field, the electron and proton will have the same...



Different signs → a. direction of motion.

Different masses:
b. speed.
c. displacement.
d. magnitude of acceleration.

(e.) magnitude of force acting on them.

2. From the electric field vector at a point, one can determine which of the following?
   - ✓ I. The direction of the electrostatic force on a test charge of known sign at that point.
   - ✓ II. The magnitude of the electrostatic force exerted per unit charge on a test charge at that point.
   - ~~III~~. The electrostatic charge at that point ← E-field @ P is independent of any charge actually being @ P.

a. I only
b. III only
(c.) I and II only
d. II and III only
e. I, II and III

3. The given figure shows two charged particles, one of charge positive Q and the other of charge -Q, that are located at the opposite corners of a square with sides of length d. What is the direction of the electric field at point P?

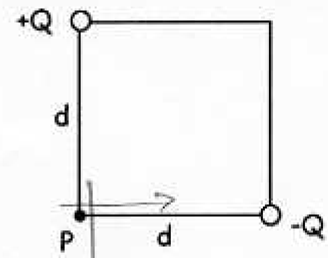
a. ↖

b. ↘

c. ↙

d. ↗

e. →



4. For the same diagram as in problem #3, what is the magnitude of the electric field at point P?

a. $\frac{kQ}{2d^2}$

b. $\frac{kQ}{\sqrt{2}d^2}$

c. $\frac{kQ}{d^2}$

d. $\frac{\sqrt{2}kQ}{d^2}$

e. $\frac{2kQ}{d^2}$

Since $E_1 = E_2$ & perp, $\Sigma E = \sqrt{2} E$

5. The diagram shows electric field lines in an isolated region of space containing two small charged spheres, Y and Z. Which one of the following statements is true?

1 inward E, 1 outward E.

a. The charge on Y is negative and the charge on Z is positive.

b. The strength of the electric field is the same everywhere.

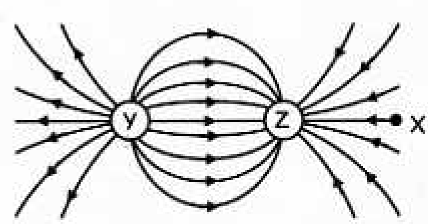
c. The electric field is strongest midway between Y and Z.

d. A small negatively charged object placed at point X would tend to move toward the right.

e. Both charged spheres Y and Z carry charge of the same sign.

Strength prop. to how closely packed lines are

Same as A.



6. A conducting sphere of radius R carries a charge of Q. Another conducting sphere has a radius of R/2, but carries the same charge. The spheres are far apart. The ratio of the electric field near the surface of the smaller sphere to the field near the surface of the larger sphere is nearest to which one of the following?

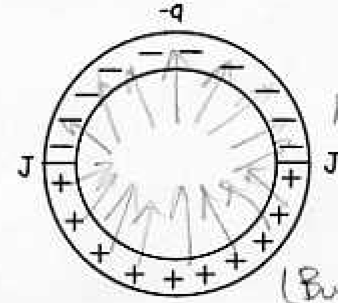
Outside of spheres, E-field same as if it was a point charge.

a. 1/4
b. 1/2
c. 1
d. 2
e. 4 (circled)

Small: $E = \frac{kQ}{(R/2)^2} = \frac{4kQ}{R^2}$ Large: $E = \frac{kQ}{R^2}$

7. A circular ring made of an insulating material is cut in half. One half is given a charge -q uniformly distributed along its arc. The other half is given a charge of +q also uniformly distributed along its arc. The two halves are then rejoined with insulation at the junctions J, as shown. If there is no change in the charge distributions, what is the direction of the net electrostatic force on an electron located at the center of the circle?

a. Toward the top of the page.
b. Toward the bottom of the page. (circled)
c. To the right.
d. To the left.
e. Into the page.



Net E-field up page. (But e- disobeys E-field.)

8. The net electric flux through a closed surface is...

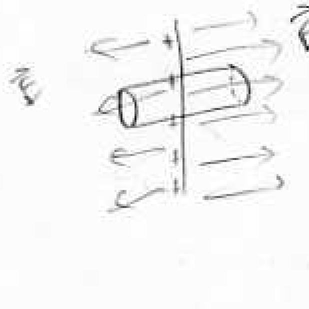
a. infinite only if there are no charges enclosed by the surface.
b. infinite only if the net charge enclosed by the surface is zero.
c. zero only if negative charges are enclosed by the surface.
d. zero only if positive charges are enclosed by the surface.
e. zero only if the net charge enclosed by the surface is zero. (circled)

$\oint \vec{E} \cdot d\vec{A} = \frac{q_{enc}}{\varepsilon_0}$ (flux)

9. The net electric field at a distance R from a sheet of charge with uniform surface charge density σ is given by...

a. $2\sigma/\varepsilon_0$ (circled)
b. σ/ε_0
c. $2\sigma/(\varepsilon_0 R)$
d. $2\sigma R/\varepsilon_0$
e. $\sigma/(\varepsilon_0 R)$

All 2's should be in denominators.



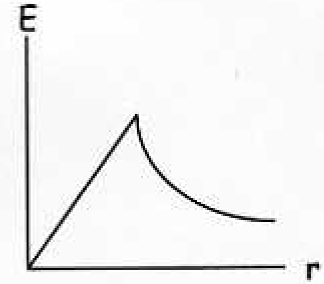
$\oint E dA = \frac{q_{enc}}{\varepsilon_0}$

$E(2A_{end\ cap}) = \frac{\sigma A_{in\ middle}}{\varepsilon_0}$

$E = \frac{\sigma}{2\varepsilon_0}$

10. The given graph shows electric field (E) versus distance from the center (r) for some type of uniform spherical charge distribution. The graph could represent a charged...

I. nonconductive solid sphere.
II. conductive solid sphere.
III. conductive spherical shell.



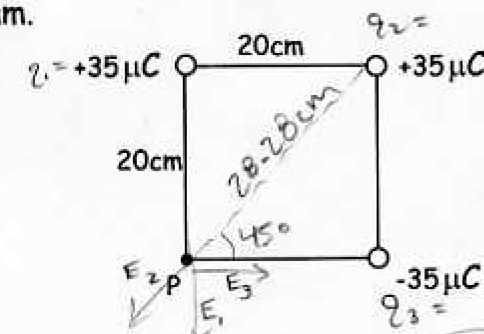
(a) I only
b. III only
c. I and II only
d. II and III only
e. I, II and III

Conductors have zero E-field inside them.

Problem Review: On this portion of the test, you may use your calculator, AP formula sheet, and AP table of information. Partial credit will be given on these problems.

11. Three charges, all of magnitude $35\mu C$, are placed at three corners of a square of side-length 20cm, as shown in the diagram.

a. Calculate the net electric field at point P in the diagram.



$E_1 = \frac{k(35E-6)}{.2^2} = 7.87E6\ N/C \downarrow$

$E_3 = 7.87E6\ N/C \rightarrow$

$E_{2x} = \frac{k(35E-6)}{.283^2}\cos 45 = 2.78E6\ N/C \leftarrow$

$E_{2y} = 2.78E6\ N/C \downarrow$

$\Sigma E_x = 1.07E7\ N/C \downarrow$

$\Sigma E_y = 5.09E6\ N/C \rightarrow$

$\Sigma E = 1.18E7\ N/C$

$\theta = 25.4°$

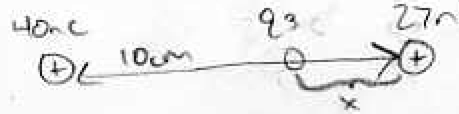
b. If a fourth charge of -20nC were to be placed at point P, calculate the electric force that it would experience.

$E = F/q_0$

$1.18E7 = F/20E-9$

$F = 0.236\ N$ @ $\theta = 25.4°$

12. A +40nC and a +27nC charge are located 10cm apart from each other. How far from the 27nC charge should a third charge be placed, so that the net electric force on the third charge is zero?



$F_1 = F_2$

$\frac{k(40E^{-9})(q_3)}{(10-x)^2} = \frac{k(27E^{-9})(q_3)}{x^2}$

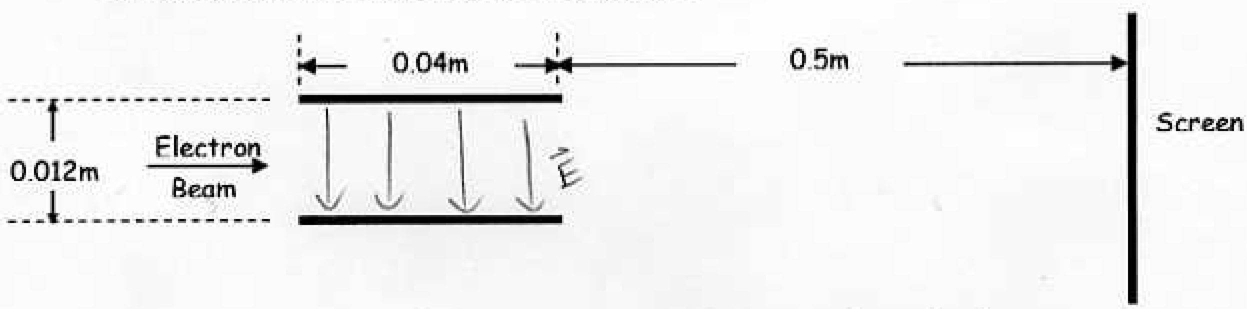
$40x^2 = 27(10-x)^2$

$1.217x = 10 - x$

$2.217x = 10$

$x = 4.51\ cm$

13. The pair of horizontal plates shown below is used to deflect electrons up or down in a television set by creating an electric field between them. The plates have length 0.04m and separation 0.012m, and the right edge of the plates is 0.50m from the screen. An electric field of magnitude 17,000N/C exists between the plates, and the electrons are deflected toward the top of the screen. Assume that the electrons enter horizontally midway between the plates with a speed of $6.0E^7$ m/s, and that fringing effects at the edges of the plates and gravity are negligible.



Considering only an electron's motion as it moves through the space between the plates, compute the following:

a. The time required for the electron to move through the plates.

Constant vel in x-dir...

$v = d/t \rightarrow 6E^7 = \frac{.04}{t} \rightarrow t = 6.67E^{-10}\ s$

b. The vertical displacement of the electron while it is between the plates.

Accel in y-dir due to elec force...

$a = F/m = qE/m = \frac{(1.6E^{-19})(17{,}000)}{9.11E^{-31}} = 2.99E^{15}\ m/s^2$

$x = ?$

$v_0 = \emptyset\ m/s$

$t = 6.67E^{-10}$

$x = v_0 t + \frac{1}{2}at^2$

$= \emptyset + \frac{1}{2}(2.99E^{15})(6.67E^{-10})^2$

$= 6.63 \times 10^{-4}\ m$