1. (5 points) Two initially uncharged metal spheres (conductors), L and M are in contact. A negatively charged rod is brought close to L but does not touch it as shown. With the rod in this position, L and M are slightly separated and the charged rod is removed. What is the charge state of the two spheres after the rod is removed?
   A. both spheres are neutral.
   B. both spheres are positive.
   C. both spheres are negative.
   D L is negative and M is positive
   E L is positive and M is negative.

insulating supports
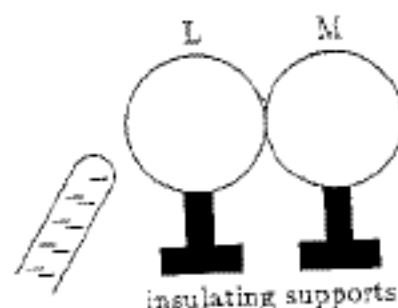
2. (6 points) Charges Q, -Q and q are placed at the vertices of an equilateral triangle as shown. The total force exerted on charge q is
   A. toward charge Q.
   B. toward charge -Q.
   C. away from charge Q.
   D. at right angles to the line joining Q and -Q.
   E. parallel to the line joining Q and -Q.

3. (6 points) Positive charge +Q is uniformly distributed on the upper half of a non-conducting rod and a negative charge -Q is uniformly distributed on the lower half. What is the direction of the electric field at point P, on the perpendicular bisector of the rod?
   A. ↑
   B. ↓
   C. ←
   D. →
   E. ↗

4. (6 points) Two capacitors $C_1 = 1.0$ μF and $C_2 = 2.0$ μF are connected in series and a potential difference is applied across the combination. The 2 μF capacitor (C_2) has:
   A. twice the charge of the 1μF capacitor.
   B. half the charge of the 1μF capacitor.
   C. twice the potential difference of the 1μF capacitor.
   D. half the potential difference of the 1μF capacitor.
   E. none of the above.

5. (6 points) Let Q denote charge, V denote potential difference, and U denote stored energy. Of these quantities, Two unequal capacitance capacitors in parallel have the same:
   A. Q only
   B. V only
   C. U only
   D. Q and U only
   E. V and U only

   Refer to the following for the next two problems.
   An electron (charge -e) moves from point i to point f, in the direction of a non-zero uniform electric field.

6. (3 points) During this displacement, the work done by the electric field
   A. is positive.
   B. is negative.
   C. is zero.

7. (3 points) During this displacement the electrostatic potential energy of the electron-electric field system
   A. increases.
   B. decreases.
   C. is unchanged.

8. (8 points) What is the magnitude of the torque on an electric dipole consisting of a proton and an electron separated by 1.00 nm = 1.00E-9 m if the dipole moment is oriented at 30° to an electric field of 800 MV/m =8.00E8 V/m. (Such large fields occur near a Uranium nucleus.)

   A. 1.3E-19 N-m

   B. 2.8E-20 N-m

   C. 6.4E-20 N-m

   D. 6.8E-2 N-m

   E. 1.3E3 N-m

9. (8 points) A 5.0 μC point charge is place at the center of a cube. The electric flux in $N \cdot m^2/C$ or $V \cdot m$ through one side of the cube is

   A. 0

   B. 7.1E4

   C. 9.4E4

   D. 1.4E5

   E. 5.6E5

10. (8 points) A parallel plate capacitor without a dielectric between the plates has a capacitance of 1.0 pF. The plate separation is doubled and a dielectric is inserted, completely filling the space between the plates. As a result of these changes the capacitance becomes 2.0 pF. The dielectric constant of the inserted dielectric is

   A. 4.0

   B. 0.25

   C. 2.0

   D. 0.5

   E. 8.0

11. (8 points) Capacitors C_1 and C_2 are identical. The first is charged so that it stores 4.0 J of energy. Let q_0 denote the magnitude of the charge on each plate of C_1. The second capacitor is initially uncharged. The capacitors are connected as shown and switch S is closed. After the charge has redistributed itself, the total stored energy in the two capacitors is::

A. 16 J
B. 8.0 J
C. 4.0 J
D. 2.0 J
E. 1.0 J
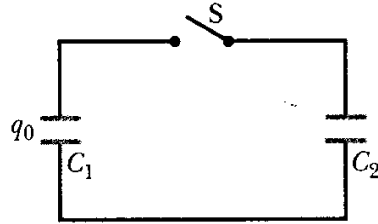
12. (8 points) Charge Q is distributed uniformly throughout a spherical region of radius R. The magnitude of the electric field at a point $r = R/2$ from the center of the charge distribution is

A. $\dfrac{Q}{4\pi\epsilon_0 R^2}$

B. $\dfrac{Q}{\pi\epsilon_0 R^2}$

C. $\dfrac{3Q}{4\pi\epsilon_0 R^2}$

D $\dfrac{Q}{8\pi\epsilon_0 R^2}$

E. 0

13. (8 points) Positive charge is distributed uniformly over one side of a thin non-conducting disc of radius $R = 0.500$ m. The amount of charge is such that $\frac{\sigma}{2\epsilon_0} = 5.60E4$ V/m. The disc lies in the xy plane with its center at the origin. We wish to evaluate E_z at the point Point $P(0,0,z)$ where $z = +1.00$ m. While this problem can be done by integrating each $d\vec{E}$ as done in the text in Section 23.7, let me suggest an easier way. First let me tell you that electric potential at P is

$$V(0,0,z) = \frac{\sigma}{2\epsilon_0}(\sqrt{(z^2 + R^2)} - z) \qquad \text{Eq. 25-37}$$

and remind you that there are ways to find the electric field from the potential. The z component of the electric field in N/C or V/m is:

A 5.9E3

B. 5.0E4

C. 4.5E4

D. 1.1E4

E. 1.1E3

14. (8 points) Two fixed point charges $q_1 = -5q$ and $q_2 = 2q$ are located on the x axis at the origin and at $x = d$. The quantites d and q are positive. Expressed as a number times d, what is the coordinate of the point on the x-axis where E is zero and x is finite?

A. There is no finite point on the x-axis where $E = 0$.

B. 1.58d

C. -1.58d

L 2.72d

E. (7/5)d

Refer to the following for the next three questions. A parallel plate capacitor with vacuum between its plates if attached to a battery and charged up. When the capacitor has charge of magnitude Q on each plate and a potential difference V across it, the battery is removed. After the battery is removed, a dielectric with $\kappa = 3$ is inserted to essentially fill the space between the plates.

15. (3 points) The potential difference across the capacitor is

A. increased

B. unchanged

C. decreased

16. (3 points) The free charge on the capacitor plates is

A. increased

B. unchanged

C. decreased

17. (3 points) The electrostatic energy density between the plates is

A. increased

B. unchanged

C decreased

PHYSICS 241 EXAM 1 Feb 11, 2002

Physics 241 test 1 Feb 11, 2002 (Carmony/Barnes)
Key and points. Total = 100

#	salmon	green	points
page 2			
01.	E	E	5
02.	E	E	6
03.	B	B	6
page 3			
04.	D	B	6
05.	B	D	6
06.	B	B	3
07.	A	A	3
page 4			
08.	C	D	8
09.	C	A	8
10.	A	C	8
11.	D	C	8
page 5			
12.	D	A	8
13.	A	D	8
page 6			
14.	D	D	8
15.	C	C	3
16.	B	B	3
17.	C	C	3

   A solution of the test will be posted here in the near future. The grades should be in your gradebook by Thursday afternoon, or perhaps 24 hour sooner depending on the test grading center's schedule. The average will be sent to you as a message in CHIP. DDC