

EXAM 2 (100 POINTS)

GS WESTON
PHY 7B
8/5/96

(10 POINTS EACH)

- Two positive charges each $+q_1$, and a negative charge, $-q_2$, are fixed at the vertices of an equilateral triangle, with sides r in length. Find the magnitude of the force on the negative charge. Hint: Write your answer in terms of k , q_1 , q_2 , r , and $\sin 30^\circ$ or $\cos 30^\circ$.
- Each of the four uncharged capacitors in Figure 1 has a capacitance of $100 \mu\text{F}$. A potential difference of 4000 V is established when the switch S is closed. How much charge then passes through the meter A ?
- A human being can be electrocuted if a current as small as 50 mA passes near the heart. An electrician working with sweaty hands makes good contact with two conductors being held one in each hand. If the electrician's resistance is 2000Ω , what might the fatal voltage be?

(12 POINTS)

- What current, in terms of V and R , does the ammeter A in Figure 3 read? Assume that A has zero resistance.

(18 POINTS)

- Calculate the electric field, E , at point P , a distance z above the midpoint of a straight line segment of length $2L$, which has a uniform charge density, $\lambda = \text{charge/length}$ as shown in Figure 2. Assume that λ is a constant.
 - Find the electric field, E , for $z \gg L$.

(20 POINTS EACH)

- Figure 4 shows a parallel plate capacitor of plate area A and plate separation d . A potential difference, V_0 , is applied between the plates. The battery is then disconnected, and a dielectric slab of thickness b and dielectric constant k that partially fills the space is placed between the plates as shown.
 - Calculate the free charge (in terms of ϵ_0 , A , d and V_0) that appears on the plates.
 - Calculate the electric field, \vec{E}_0 , in the gaps between the plates and the dielectric slab.
 - Calculate the electric field, \vec{E} , in the dielectric slab.
 - What is the potential difference between the plates after the slab has been introduced?
 - What is the capacitance with the slab in place?
- Two concentric spherical conducting shells, as shown in Figure 5, with radii a and b have $+Q$ and $-Q$ respectively.
 - Calculate the electric field, \vec{E} , using Gauss' law for $r < a$.
 - Calculate the electric field, \vec{E} , using Gauss' law for $a < r < b$.
 - Calculate the electric field, \vec{E} , using Gauss' law for $r > b$.
 - Calculate the electric potential, V , between the spheres.
 - Calculate the capacitance between the spheres.

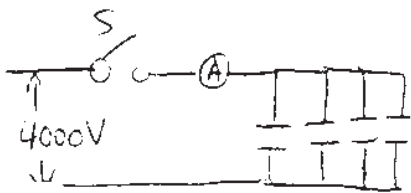


Figure 1



Figure 2

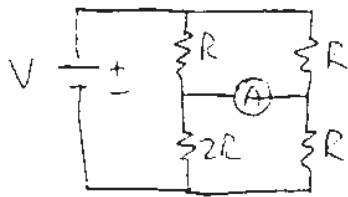


Figure 3

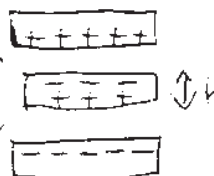


Figure 4



Figure 5