

## PH 223 Recitation Homework Fall 2018

### Problem 1 (due Thu 10/04)

One-hundred and eight electrons are equally spaced around a circle of radius 10.0 cm. (A) What is the electric field at the center of the circle? Explain your reasoning. (B) What would be the electric field be at the same location if one electron was removed? Label the location of electron before it was removed as point P.

### Problem 2 (due Thu 10/18)

A sphere of radius  $a$  has total charge  $Q$ . The volume charge density (in  $C/m^3$ ) within the sphere is  $\rho(r) = C/r^2$ , where  $C$  is a constant equal to  $Q/(4\pi a)$ . (A) Use Gauss's law to find expressions for the electric field both inside and outside the sphere as a function of the radial distance from its center. (B) Graph the electric field both inside and outside the sphere (on the vertical axis) as a function of the radial distance (on the horizontal axis).

### Problem 3 (due Thu 10/25)

(A) What potential difference is needed to accelerate electrons from rest to a speed of  $5.25 \times 10^6$  m/s over a distance of 12.5 cm? (B) What would be the magnitude of the electrons' acceleration in this case?

### Problem 4 (due Thu 11/01)

Four capacitors are connected in series across a 12.0-V battery. Their capacitances are 1.00, 2.00, 4.00 and 4.00 mF. What must be the capacitance of a fifth capacitor that when added in series to the circuit reduces the voltage across the 1.00 mF capacitor by 1.00 V?

### Problem 5 (due Thu 11/08)

In an industrial non-linear amplifier, the current as a function of time during the interval  $0 < t < 4.00$  s is given as  $I(t) = 4t - t^2$ , where current is measured in amps and time is measured in seconds. How much charge passes past a point in the amplifier during the 4.00-second interval?

### Problem 6 (due Thu 11/15)

A certain number of identical resistors are connected in series and their total resistance is measured. When the resistors are disconnected and re-connected in parallel, their total resistance drops to one-percent of the value measured when they were connected in series. How many resistors are there?

### Problem 7 (due Thu 11/29)

A proton with initial velocity components  $v_x = 1.30 \times 10^6$  m/s,  $v_y = 0$ ,  $v_z = 2.10 \times 10^4$  m/s is placed in a constant and uniform magnetic field in the positive  $z$ -direction with magnitude 0.600 T. The proton subsequently travels in a helical trajectory. Find the initial magnetic force on the proton, its initial acceleration due to magnetism, the radius of the helix and the  $z$ -component of the proton's displacement during one revolution.