

Physics 7b
Spring 2000
Midterm 2
R. Packard

Exam & Solution 1/5

Name: _____

SID _____

GSI name _____ Section number (or time) _____

Work all four problems. They are weighted equally. If you don't understand the question ask the proctor for clarification. Do not perform any numerical work until you have a "boxed" algebraic answer. Do a dimension check on your final answer.

$$e=1.6 \times 10^{-19} \text{C}, N_A=6.02 \times 10^{23}, k_B=1.38 \times 10^{-23} \text{JK}^{-1}, \epsilon_0=8.85 \times 10^{-12}$$

1. _____

2. _____

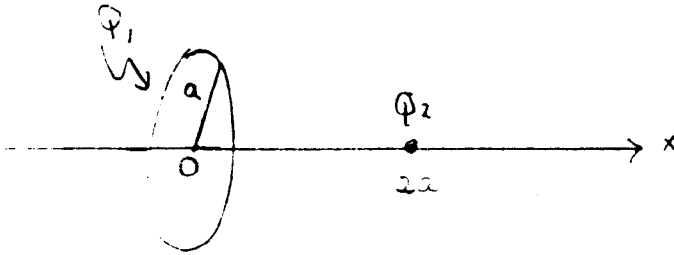
3. _____

4. _____

Total _____

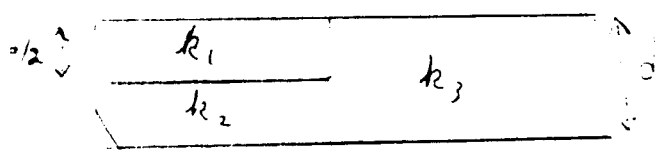
1. A point charge $+Q$ is located at the origin and is surrounded by a spherical charge distribution that varies proportional to the distance from the origin: $\rho = \alpha r$ for $r \leq R$. The charge density drops to zero when $r > R$. The total charge is zero. A) Find the constant α . B) Find the electric field for all r .

2. A uniformly charged ring of radius a and charge Q_1 lies in the yz plane with its axis along the x axis. A point charge Q_2 is placed on the x axis at $x=2a$. Find the work required to move the point charge to the origin.



3. A) Find the capacitance of the parallel plate capacitor shown in the figure. The plate separation is 1mm, the plate area is $25 \times 10^{-2} \text{m}^2$, $k_1=2$, $k_2=4$ and $k_3=3$. The dielectric slabs on the left are of equal thickness and take up half the area between the plates.

B) Assume a capacitor with similar plate area and separation is filled with a single dielectric slab of dielectric constant $k=3$. This capacitor is charged to 200V. How much work is required to pull the dielectric completely out of the capacitor. Neglect friction.



4. A copper wire (mass density $\rho_m=8.9 \times 10^3 \text{ kg/m}^3$, $M_w=63 \times 10^{-3} \text{ kg}$, conductivity $\sigma=6 \times 10^7 \text{ } (\Omega\text{m})^{-1}$) is 100m long and has a diameter of 0.8mm. Under the influence of a current an electron takes $3 \times 10^5 \text{ s}$ to travel the length of the wire. What is the electric field in the wire?