KING FAHD UNIVERSITY OF PETROLEUM AND MINERALS

ELECTRICAL ENGINEERING DEPARTMENT

SECOND SEMESTER 2006/2007

EE 340 (01) MAJOR EXAM I

LOCATION: 7-122

TIME: 6:30 -8:00 P.M.

DATE: SUNDAY 1-APRIL-2007

Student’s Name:………………………………………….

Student’s I.D. Number: ………………….

	Maximum Score	**Score**
Problem 1	**25**	
Problem 2	**25**	
Problem 3	**25**	
Problem 4	**25**	
Total	**100**	

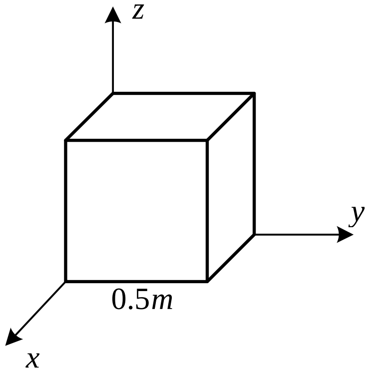
Problem 1 [25 points]

The electrostatic potential $V = 10e^{-(x+2y+3z)}$ [V] exists in free space.

a) Calculate the volume charge density in C/m^3 at point P whose rectangular coordinates are $(1,0,0)$.

b) Calculate the maximum electrostatic energy density in Joule per cubic meter.

c) Calculate the total stored *electrostatic energy* inside the cubic volume $0.50\,[m]$ on the side (see figure).

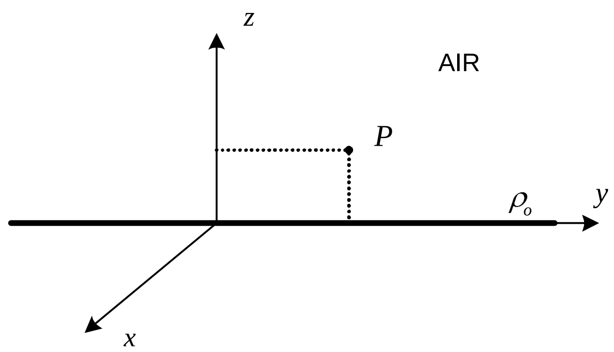


Problem 2 [25 points]

An infinitely long line of charge of uniform density $\rho_L = \rho_o$ is placed on the entire y axis as shown in the diagram. The surrounding medium is air. Consider the point P which is situated in the $y-z$ plane [i.e. $P = P(0, y, z)$].

a) Develop an expression for the electric field intensity vector $\vec{E}$ at point P.

b) Now consider the two points A and B with rectangular coordinates (0, 2, 4) and (0, 6, 9), respectively. Calculate the resulting potential difference V_{AB} for $\rho_o = -3[nC/m]$.



Problem 3 [25 points]

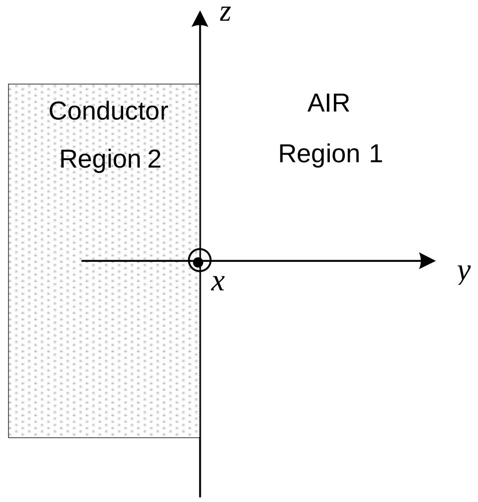
The plane boundary $y = 0$ separates two the semi infinite regions, region 1 ($y > 0$) and region 2 ($y < 0$). Region 1 is an air region and region 2 is a conductor.

Consider the electrostatic field: $\vec{E}_1 = -2xy\vec{a}_x - x^2\vec{a}_y + y\vec{a}_z$ [V/m], which exists in air.

a) Find the electrostatic field on the conductor/air boundary.

b) Find the surface charge density ρ_s on the conductor/air boundary.

c) Calculate the total charge Q residing on the square area ($0 \le x \le 1$, $y = 0$, $0 \le z \le 1$).



Problem 4 [25 points]

A spherical shell of inner radius a and outer radius b exists in free space. This shell contains a uniform volume charge density $\rho_v = \rho_o$. Derive an expression for the electric flux density vector $\vec{D}$ in the regions:

a) $r < a$.

b) $b > r > a$.

c) $r > b$.