Assiut University	First Year
Faculty of Engineering	Theory of Electric Fields
E.E. Department	Time allowed: 3 hours

Final Exam

Answer the following questions:

1) a- An electric dipole whose positive and negative charges have coordinates (0, 0, d\2) and (0, 0, -d/2), respectively. Derive expressions for the potential and field of the dipole at point p(r, θ, π/2). **(8 points)**

b- Find the force on a 10^{-5}C point-charge at (0, 0, -1) due to a point-charge 2×10^{-4} C located at (1, 1, 1) and a 3×10^{-4}C point-charge located at (2, -1, 3). **(8 points)**

c- An electric field is given by $\bar{E} = \frac{1.5}{\epsilon_0}x^2y^2\bar{a}_x + \frac{1}{\epsilon_0}x^3y\bar{a}_y(V/m)$

How much charge lies within a cube 1m on a side lying in the first octant $0 \le x \le 1$, $0 \le y \le 1$, $0 \le z \le 1$. **(8 points)**

2) a- Comment briefly on (i) first Maxwell's equation, (ii) electric displacement, (iii) streamlines, and (iv) flux lines. **(8 points)**

b- A changed circular disk with uniform charge density ρ_s is located in the plane z = 0. The disk is centered at origin with radius a. Calculate the potential at a point on the z – axis at $z = z_0$. **(8 points)**

c- A circular ring of radius a caries a uniform charge ρ_L C/m and is placed in the plane z = 0 with axis the same as the z – axis.

(i) Derive an expression for the electric field at (0, 0, h) **(4 points)**

(ii) What values of h give the max value of E? **(4 points)**

3) a- Starting from first principles, derive the divergence theorem applied to a vector field.

b- A charge distribution with spherical symmetry has density $\rho_v = \rho_0$ r/R for $0 \le r \le R$ and ρ_v = zero. **(8 points)**

Apply Gauss's law to determine $\bar{E}$ everywhere. **(8 points)**

c- A point charge 5 nC is located at (-3, 4, 0) while line y = 1, z = 1 carries uniform charge 2 nC/m. If V = 0V at the origin (0, 0, 0), find V at A (5, 0, 1). **(8 points)**

GOOD LUCK