**University of Sargodha**

**Department of Physics**

**PHYS-5104 Assignment # 2 April 01, 2020**

**Problem # 1**

Electric field along the line passing through two point charges.

A point charge Q1 = + 3μC is placed at the origin, and a point charge Q2= -7μC is placed at x = 0.4 m on the x-axis of a Cartesian coordinate system.

(a) Determine the electric field, , at all points along the x-axis.

(b) Plot E(x) vs. x for x < 0.

**Problem # 2**

Show that the components of **E** due to a dipole are given, at distant points, by

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where x and z are coordinates of point *P* in figure. Show that this general result includes the special results

$E= \frac{1}{2πε\_{0}}\frac{p}{z^{3}}$ $E= \frac{1}{4πε\_{0}}\frac{p}{x^{3}}$

**Problem # 3**

The electric field produced by, a thin rod of length L that lies along the z axis and carries uniformly distributed positive charge q,at a point *P*located on the perpendicular bisector of the rod (the positive y axis) a distance y from its center is given by equation.

$$E= \frac{1}{4πε\_{0}}\frac{q}{y\sqrt{y^{2}+\frac{L^{2}}{4}}}$$

a) The above equation was derived assuming the point *P* was located on the positive y axis. Does this equation remain valid if the point *P* is located at negative y axis? Explain.

b) Write an equation similar to above equation if the point *P*is instead located a distance x from the rod on the positive or negative x axis.

c) Write an equation in vector component form for the electric field when point *P* is located a distance d from the rod on the 45º line that bisects the positive x and y axes.

d) Write an equation in vector component form that gives the electric field when point *P* is located at an arbitrary point x,y anywhere in the xy plane. Check that the components have the correct signs when the point x,y is located in each of the four quadrants.

**Problem # 4**

The electric field produced by, a thin ring of radius R that carries uniformly distributed positive charge q,at a point *P* located on the axis of the ring (which we choose as the positive z axis) a distance z from its center is given by equation

$$E\_{z}= \frac{1}{4πε\_{0}}\frac{qz}{\sqrt[3]{z^{2}+R^{2}}}$$

1. Starting with above equation write an equation in vector form that gives the electric field when point *P*is located either on the positive or negative axis of the ring of charge.

**Problem #5**

The electric field produced by, a disk of radius R that carries uniformly distributed positive charge q,at a point*P*located on the axis of the disk (which we choose as the positive z axis) a distance z from its center is given by equation

$$E\_{z}= \frac{1}{4πε\_{0}}\frac{2qz}{R^{2}}\left(1- \frac{z}{\sqrt{z^{2}+R^{2}}}\right)$$

1. Starting with above equation write an equation in vector form that gives the electric field when point *P* is located either on the positive or negative axis of the disk of charge.

**Problem # 6**

Positive charge Q is distributed uniformly along the positive y-axis between y = 0 and y = a. A point *P*lies on the positive x-axis, a distance x from the origin (see figure)

a) Calculate the x and y-components of the electric field produced by the charge distribution Q at points on the positive x-axis.

b) Show that if x>> a,

$E\_{x}≅ \frac{Q}{4πε\_{0}x^{2}\_{}}$ and $E\_{y}≅ - \frac{Qa}{8πε\_{0}x^{3}\_{}}$

Explain why this result is obtained.

**Problem # 7**

Negative charge -Q is distributed unifonnly around a quarter-circle of radius a that lies in the first quadrant, with the center of curvature at the origin. Find the x- and y-components of the net electric field at the origin.

**Due before April 22, 2020.**