ADDIS ABABA SCIENCE AND TECHNOLOGY UNIVERSITY

Electricity and Magnetism (Phys 206) Work Sheet II

1. A battery produces a specified potential difference ΔV between conductors attached to the battery terminals. A 12-V battery is connected between two parallel plates, as shown in Fig.1.The separation between the plates is $d = 0.30$ cm, and we assume the electric field between the plates to be uniform. Find the magnitude of the electric field between the plates.

2. A proton is released from rest in a uniform electric field that has a magnitude of $8.0 \times 10^4 V/m$ (Fig.2). The proton undergoes a displacement of 0.50 m in the direction of E.
   a)Find the change in electric potential between points A and B.
   b)Find the change in potential energy of the protonfield system for this displacement.
   c)Find the speed of the proton after completing the 0.50 m displacement in the electric field.

3. An electric dipole consists of two charges of equal magnitude and opposite sign separated by a distance 2a, as shown in Fig.3. The dipole is along the x axis and is centered at the origin. Calculate:
   (a) the electric potential at point P, (b) V and E_x at a point far from the dipole, and c)V and E_x if point P is located anywhere between the two charges.

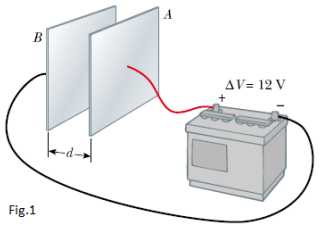

Fig.1

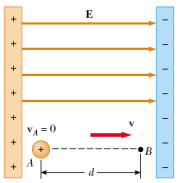

Fig. 2

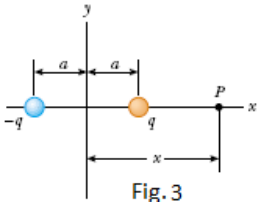

Fig. 3

4. Show that the amount of work required to assemble four identical point charges of magnitude Q at the corners of a square of side s is $\frac{5.41kQ^2}{s}$.

5. A charge $q_1 = 2.0\mu C$ is located at the origin, and a charge $q_2 = -6.0\mu C$ is located at $(0, 3.0)$ m, as shown in Fig.4. (a) Find the total electric potential due to these charges at the point P, whose coordinates are (4.00, 0) m. (b) Find the change in potential energy of the system of two charges plus a charge $q_3 = 3.0\mu C$ as the latter charge moves from infinity to point P(Fig.4(b)).

6. Given two $2.0\mu C$ charges, as shown in Fig.5, and a positive test charge $q = 1.28 \times 10^{18} C$ at the origin, (a) what is the net force exerted by the two $2.00\mu C$ charges on the test charge q? (b) What is the electric field at the origin due to the two $2.00\mu C$ charges? (c) What is the electric potential at the origin due to the two $2.00\mu C$ charges?

7. Calculate the energy required to assemble the array of charges shown in Fig.6, where a = 0.200 m, b = 0.400 m, and $q = 6.00\mu C$.

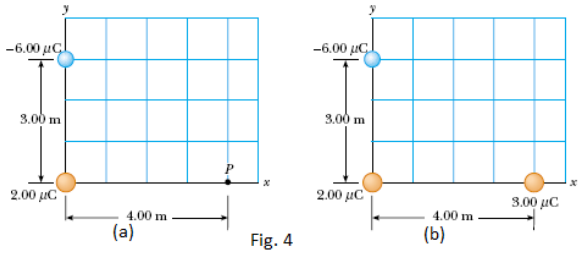

Fig. 4

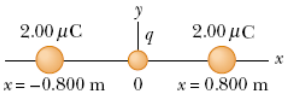

Fig. 5

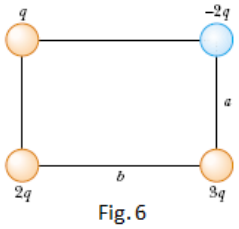

Fig. 6

8. The potential in a region between $x = 0$ and $x = 6.00m$ is $V = a + bx$, where $a = 10.0V$ and $b = -7.00V/m$. Determine (a) the potential at $x = 0, 3.00m, and 6.00m$, and (b) the magnitude and direction of the electric field at $x = 0, 3.00m, and 6.00m$.

9. Over a certain region of space, the electric potential is $V = 5x - 3x^2y + 2yz^2$. Find the expressions for the x, y, and z components of the electric field over this region. What is the magnitude of the field at the point P that has coordinates (1, 0, -2) m?

10. a) Find an expression for the electric potential at a point P located on the perpendicular central axis of a uniformly charged ring of radius a and total charge Q(Fig.9). b) Find an expression for the magnitude of the electric field at point P.

11. A uniformly charged disk(Fig.10) has radius a and surface charge density ρ. Find: (a) the potential and (b) the magnitude of the electric field along the $\perp$ central axis of the disk.

12. A rod of length l shown in Figure.11 has a total charge Q and a uniform linear charge density $\lambda = \frac{Q}{l}$. Find the potential at a point P located on the y axis a distance a from the origin.

13. An insulating solid sphere (Fig. 12) of radius R has a uniform positive volume charge density and total charge Q. (a) Find the electric potential at a point outside the sphere,that is, for $r > R$. Take the potential to be zero at $r = \infty$. (b) Find the potential at a point inside the sphere, that is, for$r < R$.

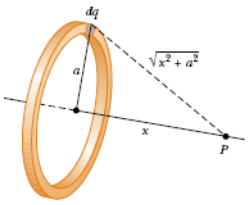

Fig.9

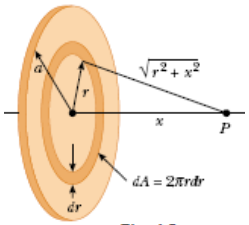

Fig.10

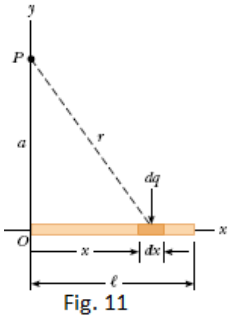

Fig. 11

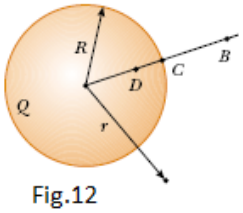

Fig.12

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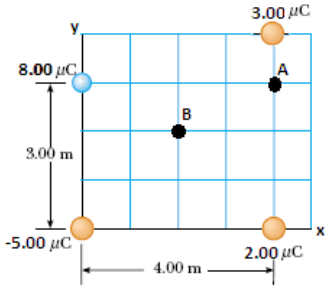
Electricity and Magnetism (Phys 206) Questions for Assignment No. II

1. What work is required to move a fifth 6.00 μC charge from point A to point B for the system of point charges shown in the Figure below?



2. For a region with potential $V(x, y, z) = x^3yz^2 - 3xyz + 3y^2z$, find (a) an expression for the electric field as a function of position coordinates, and (b) determine the magnitude of the electric field at $(-1, 1, 1)$.

3. A total charge $Q = 120\mu C$ is uniformly distributed along a rod of length $\ell = 1\ m$ placed along the x axis as shown in Figure below.Find the potential at a point with coordinates $(0m, 1m)$