Electric Potential

1. Two charges are located on the x-y plane. Charge \( q_1 \) is located at the point \((-d, 0)\), and charge \( q_2 \) is located at the point \((d, 0)\). Determine the electric potential at an arbitrary point \((x, y)\).

2. Using your answer to the previous problem, determine the electric field everywhere for the same charge configuration.

3. A long, thin, uniformly charged rod of length \( \ell \) and total charge \( Q \) lies along the x-axis with its left end at the origin. Determine the electric potential on the x-axis a distance \( d \) to the right of the right end of the rod.

4. Four charges are arranged at the corners of a square with sides of length \( a \). The charge at the top left is \( q \), the charge at the top right is \( 2q \), the charge at the bottom left is \( 3q \), and the charge at the bottom right is \( 4q \). How much electrical potential energy is stored in this configuration?

5. A thin, uniformly charged ring has radius \( R \) and total charge \( +Q \). A particle with charge \( +q \) and mass \( m \) is placed at rest in the center of the ring and then given a slight nudge in the direction straight through the circular ring (perpendicular to the plane of the ring). What happens? What is the final velocity of the particle?

6. A long, thin, uniformly charged rod with total charge \( Q \) is bent into the shape shown below. The circular part makes a perfect half-circle with radius \( R \), and each long end has length \( \ell \). Determine the electric potential at point \( A \) located at the center of the half-circle.