**CHAPTER 24 | Electric Potential**

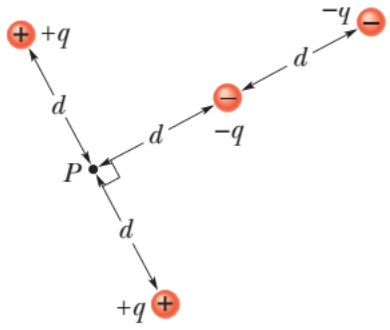
1 | Suppose that in a lightning flash the potential difference between a cloud and the ground is $1.0 \times 10^9\ V$ and the quantity of charge transferred is $30\ C$.
a) What is the change in energy of that transferred charge?
$(Ans: \Delta U = 3.0 \times 10^{10}\ J)$
b) If all the energy released could be used to accelerate a $1000\ kg$ car from rest, what would be its final speed? $(Ans: v = 7.7 \times 10^3\ m/s)$

2 | The electric field in a region of space has the components $E_y = 0,\ E_z = 0$ and $E_x = (4.00\ N/C)x$. Point $A$ is on the $y$ axis at $y = 3.00\ m$, and point $B$ is on the $x$ axis at $x = 4.00\ m$. What is the potential difference $V_B - V_A$?
$(Ans: \Delta V = -32.0\ V)$

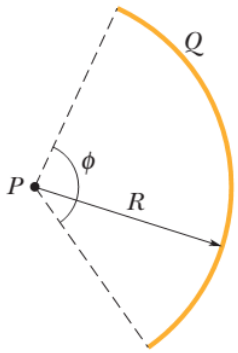
3 | Two uniformly charged, infinite, nonconducting planes are parallel to a $yz$ plane and positioned at $x = -50\ cm$ and $x = +50\ cm$. The charge densities on the planes are $-50\ nC/m^2$ and $+25\ nC/m^2$, respectively. What is the magnitude of the potential difference between the origin and the point on the $x$ axis at $x = +80\ cm$? (Hint: Use Gauss' law.) $(Ans: \Delta V = 2.5 \times 10^3\ V)$

4 | A nonconducting sphere has radius $R = 2.31\ cm$ and uniformly distributed charge $q = 3.50\ fC$. Take the electric potential at the sphere's center to be $V_0 = 0$. What is $V$ at radial distance
a) $r = 1.45\ cm$ $(Ans: V = -2.68 \times 10^{-4}\ V)$ and
b) $r = R$. $(Ans: V = -6.81 \times 10^{-4}\ V)$

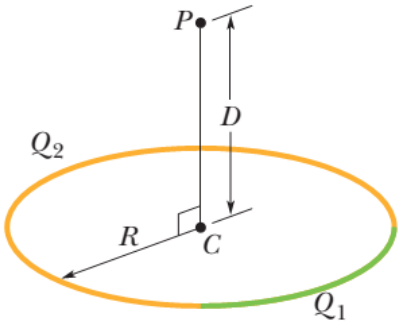
5 | In the figure, what is the net electric potential at point $P$ due to the four particles if $V = 0$ at infinity, $q = 5.00\ fC$, and $d = 4.00\ cm$?
$(Ans: V = 5.6 \times 10^{-4}\ V)$



6 | In the figure, a plastic rod having a uniformly distributed charge $Q = -25.6\,pC$ has been bent into a circular arc of radius $R = 3.71\,cm$ and central angle $\phi = 120°$ .With $V = 0$ at infinity, what is the electric potential at $P$, the center of curvature of the rod? $(Ans: V_P = -6.20\,V)$



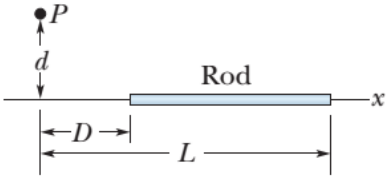

7 | A plastic rod has been bent into a circle of radius $R = 8.20\,cm$ . It has a charge $Q_1 = +4.20\,pC$ uniformly distributed along onequarter of its circumference and a charge $Q_2 = -6Q_1$ uniformly distributed along the rest of the circumference. With $V = 0$ at infinity, what is the electric potential at




a) the center $C$ of the circle $(Ans: V_C = -2.3\,V)$

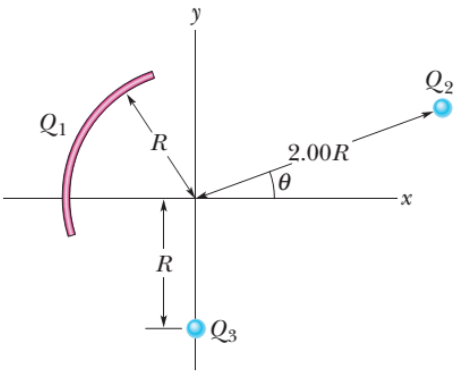
b) and point $P$, on the central axis of the circle at distance $D = 6.71\,cm$ from the center? $(Ans: V_P = -1.78\,V)$

8 | Figure in front shows a thin rod with a uniform charge density of $2.00\,mC/m$. Evaluate the electric potential at point $P$ if $d = D = L/4.00$. Assume that the potential is zero at infinity.




$(Ans: V = 2.18 \times 10^4\,V)$

9 | In the figure, what is the net electric potential at the origin due to the circular arc of charge $Q_1 = +7.21\,pC$ and the two particles of charges $Q_2 = 4.00Q_1$ and $Q_3 = -2.00Q_1$ ? The arc's center of curvature is at the origin and its radius is $R = 2.00\,m$; the angle indicated is $\theta = 20.0°$.




$(Ans: V = 3.24 \times 10^{-2}\,V)$

10 | The electric potential is given by $V = (2.0\ V/m^2)x^2 - (3.0\ V/m^2)y^2$ at points in an $xy$ plane. In unit-vector notation, what is the electric field at the point $(3.0\ m, 2.0\ m)$? $\left(Ans: \vec{E} = 12(-\hat{\imath} + \hat{\jmath})V/m\right)$

11 | At the point $(3.00\hat{\imath} + 2.00\hat{\jmath} + 4.00\hat{k})\ m$ what is the magnitude of the electric field if the electric potential in the region is given by $V = 2.00xyz^2$, where $V$ is in volts and coordinates $x$, $y$, and $z$ are in meters? $(Ans: E = 150\ N/C)$

12 | In figure, how much work must we do to bring a particle, of charge $Q = +16e$ and initially at rest, along the dashed line from infinity to the indicated point near two fixed particles of charges $q_1 = +4e$ and $q_2 = -q_1/2$? Distance $d = 1.40\ cm$, $\theta_1 = 43°$, and $\theta_2 = 60°$. $(Ans: W = 0)$