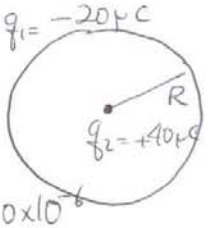
Physics 102-Rec
Quiz#9
Chapter 24

Name: Key Id#: Sect#:

Consider a spherical shell of radius R = 10 cm and charge $q_1 = -20\ \mu C$. A point charge $q_2 = +40\ \mu C$ is located at the center of the shell. Calculate the electric potential at

(a) $r_1 = 8.0$ cm



$r_1 < R$ $\quad V_1 = \frac{kq_1}{R} + \frac{kq_2}{r_1}$

$= \frac{9\times10^9 \times (-20\times10^{-6})}{0.1} + \frac{9\times10^9 \times 40\times10^{-6}}{0.08}$

$= -1.8\times10^6 + 4.5\times10^6 = \boxed{2.7\times10^6\ V}$

(b) $r_2 = 20$ cm from the center of the sphere.

$r_2 > R$ $\quad V_2 = \frac{kq_1}{r_2} + \frac{kq_2}{r_2}$

$= \frac{9\times10^9 (-20+40)\times10^{-6}}{0.2}$

$= \boxed{9\times10^5\ V}$

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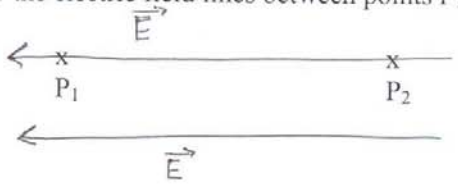
1. Consider two points in an electric field. The potential at point P_1 is $V_1 = -140$ V, and the potential at point P_2 is $V_2 = 260$ V.

(a) Draw the electric field lines between points P_1 and P_2.



(b) How much work is required in moving a charge $q = -12\ \mu C$ from point P_2 to point P_1.

$$W_{app} = \Delta U = q(V_1 - V_2)$$

$$= (-12 \times 10^{-6})(-140 - 260)$$

$$= \boxed{4.8 \times 10^{-3}\ J}$$

(c) Assume the electric field has magnitude of 5000 V/m, what is the distance between points P_1 and P_2?

$$\Delta V = -E\,d$$

$$-140 - 260 = -5000\,d$$

$$d = \boxed{0.08\text{m} = 8\text{cm}}$$

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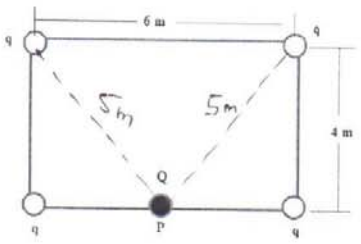
(a) Four identical point charges, each with charge q = + 30 μC, are placed at the corners of a rectangle, as shown in the figure. How much work must be done to bring a charge Q = +56 μC from infinity to point P, located at the midpoint of one of the 6.0-m long sides of the rectangle?



$$W_{app} = \Delta U = U_f - U_i^{\nearrow 0}$$

$$= Q V_p = Q \left[\frac{2kq}{3} + \frac{2kq}{5} \right]$$

$$= 56 \times 10^{-6} \left[\frac{2 \times 9 \times 10^9 \times 30 \times 10^{-6}}{3} + \frac{2 \times 9 \times 10^9 \times 30 \times 10^{-6}}{5} \right]$$

$$= \boxed{16.1\ \text{J}}$$

(b) Is work done by the electric field or external agent? Why?

Work done by applied force because it is positive.