Chapter 6 Review Questions

Solutions can be found in Chapter 12.

Section I: Multiple Choice

1. An experiment is conducted and data is gathered for the electric potential V at various positions r away from a uniformly charged sphere. All measurements are taken outside of the sphere. Which of the following graphs yields a straight line?

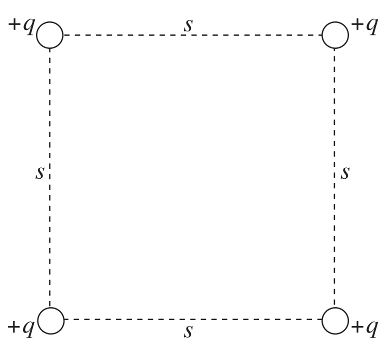
   (A) V as a function of $\frac{1}{r^2}$

   (B) V as a function of $\frac{1}{r}$

   (C) V as a function of r

   (D) V as a function of r^2

2.



   The work required to assemble the system shown above, bringing each charge in from an infinite distance, is equal to

   (A) $\frac{1}{4\pi\varepsilon_0}\frac{4q^2}{s}$

   (B) $\frac{1}{4\pi\varepsilon_0}\frac{(4+\sqrt{2})q^2}{s}$

   (C) $\frac{1}{4\pi\varepsilon_0}\frac{6q^2}{s}$

   (D) $\frac{1}{4\pi\varepsilon_0}\frac{(4+2\sqrt{2})q^2}{s}$

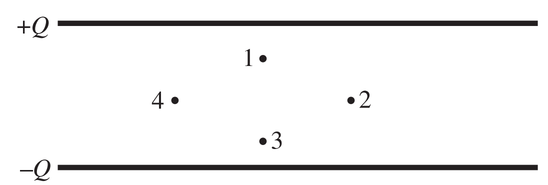
3. Negative charges are accelerated by electric fields toward points

   (A) at lower electric potential
   (B) at higher electric potential
   (C) where the electric field is weaker
   (D) where the electric field is stronger

4. A charge q experiences a displacement within an electric field from Position A to Position B. The change in the electrical potential energy is ΔU_E, and the work done by the electric field during this displacement is W_E. Then

   (A) $V_A - V_B = qW_E$
   (B) $V_B - V_A = qW_E$
   (C) $V_A - V_B = \Delta U_E/q$
   (D) $V_B - V_A = \Delta U_E/q$

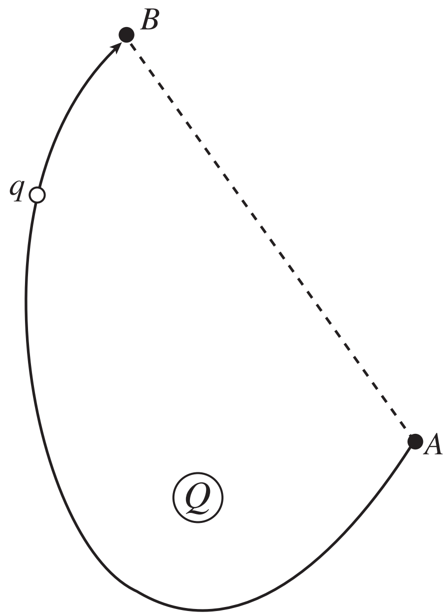
5.



   Which points in this uniform electric field (between the plates of the capacitor) shown above lie on the same equipotential?

   (A) 1 and 3 only
   (B) 2 and 4 only
   (C) None lie on the same equipotential.
   (D) 1, 2, 3, and 4 all lie on the same equipotential since the electric field is uniform.

6.

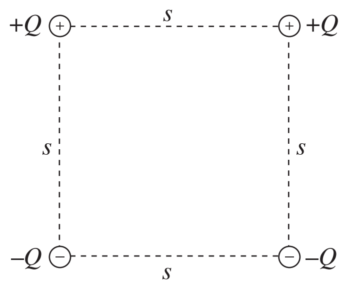


How much work would the electric field (created by the stationary charge Q) perform as a charge q is moved from Point A to B along the curved path shown? $V_A = 200$ V, $V_B = 100$ V, $q = -0.05$ C, length of line segment $AB = 10$ cm, length of curved path = 20 cm.

(A) –10 J
(B) –5 J
(C) +5 J
(D) +10 J

Section II: Free Response

1. In the figure shown, all four charges are situated at the corners of a square with sides *s*.



(a) What is the total electrical potential energy of this array of fixed charges?

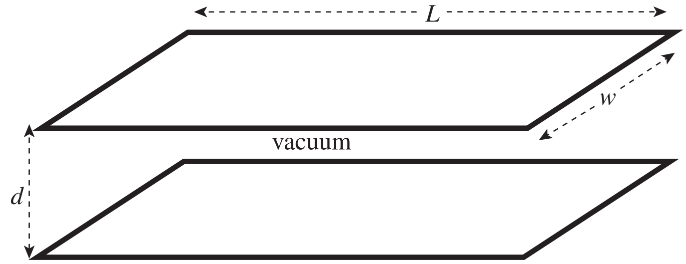
(b) What is the electric field at the center of the square?

(c) What is the electric potential at the center of the square?

(d) Sketch (on the diagram) the portion of the equipotential surface that lies in the plane of the figure and passes through the center of the square.

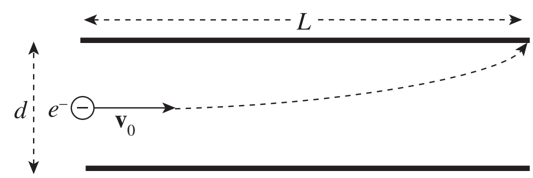
(e) How much work would the electric field perform on a charge *q* as it moved from the midpoint of the right side of the square to the midpoint of the top of the square?

2. The figure below shows a parallel-plate capacitor. Each rectangular plate has length L and width w, and the plates are separated by a distance d.



(a) Determine the capacitance.

An electron (mass m, charge $-e$) is shot horizontally into the empty space between the plates, midway between them, with an initial velocity of magnitude v_0. The electron just barely misses hitting the end of the top plate as it exits. (Ignore gravity.)



(b) In the diagram, sketch the electric field vector at the position of the electron when it has traveled a horizontal distance of $L/2$.

(c) In the diagram, sketch the electric force vector on the electron at the same position as in part (b).

(d) Determine the strength of the electric field between the plates. Write your answer in terms of L, d, m, e, and v_0.

(e) Determine the charge on the top plate.

(f) How much potential energy is stored in the capacitor?

3. A solid conducting sphere of radius a carries an excess charge of Q.

(a) Determine the electric field magnitude, $E(r)$, as a function of r, the distance from the sphere's center.

(b) Determine the potential, $V(r)$, as a function of r. Take the zero of potential at $r = \infty$.

(c) On the diagrams below, sketch $E(r)$ and $V(r)$. (Cover at least the range $0 < r < 2a$.)