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?

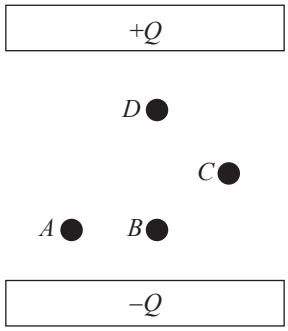
   (A) V as a function of $\frac{1}{r^2}$

   (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. Below is shown a section near the center of a parallel plate capacitor. There are 4 labeled positions between the plates shown as A, B, C, and D. Relative to A, which point has the largest potential difference and why?



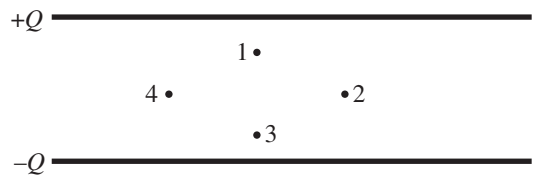
   (A) Point A because the potential difference is infinite when the position between points is 0 m.
   (B) Point B because it is the same distance from the $-Q$ plate as A.
   (C) Point C because it is farther in distance from Point A.
   (D) Point D because it is closest to the $+Q$ Plate.

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

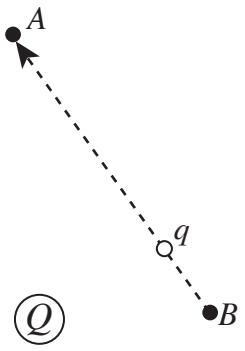
   (A) $V_A - V_B = qW_E$
   (B) $V_B - V_A = qW_E$
   (C) $V_A - V_B = \Delta U_E/q$
   (D) $V_B - V_A = \Delta U_E/q$



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.

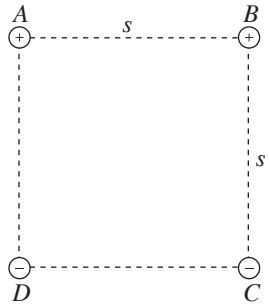
6. A charge Q creates an electric field through which a second charge q moves, as shown below. q is initially at point B and is moved to point A. The potential from Q at position A is $V_A = 100$ V and at B is $V_B = 200$ V. The charge on q is negative. What is the sign of Q and the sign of the work done by the electric field of Q as q is moved from B to A?



(A) Q is positive and the work done by the electric field is positive.
(B) Q is positive and the work done by the electric field is negative.
(C) Q is negative and the work done by the electric field is positive.
(D) Q is negative and the work done by the electric field is negative.

Section II: Free Response

1. In the figure shown below, four charges, each of magnitude Q, are situated at the corners of a square with side lengths s. The two charges on the top of the square are positively charged, while the two on the bottom of the square are negatively charged.



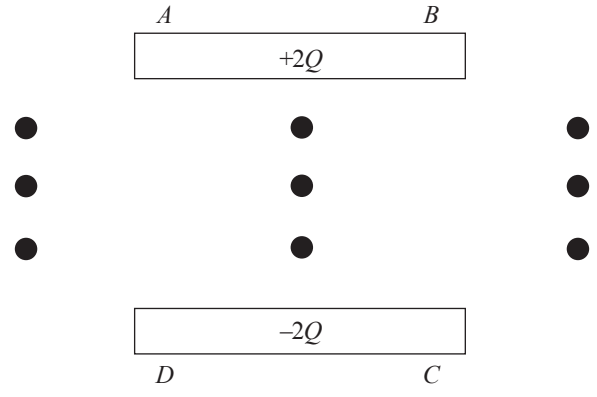
(a) These charges were assembled in order by first bringing in charge A, then bringing in charge B, then bringing in C, and finally bringing in charge D. Rank the amount of energy in the charge distribution in the present of charge only charge A, only charges A and B, only charges A, B, and C, and in the presence of all four charges. Negative numbers should be taken as smaller then positive numbers. Justify your answer.

Greatest (most positive) ____ ____ _____ ____ Least (most negative)

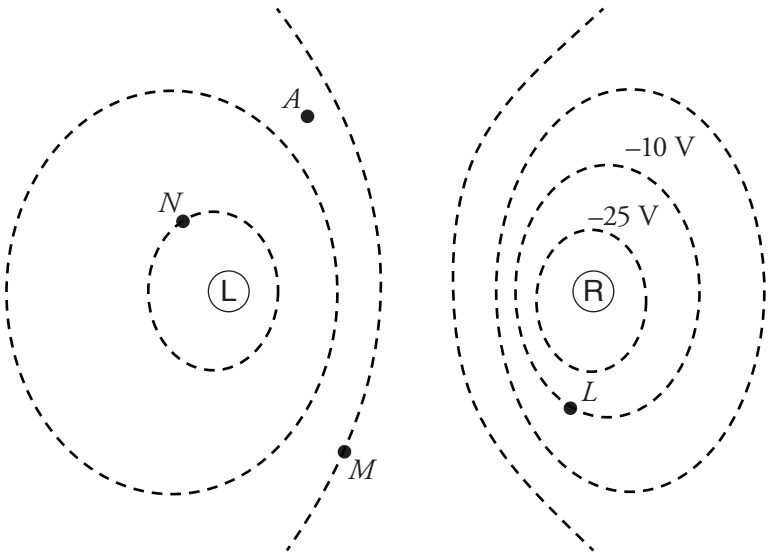
(b) Show the potential at the exact center of the square is 0 V by calculating the potential from each charge at that location.

(c) 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.

(d) As shown below, solid conducting bars are placed to connect points A to B and also to connect points C to D. The charge is allowed to distribute over these conductors. Sketch the electric field at each of the dots. Explain why the field is constant at the dots in the center but not at the dots on the edges.



2. The image below shows the isolines of electric potential surrounding two charges spheres, labeled L and R. The spheres carry opposite charges and the potential difference between adjacent pairs of lines is $\Delta V = 15$ V. The isolines with a voltages of –25 V and –10 V are indicated.



(a) Sketch in the line of potential 0 V on the drawing.

(b) Approximately what is the value of the potential at the points labeled *A*?

(c)

i. Which sphere, L or R, carries a negative charge? Explain your answer.

ii. Which sphere, L or R, carries a greater magnitude of charge? Explain how you know.

(d)

i. Draw arrows to indicate the electric fields at the points labeled *L*, *M*, and *N*.

ii. Rank the magnitude of the electric field strength at points *L*, *M*, and *N*. Explain your answer.

(e) If the sphere labeled L were replaced with another sphere to have the same magnitude of charge but of the opposite sign, would the value of the potential at the point labeled *N* be larger, smaller, or stay the same? Justify your answer.

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 $0 < r < 2a$.)