Lesson 10: Ch 24.6-24.8 Solutions

1) By Gauss's Law, \( \mathbf{E} \) is constant at all points, so \( \Delta V = 0 \) between all points in sphere, so \( V \) is constant in sphere.

Outside, \( \mathbf{E} \) looks like that of a point charge, so \( V \) looks like that of a point charge. Also, \( V \) must be continuous at the surface, so:

a) \( V = k \frac{Q}{R} \)

b) \( V = k \frac{Q}{R} \)

c) \( V = k \frac{Q}{R} \)

d) \( V = k \frac{Q}{2R} \)

2) Potentials add, so

a) \( V = k \frac{Q}{R} + k \frac{(-Q)}{0} = \infty \)

b) \( V = k \frac{Q}{R} + k \frac{(-Q)}{R} = -k \frac{Q}{R} \)

c) \( V = k \frac{Q}{R} + k \frac{(-Q)}{R} = 0 \)

d) \( V = k \frac{Q}{2R} + k \frac{(-Q)}{2R} = 0 \)

e) \( V = k \frac{Q}{R} - k \frac{Q}{R} = 0 \)
\[ W_{\text{ext}} = \Delta U = U_s - U_i = U_{\text{middle}} - U_\infty \]

\[ U = qV = 2eV, \quad s_0 \]

\[ U_{\text{middle}} = 2eV_{\text{middle}} \]

\[ U_\infty = 2eV_\infty = 0, \quad s_0 \]

\[ W_{\text{ext}} = 2eV_{\text{middle}} \]

\[ V_{\text{middle}} = -k \frac{2e}{(\frac{L}{2})} + k \frac{3e}{(\frac{L}{2})} + k \frac{2e}{(\frac{L}{2})} = 6k \frac{e}{L}, \quad s_0 \]

\[ W_{\text{ext}} = 2e 6k \frac{e}{L} = 12k \frac{e^2}{L} \]