Chapter 20

1. $\Delta U = q_0 Ed$

(a) $\Delta U = q_0 E(0) = 0$

(b) $\Delta U = -q_0 Ed = -(4.5 \times 10^{-6} \text{C})(6.1 \times 10^5 \frac{\text{N}}{\text{C}})(6.0 \text{m}) = -16 \text{J}$

(c) $\Delta U = -q_0 Ed = -(4.5 \times 10^{-6} \text{C})(6.1 \times 10^5 \frac{\text{N}}{\text{C}})(6.0 \text{m}) = -16 \text{J}$

3. $E = \frac{\Delta V}{d} = \frac{0.070 \text{V}}{0.10 \times 10^{-6} \text{m}} = 7.0 \times 10^5 \text{V/m}$
   The electric field points from higher to lower potential, so the electric field is $7.0 \times 10^5 \text{V/m}$ directed outward from the cell.

9. (a) $\Delta U = -qEd = -(12.5 \times 10^{-6} \text{C})(5250 \frac{\text{N}}{\text{C}})(0.0550 \text{ m}) = -361 \text{ mJ}$

(b) $\Delta U = qEd = (12.5 \times 10^{-6} \text{C})(5250 \frac{\text{N}}{\text{C}})(0.0550 \text{ m}) = 361 \text{ mJ}$

(c) $\Delta U = qE(0) = 0$

17. $\frac{1}{2}mv^2 = e\Delta V$

$v = \sqrt{\frac{2e\Delta V}{m}} = \sqrt{\frac{2(1.60 \times 10^{-19} \text{C})(25.000 \text{V})}{9.11 \times 10^{-31} \text{kg}}} = 9.4 \times 10^7 \text{m/s}$

Note that relativistic effects have been ignored.

24. $U = \frac{kdq_1q_2}{r}$

$r = \frac{kq_1q_2}{U} = \frac{(8.99 \times 10^9 \frac{\text{N} \cdot \text{m}^2}{\text{C}^2})(7.22 \times 10^{-6} \text{C})(-26.1 \times 10^{-6} \text{C})}{-126 \text{ J}} = 1.34 \text{ cm}$

43. (a) $V = \frac{Q}{C} = \frac{Qd}{\kappa \varepsilon_0 A} = \frac{(4.7 \times 10^{-6} \text{C})(0.88 \times 10^{-3} \text{m})}{2.0(8.85 \times 10^{-12} \frac{\text{C}^2}{\text{N} \cdot \text{m}^2})(0.012 \text{m}^2)} = 99 \text{kV}$

(b) The answer to part (a) will decrease because $V$ is inversely proportional to $\kappa$.

(c) $V = \frac{(4.7 \times 10^{-6} \text{C})(0.88 \times 10^{-3} \text{m})}{4.0(8.85 \times 10^{-12} \frac{\text{C}^2}{\text{N} \cdot \text{m}^2})(0.012 \text{m}^2)} = 97 \text{kV}$

51. $W = E = \frac{1}{2}CV^2 = \frac{1}{2}(8.0 \times 10^{-6} \text{F})(3.0 \text{V})^2 = 36 \mu\text{J}$
68. \[ W = \frac{1}{2} QV = \frac{1}{2} NeV = \frac{1}{2} (3.75 \times 10^{16})(1.60 \times 10^{-19} \text{ C})(325 \text{ V}) = 0.975 \text{ J} \]