1. a) $V = \dfrac{kq}{2a}$

b) $V = \dfrac{kq}{\sqrt{x_0^2 + (y_0 - a)^2}} + \dfrac{kq}{\sqrt{(x_0 - a)^2 + y_0^2}} - \dfrac{3kq}{\sqrt{(x_0 - \sqrt{2}a)^2 + (y_0 - \sqrt{2}a)^2}}$

2. a) $x = \dfrac{2d}{3}$

$x = 2d$

b) 2 points

c) 1 point

3. a-b) $W = +\dfrac{kq^2}{b}$

c) $v_f = \sqrt{\dfrac{kq^2}{bm}}$

d) $W = -\dfrac{kq^2}{b}$

4. a) $V_a - V_b = \dfrac{2kq}{r} - \dfrac{2kq}{d - r}$

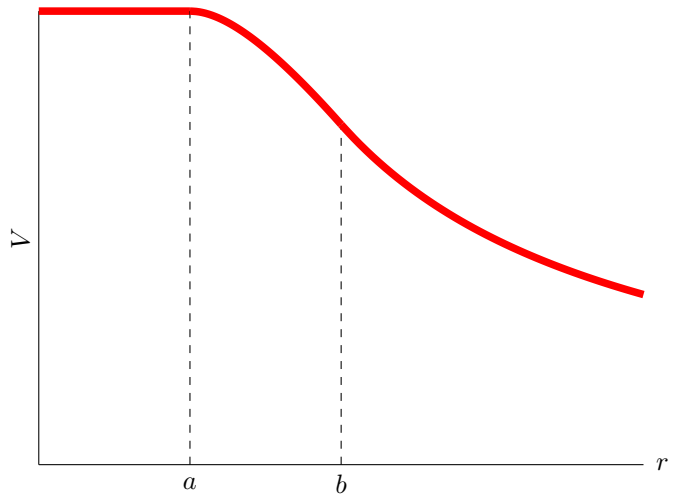
b) $q = 0$

c) $\Delta V = 0$

5. above end: $V = k\lambda_0 \displaystyle\int_{-\ell}^{0} \frac{\left(x + \frac{\ell}{2}\right)^2 dx}{\sqrt{x^2 + y_0^2}}$

right end: $V = k\lambda_0 \displaystyle\int_{-\ell}^{0} \frac{\left(x + \frac{\ell}{2}\right)^2 dx}{\sqrt{(x_0 - x)^2}}$

6. $V(r) = \begin{cases} \frac{\gamma b}{\epsilon_0} - \frac{\gamma a}{\epsilon_0} & r < a \\ -\frac{\gamma}{2\epsilon_0} r + \frac{\gamma b}{\epsilon_0} - \frac{\gamma a^2}{2\epsilon_0 r} & a < r < b \\ \frac{\gamma(b^2 - a^2)}{2\epsilon_0 r} & b < r \end{cases}$



7. a) $(x, y) = (11, -\frac{4}{11})$ and $(-11, \frac{4}{11})$

b) $\vec{E}(x, y, z) = -2\cos[10(x^2 + y^2 + z^2)]\left(x\hat{\imath} + y\hat{\jmath} + z\hat{k}\right)$

c) $\vec{E}(x, y, z) = -\dfrac{1}{\sqrt{0.4^2 - \left(0.6 - \sqrt{x^2 + y^2 + z^2}\right)^2}} \dfrac{0.6 - \sqrt{x^2 + y^2 + z^2}}{\sqrt{x^2 + y^2 + z^2}}(x\hat{\imath} + y\hat{\jmath} + z\hat{k})$

8. The potential does not converge to a fixed value