\( V_B - V_A = -\int_A^{B} \vec{E} \cdot d\vec{s} = -\int_A^{C} \vec{E} \cdot d\vec{s} - \int_C^{B} \vec{E} \cdot d\vec{s} \)

\( V_B - V_A = (E \cos 180^\circ) \int_{-0.200}^{0.500} dy - (E \cos 90^\circ) \int_{-0.300}^{0.400} dx \)

\( V_B - V_A = (3.25) (0.800) = +260V \)

(a) Since the charges are equal and placed symmetrically, \( E = 0 \)

(b) \( E = 0 \)

(c) \( V = 2k_e \frac{q}{r} = 2(8.99 \times 10^9 \text{N} \cdot \text{m}^2/\text{C}^2) \left( \frac{2.00 \times 10^{-6} \text{C}}{0.800 \text{m}} \right) \)

\( V = 4.50 \times 10^4 \text{V} = 45.0 \text{ kV} \)

(a) The potential at 1.00 cm is

\( V_1 = k_e \frac{q}{r} = \left( 8.99 \times 10^9 \text{N} \cdot \text{m}^2/\text{C}^2 \right) \left( 1.60 \times 10^{-19} \text{C} \right) / \text{1.00} \times 10^{-2} \text{m} \)

\( V_1 = 1.44 \times 10^{-7} \text{V} \)

(b) The potential at 2.00 cm is

\( V_2 = k_e \frac{q}{r} = \left( 8.99 \times 10^9 \text{N} \cdot \text{m}^2/\text{C}^2 \right) \left( 1.60 \times 10^{-19} \text{C} \right) / \text{2.00} \times 10^{-2} \text{m} \)

Thus, the difference in potential between the two points is

\( \Delta V = V_2 - V_1 = -7.19 \times 10^{-8} \text{V} \)

(c) The approach is the same as above except the charge is \(-1.60 \times 10^{-19} \text{C}\). This changes the sign of each answer, with its magnitude remaining the same.

That is, the potential at 1.00 cm is \(-1.44 \times 10^{-7} \text{V}\).

The potential at 2.00 cm is \(-7.19 \times 10^{-7} \text{V}\).

\( \Delta V = V_2 - V_1 = 7.19 \times 10^{-8} \text{V} \)
(29) \quad V = a + bx = 10.0V + (-7.00\text{V/m})x

(a) At \(x = 0\), \(V = 10.0V\)

At \(x = 3.00\text{m}\), \(V = -11.0V\)

At \(x = 6.00\text{m}\), \(V = -32.0V\)

(b) \(E = -\frac{dV}{dx} = -b = -(-7.00\text{V/m}) = 7.00\text{N/C in the +x direction}\)

(31) \quad V = 5x - 3x^2y + 2xz^2

Evaluate \(E\) at \((1, 0, -2)\)

\(E_x = -\frac{\partial V}{\partial x} = -5 + 6xy = -5 + 6(1)(0) = -5\)

\(E_y = -\frac{\partial V}{\partial y} = 3x^2 - 2z^2 = 3(1)^2 - 2(-2)^2 = -5\)

\(E_z = -\frac{\partial V}{\partial z} = -4xz = -4(1)(-2) = 0\)

\[E = \sqrt{E_x^2 + E_y^2 + E_z^2} = \sqrt{(-5)^2 + (-5)^2 + 0^2} = 7.07\text{N/C}\]