Problem 1: (20 pts.) Two points charges are placed on the x-axis. One point charge, 8.00 nC, is placed at $x = -1.00\,\text{m}$, and the second point charge, $-4.00\,\text{nC}$, is placed at $x = +1.00\,\text{m}$. Find one point along the x-axis (other than infinity) where the electric potential is zero. (There are actually 2 such points, but you only need to find one for this problem.)

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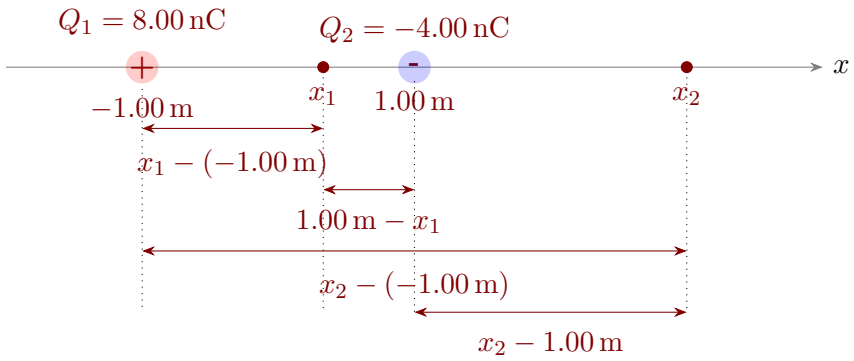

Since $|Q_2| < |Q_1|$, the field point where V equals 0 will have to be closer to Q_2 than to Q_1. That means it can't be to the left of Q_1. Consider the other two possibilities:

First, consider a point x_1, between the two charges. The distances between point x_1 and each of the charges are shown in the figure. Set the potential at x_1 equal to 0, and then solve for x_1.

$$V_1 + V_2 = 0$$
$$\frac{KQ_1}{x_1 - (-1.00\,\text{m})} + \frac{KQ_2}{1.00\,\text{m} - x_1} = 0$$
$$\frac{1.00\,\text{m} - x_1}{x_1 - (-1.00\,\text{m})} = -\frac{Q_2}{Q_1}$$
$$\frac{1.00\,\text{m} - x_1}{x_1 - (-1.00\,\text{m})} = -\frac{-4.00\,\text{nC}}{8.00\,\text{nC}} = \frac{1}{2}$$
$$2\,(1.00\,\text{m} - x_1) = x_1 - (-1.00\,\text{m})$$
$$1.00\,\text{m} = 3x_1$$
$$x_1 = \boxed{0.333\,\text{m}}$$

Next, consider a point x_2, to the right of both charges. The distances between point x_2 and each of the charges are shown in the figure. Set the potential at x_2 equal to 0, and then solve for x_2.

$$V_1 + V_2 = 0$$
$$\frac{KQ_1}{x_2 - (-1.00\,\text{m})} + \frac{KQ_2}{x_2 - 1.00\,\text{m}} = 0$$
$$\frac{x_2 - 1.00\,\text{m}}{x_2 - (-1.00\,\text{m})} = -\frac{Q_2}{Q_1}$$
$$\frac{x_2 - 1.00\,\text{m}}{x_2 - (-1.00\,\text{m})} = -\frac{-4.00\,\text{nC}}{8.00\,\text{nC}} = \frac{1}{2}$$
$$2\,(x_2 - 1.00\,\text{m}) = x_2 - (-1.00\,\text{m})$$
$$x_2 = \boxed{3.00\,\text{m}}$$