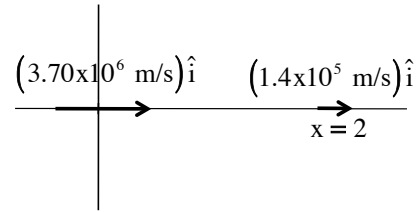## Problem 25.5

An electron's velocity at two different points is shown.

a.) What is the potential difference between the points:

$\left(3.70 \times 10^6 \text{ m/s}\right)\hat{i} \qquad \left(1.4 \times 10^5 \text{ m/s}\right)\hat{i}$

$x = 2$

Using conservation of energy:

$$\sum KE_1 + \sum U_1 + \sum W_{ext} = \sum KE_2 + \sum U_2$$

$$\frac{1}{2}mv_1^2 + qV_1 + 0 = \frac{1}{2}mv_2^2 + qV_2$$

$$\frac{1}{2}mv_1^2 - \frac{1}{2}mv_2^2 = q\left(V_2 - V_1\right)$$

$$\Rightarrow \quad \frac{1}{2}mv_1^2 - \frac{1}{2}mv_2^2 = q\left(\Delta V\right)$$

$$\Rightarrow \quad \Delta V = \frac{\frac{1}{2}mv_1^2 - \frac{1}{2}mv_2^2}{q}$$

$$\Rightarrow \quad \Delta V = \frac{\frac{1}{2}\left(9.1 \times 10^{-31}\right)\left(3.7 \times 10^6\right)^2 - \frac{1}{2}\left(9.1 \times 10^{-31}\right)\left(1.4 \times 10^5\right)^2}{\left(-1.6 \times 10^{-19}\right)}$$

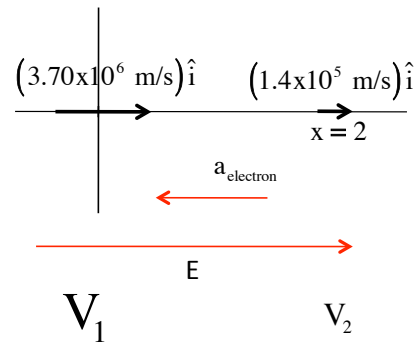$$\Rightarrow \quad \Delta V = -38.9 \text{ volts}$$

1.)

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b.) Which point has the higher potential?

If the electron is slowing down as it moves to the right, it must be accelerated to the left.

An electron will accelerate *opposite* the direction of an electric field, so the field must be to the right.

The direction of an electric field goes from HIGHER electrical potential to LOWER electric potential, so the origin must be at higher potential.

$\left(3.70 \times 10^6 \text{ m/s}\right)\hat{i} \qquad \left(1.4 \times 10^5 \text{ m/s}\right)\hat{i}$

$x = 2$

$a_{electron}$

E

$V_1 \qquad\qquad V_2$

2.)