ELECTRIC POTENTIAL ENERGY- ELECTRIC POTENTIAL- POTENTIAL DIFFERENCE

EXERCISES

1. M Oppositely charged parallel plates are separated by 5.33 mm. A potential difference of 600 V exists between the plates. (a) What is the magnitude of the electric field between the plates? (b) What is the magnitude of the force on an electron between the plates? (c) How much work must be done on the electron to move it to the negative plate if it is initially positioned 2.90 mm from the positive plate?

***P25.1** (a) From Equation 25.6,

$$E = \frac{|\Delta V|}{d} = \frac{600 \text{ J/C}}{5.33 \times 10^{-3} \text{ m}} = \boxed{1.13 \times 10^{5} \text{ N/C}}$$

(b) The force on an electron is given by

$$F = |q|E = (1.60 \times 10^{-19} \text{ C})(1.13 \times 10^{5} \text{ N/C}) = \boxed{1.80 \times 10^{-14} \text{ N}}$$

(c) Because the electron is repelled by the negative plate, the force used to move the electron must be applied in the direction of the electron's displacement. The work done to move the electron is

$$W = F \cdot s \cos\theta = (1.80 \times 10^{-14} \text{ N})[(5.33 - 2.00) \times 10^{-3} \text{ m}]\cos 0°$$

$$= \boxed{4.37 \times 10^{-17} \text{ J}}$$

---

7. AMT M An electron moving parallel to the x axis has an initial speed of 3.70×10^{6} m/s at the origin. Its speed is reduced to 1.40×10^{5} m/s at the point $x = 2.00$ cm. (a) Calculate the electric potential difference between the origin and that point. (b) Which point is at the higher potential?

Because of the energy is conserved, the kinetic energy is equal to the potential energy

$$\Delta U = -(\Delta K)$$

$$\Delta U = -\frac{1}{2}m\left(v_f^2 - v_i^2\right) = -\frac{1}{2}\left(9.11\times10^{-31}\ \text{kg}\right)\left[\left(1.40\times10^{5}\ \text{m/s}\right)^2 - \left(3.70\times10^{6}\ \text{m/s}\right)^2\right] = 6.23\times10^{-18}\ \text{J}$$

$$\Delta U = q\Delta V: \qquad +6.23\times10^{-18} = \left(-1.60\times10^{-19}\right)\Delta V$$

$$\Delta V = \boxed{-38.9\ \text{V. The origin is at highest potential.}}$$

(b) The negative sign means that the 2.00-cm location is lower in potential than the origin: