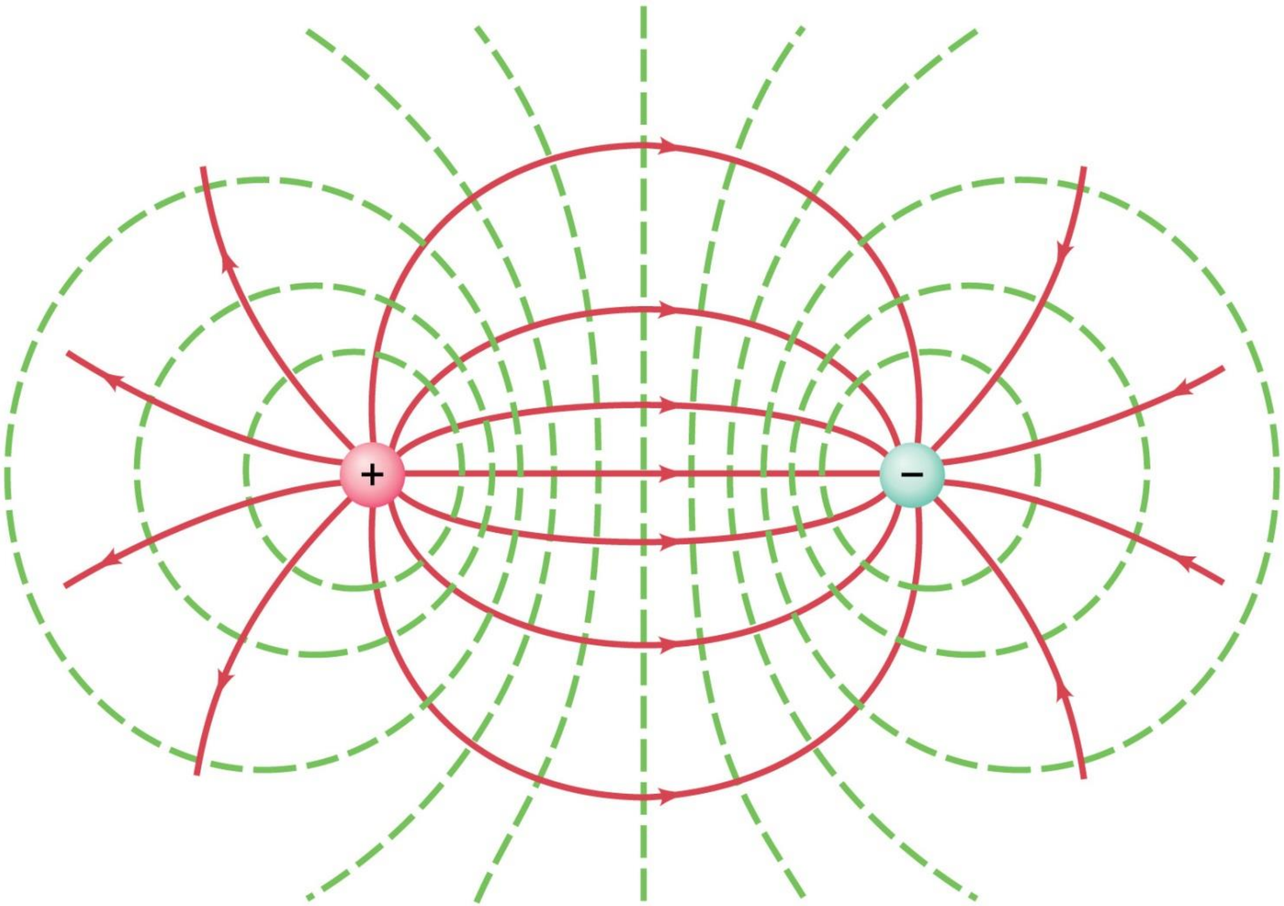


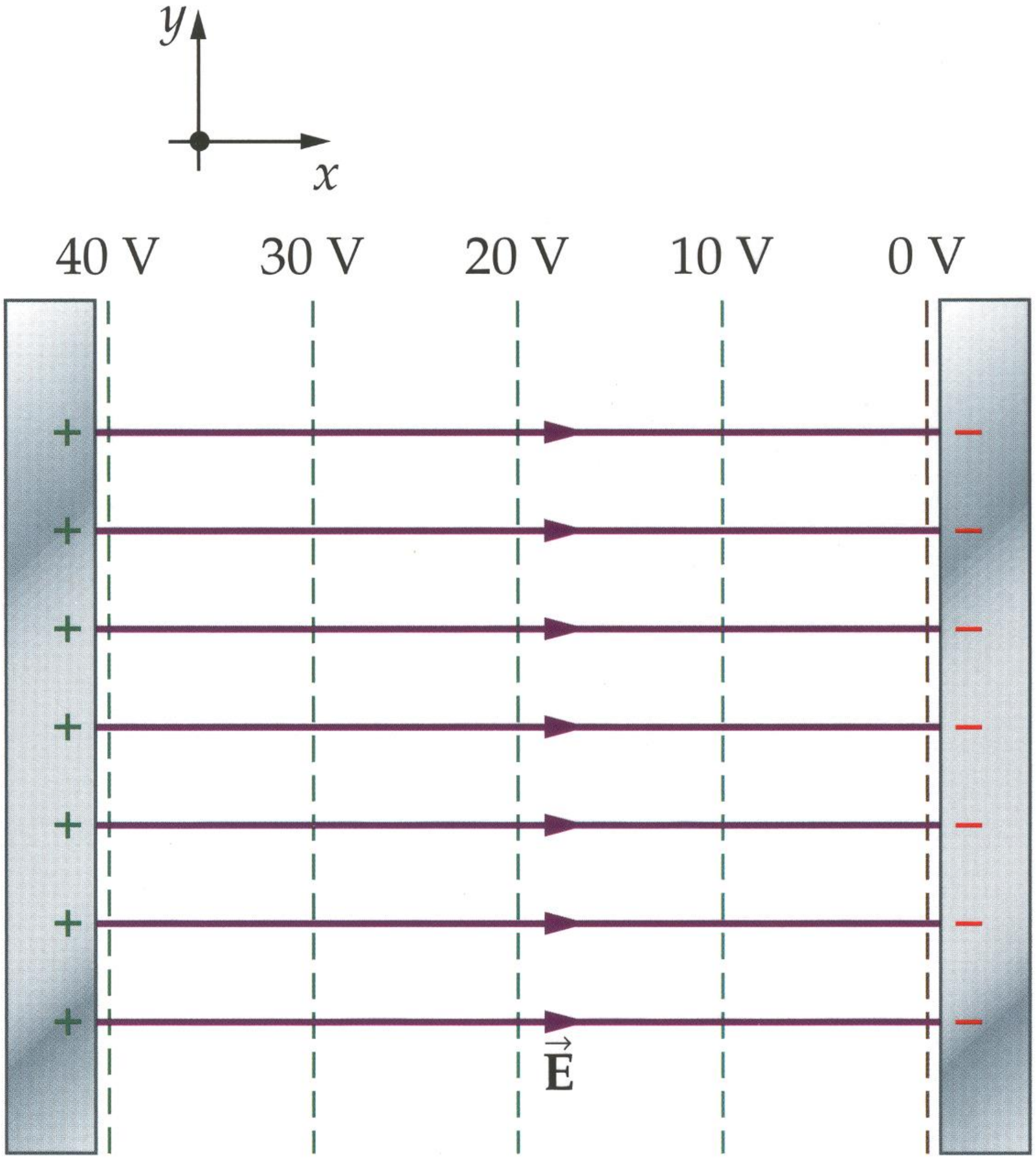
Energy Conservation

Electron volt

- a common unit of energy is the electron volt (eV): the energy **gained or lost** by an electron as it moves across a potential difference of 1 V

- Not SI!

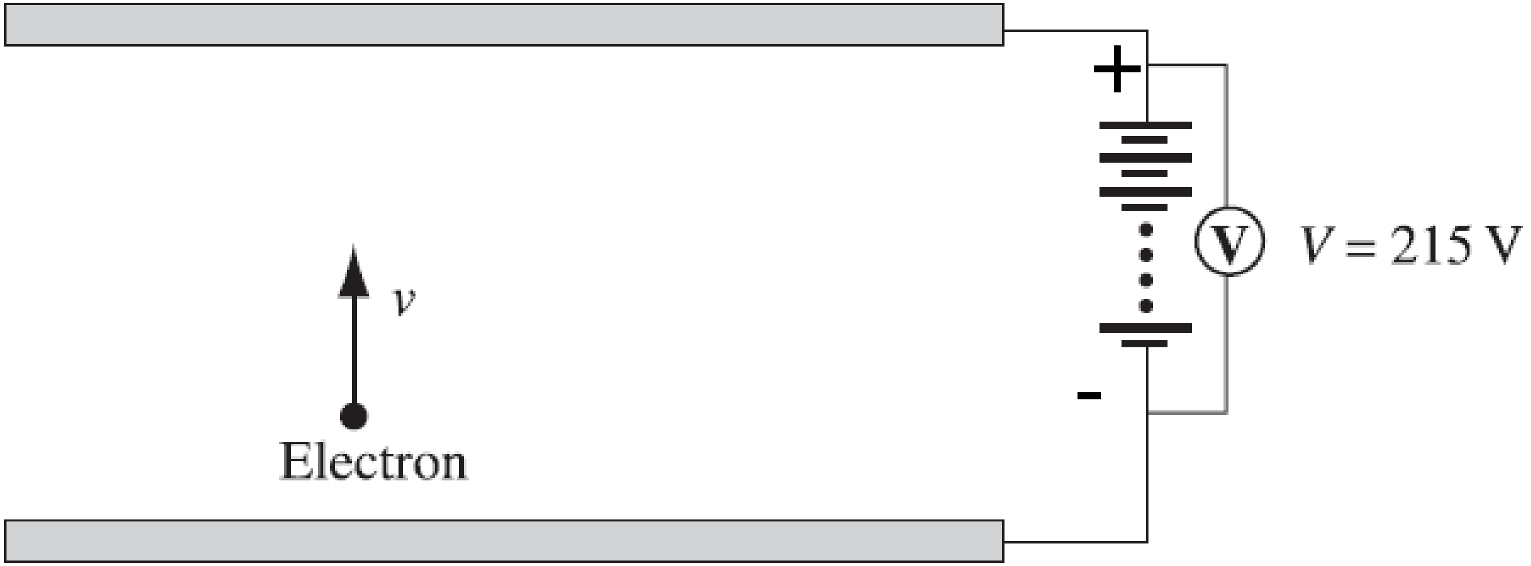
- 1 eV = 1.60 x 10^{-19} J (on data sheet)



Positive charges will lose Ep and gain 40 eV of Ek as they move from high to low potential

Electrons will gain 40eV of kinetic energy as they move from – plate to + plate

Example



- An electron is released from rest at the negative plate. Determine the speed at which it hits the positive plate.

Solution

- Ek initial = 0 J
- Ep initial = 215 eV = 3.44×10^{-17} J

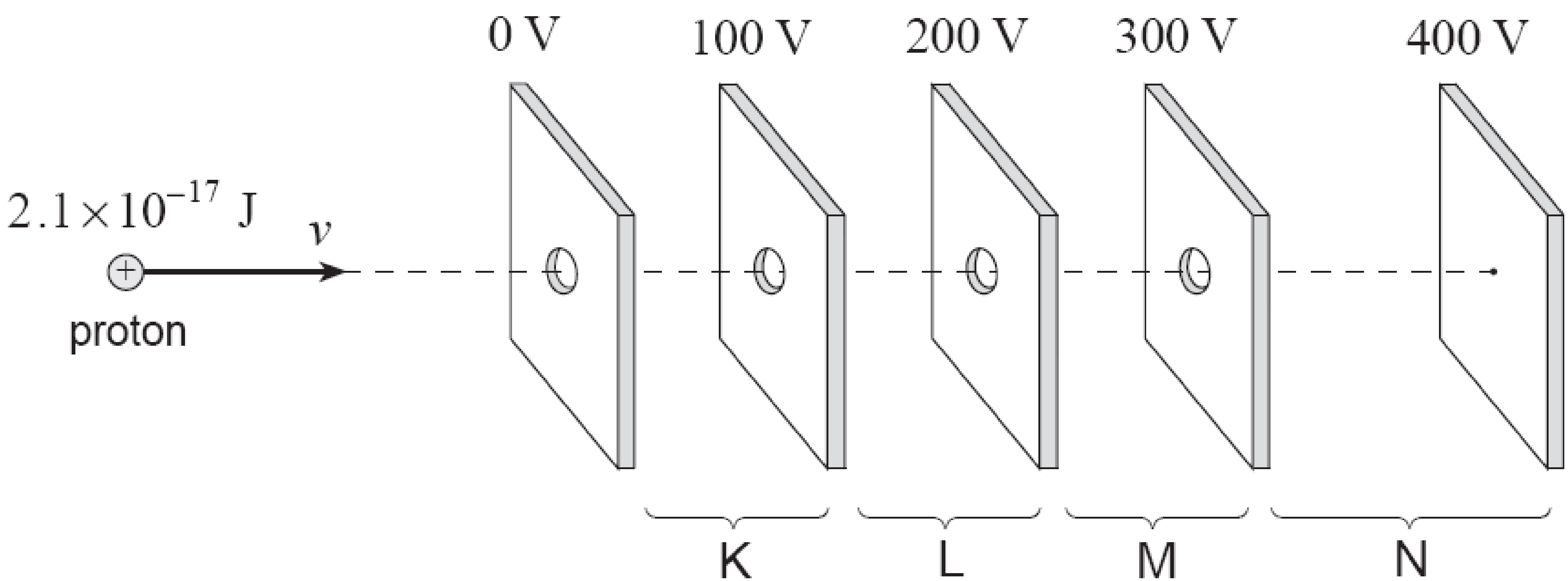
$$E_k = \frac{1}{2}mv^2$$

$$v = \sqrt{\frac{2E_k}{m}} = \sqrt{\frac{2\left(3.44\times10^{-17}J\right)}{9.11\times10^{-31}kg}}$$

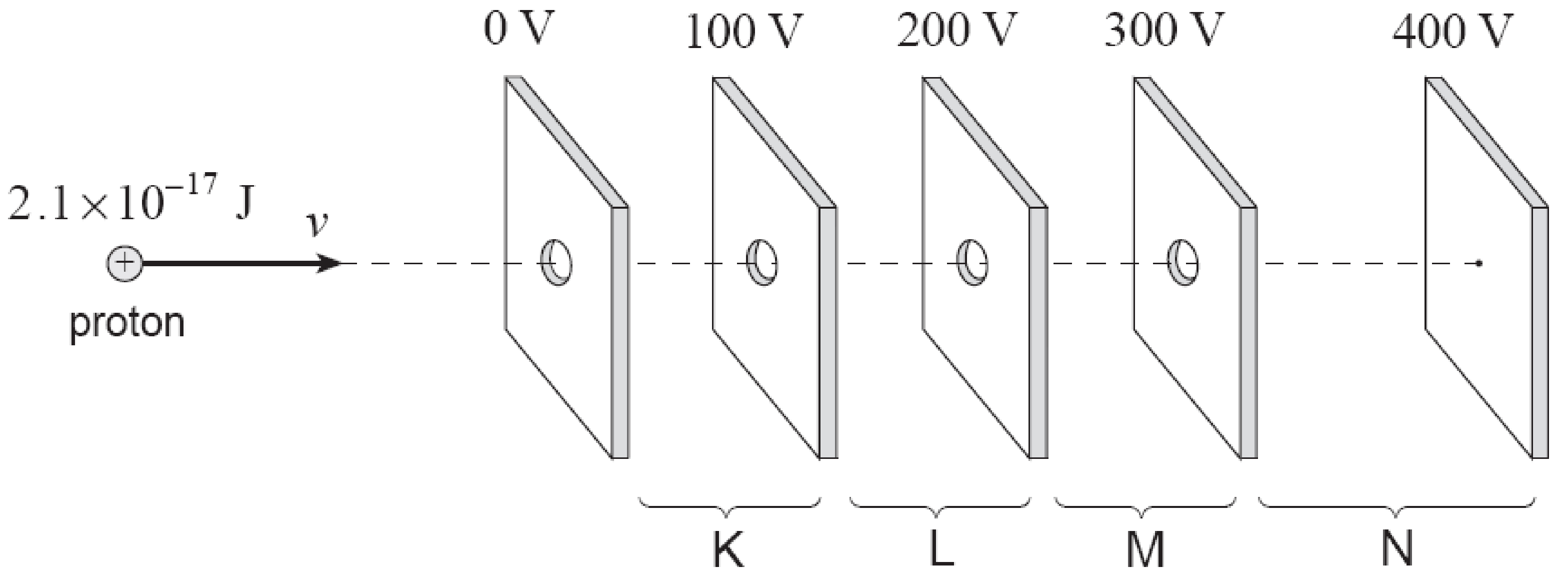
$$= 8.69\times10^{6}m/s$$

Example

- A proton has 2.1 x 10^{-17} J of kinetic energy as it enters a series of electric fields as shown below. In which region will it come to a stop?



Solution



- Initial kinetic energy = 131.25 eV

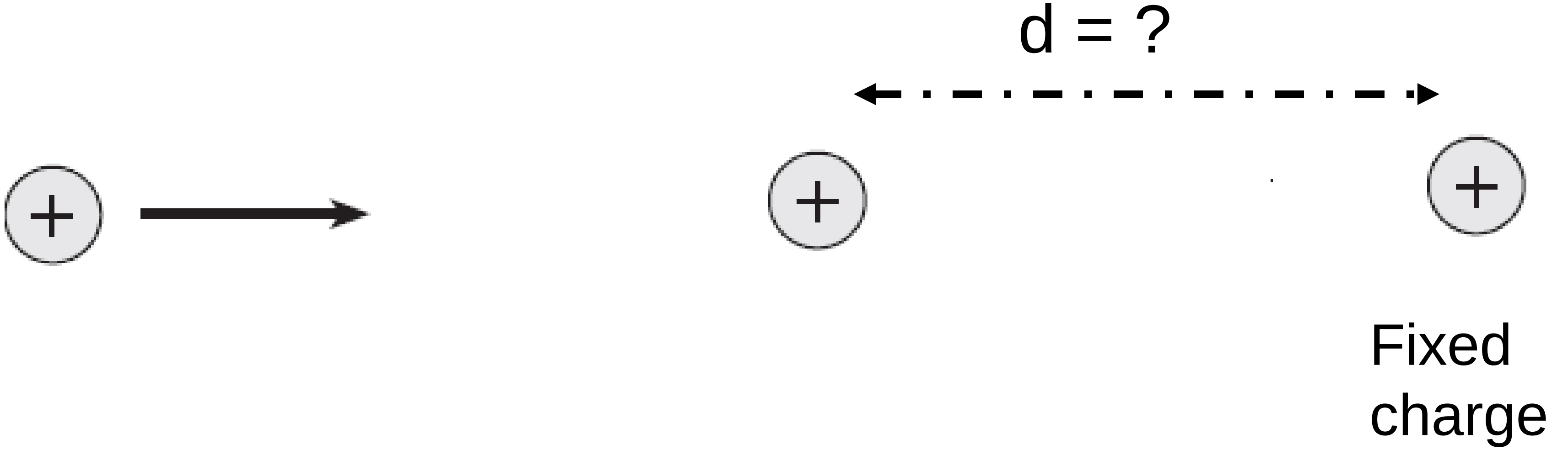
- Proton will lose 100 eV in region K
- Will lose more energy in region L

- So it will stop in region L

- P 576: 9, 10, 11, 12

Example

- A proton is moving at 1.5 x 10^6 m/s towards a fixed +5.0 x 10^{-6} C charge. Determine the closest approach of the proton.



Solution

W = ΔE

$$\left|\vec{F}\right|\left|\vec{d}\right|\cos\theta = \Delta E_k$$

$$\left|\vec{F}\right|\left|\vec{d}\right|\cos\theta = 0 - \frac{1}{2}mv^2$$

$$\left|\vec{F}\right|\left|\vec{d}\right|\cos\theta = 0 - \frac{1}{2}\left(1.67x10^{-27}kg\right)\left(1.5x10^{6}m/s\right)^2$$

$$\frac{kq_1q_2}{r^2} d\cos\theta = -1.8788x10^{-15} \text{ J}$$

at closest approach, r $=$ d, proton will lose EK, gain $E_{\text{elec pot}}$

$$\frac{kq_1q_2}{r} = 1.8788x10^{-15} \text{ J}, \quad \cos\theta = -1$$

$$\text{r} = \frac{kq_1q_2}{1.8788x10^{-15} \text{ J}}$$

$$r = \frac{8.99N \bullet m^2 / C^2 \left(1.60x10^{-19}C\right)\left(5.0x10^{-6}C\right)}{1.8788x10^{-15} \text{ J}}$$

$$r = 3.8 \text{ m}$$

Practice

- P 579: 17, 20, 22, 24, 25, 27,