## Physics 3B Week 7: Electric Potential and Capacitance



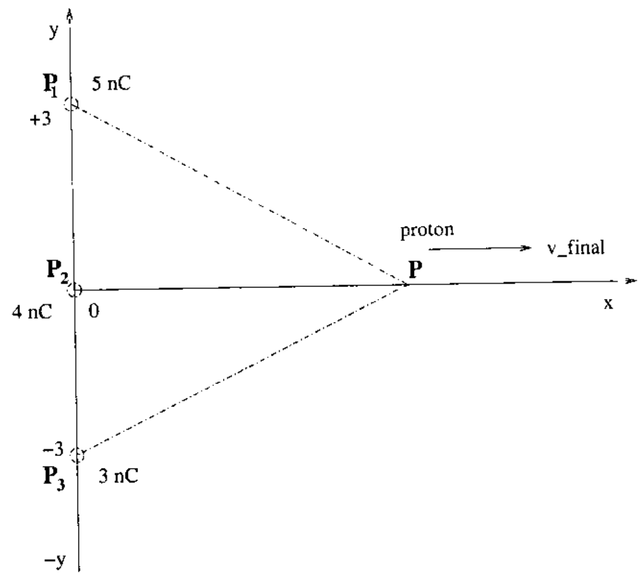
Name: Andrea Silvestri, ID#:

TA: Andrea Silvestri

Date: February 20, 2008 Day: Wednesday Hour: 8:00 - 12:50

### 1. Problem 1

(a) Find the electric potential difference $\Delta V(\mathbf{P})$ at point $\mathbf{P}(\mathbf{x}, \mathbf{y}) = (+4, 0)$ (meter) due to three charges $q_1 = 5$ nC, $q_2 = 4$ nC, $q_3 = 3$ nC distributed along the y-axis at $\mathbf{P_1} = (0, +3)$ (meter), $\mathbf{P_2} = (0, 0)$ (meter), $\mathbf{P_3} = (0, -3)$ (meter). Set $V(\infty) = 0$. (b) If a proton is placed at point $\mathbf{P}$ and released, what is its final velocity?




Potential difference due to point charges:

$$V_B - V_A = -\int_A^B \vec{E} \cdot d\vec{s} = -\int_A^B \frac{k_e}{r^2} q \, \hat{r} \cdot d\vec{s} = k_e q \left[ \frac{1}{r_B} - \frac{1}{r_A} \right].$$

Using Prin. of Superposition and $V(\infty) = 0$, then:

$$V_1 = k_e \frac{q_1}{r_1}; \quad V_2 = k_e \frac{q_2}{r_2}; \quad V_3 = k_e \frac{q_3}{r_3}.$$

a) $\Delta V(\bar{P}) = k_e \left( \frac{q_1}{r_1} + \frac{q_2}{r_2} + \frac{q_3}{r_3} \right) = 23.37\ V.$

ii

Potential Energy of proton at point P:

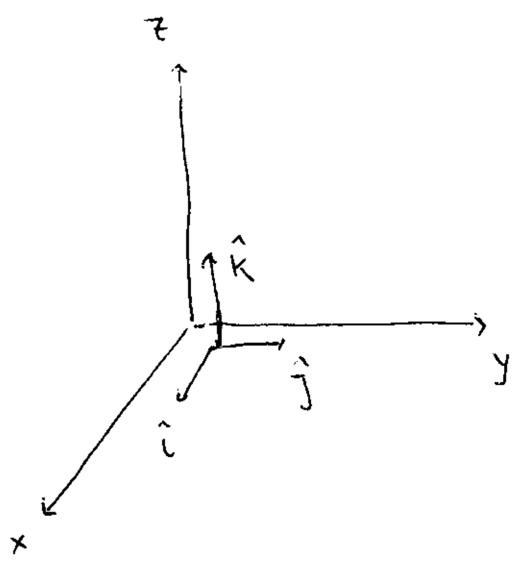
$U(\bar{P}) = q_p \Delta V = \frac{1}{2} m_p v_f^2$  since $U_i + U_f = KE_i + KE_f$

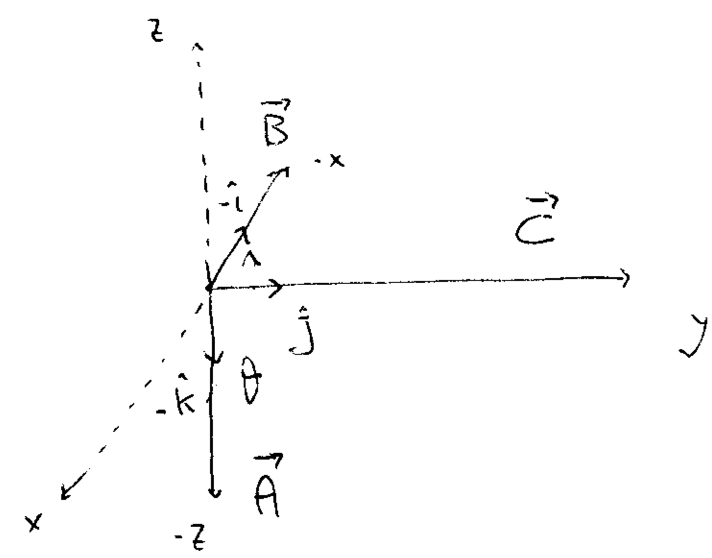
$\Rightarrow v_p = \sqrt{\frac{2 q_p \Delta V}{m_p}}$

$v_p = \sqrt{\frac{2 \times 1.6 \times 10^{-19}\ C \times 23.37\ V}{1.672 \times 10^{-27}\ Kg}} = \boxed{6.7 \times 10^4\ m/s}$

**2. Problem 2**

Vector **A** =- 3 k̂ and vector **B** = - 2 î, calculate magnitude and direction of **C** = **A** x **B**, and draw the vectors in a Cartesian coordinate system, labeling all vectors (**A**, **B**, and **C**).




$\bar{C}$ points to the POSITIVE y- direction

$|C| = |A||B| \sin\theta = 3 \cdot 2 \sin 90° = 6 \Rightarrow \boxed{\vec{C} = +6\hat{j}}$