Physics 172
Winter Quarter 1984
George Williams

FINAL EXAM

2

Name (Print) CHI YAN Name (Sign) _____

Discussion Instructor (CIRCLE ONE): Bott Love Neilsen Ransom

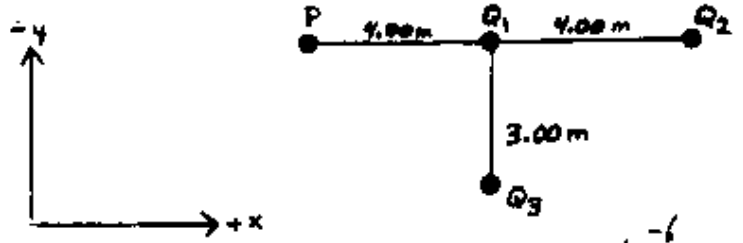
Discussion Section # _____ Spannring Stimpson Stone Wiseman

Report all numbers to three significant figures!
Use the conversion constants given on the front page.

SHOW ALL WORK!!

[30 pts.]

1° (a) Calculate the electric potential at point P in the drawing shown.
2° (b) Calculate the electric field, magnitude and direction, at point P. Use the coordinate system shown.



Q_1 = +6.50 μC

Q_2 = -7.50 μC

Q_3 = +9.75 μC

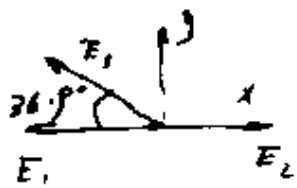
1 $V_P = \frac{1}{4\pi\varepsilon_0}\left[\frac{Q_1}{r_1} + \frac{Q_2}{r_2} + \frac{Q_3}{r_3}\right] = \frac{10^{-6}}{4\pi\varepsilon_0}\left[\frac{6.5}{4} - \frac{7.5}{8} + \frac{9.75}{5}\right] = 2.37\times10^4$ V

3 $\vec{E}_1 = \frac{1}{4\pi\varepsilon_0}\frac{Q_1}{r_1^2}\vec{r}_1 = \frac{1}{4\pi\varepsilon_0}\cdot\frac{6.5}{16}\times10^{-6} = 3.65\times10^3$ (−x direction)

3 $\vec{E}_2 = \frac{1}{4\pi\varepsilon_0}\frac{Q_2}{r_2^2}\vec{r}_2 = \frac{1}{4\pi\varepsilon_0}\cdot\frac{-7.5}{64}\times10^{-6} = -1.05\times10^3$ (x direction)

3 $\vec{E}_3 = \frac{1}{4\pi\varepsilon_0}\frac{Q_3}{r_3^2}\vec{r}_3 = \frac{1}{4\pi\varepsilon_0}\cdot\frac{9.75}{25}\times10^{-6} = 3.51\times10^3$ (36.9° against −x axis)

3 $E_x = E_2 - E_1 - E_3\cos 36.9° =$
$= 1.05\times10^{+3} - 3.65\times10^{+3} - 3.51\times10^{+3}\cos 36.9°$
$= -5.40\times10^3$



3 $E_y = E_3\sin 36.9° = 3.51\times10^3\sin 36.9° = 2.11\times10^3$

5 $|E| = (E_x^2 + E_y^2)^{1/2} = 6.296\times10^3$ N/C = V/m

$\theta = \tan^{-1}\frac{E_y}{E_x} = \tan^{-1}\frac{2.11\times10^3}{-5.4\times10^3} = -21.3° = 158°$