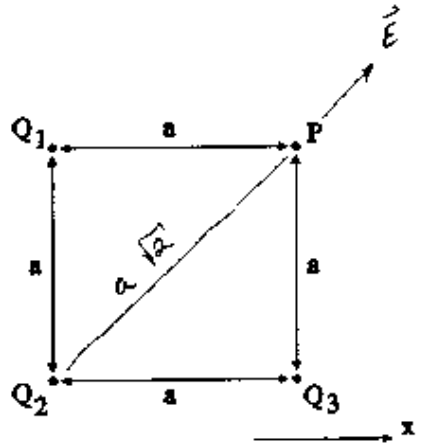
SECOND MIDTERM

Name (print) D. GODFREY-SMITH Name (signed) _____

Discussion Instructor (circle): Condella Godfrey-Smith Guilkey Leong Nott Paul

Discussion Section # _____

SHOW ALL WORK!!!!!
REPORT ALL NUMBERS TO THREE SIGNIFICANT FIGURES!
Use the conversion constants and data given on the front page.



Four points are at the corners of a square, as shown.

(a) For the values of the charges given, calculate the electric potential at P.
(b) For the values of the charges given, find the work needed to bring an electron from far away to P.
(c) For the values of the charges given, find the direction of the electric field at P, measured as an angle counterclockwise from the positive x axis.

$Q_1 = +2.70 \times 10^{-7}$ C
$Q_2 = -4.00 \times 10^{-6}$ C $= -40 \times 10^{-7}$ C
$Q_3 = +1.00 \times 10^{-7}$ C
a = 4.25 mm $= 0.00425$ m

method : answer = 2 : 1 ratio

10 a) $V = \sum_i \frac{kQ_i}{r_i} = \frac{kQ_1}{a} + \frac{kQ_3}{a} + \frac{kQ_2}{a\sqrt{2}}$

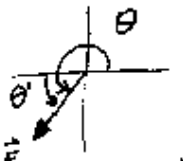
$= \frac{k}{a}\left[Q_1 + Q_3 + \frac{Q_2}{\sqrt{2}}\right] = -5.21 \times 10^6$ V

5 b) $W = V_q = V \cdot e = 8.33 \times 10^{-13}$ J

c) $E = \frac{kq}{r^2}\hat{r}$

10 $E_x = \left(\frac{kQ_1}{a^2} + \frac{kQ_2}{2a^2} \cdot \frac{a}{a\sqrt{2}}\right)\hat{i} = -5.70 \times 10^{8} \frac{V}{m}\hat{i}$

$E_y = \left(\frac{kQ_3}{a^2} + \frac{kQ_2}{2a^2} \cdot \frac{a}{a\sqrt{2}}\right)\hat{j} = -6.55 \times 10^{8} \frac{V}{m}\hat{j}$



−2 if $\tan^{-1}(\ )$ not computed

$\theta' = \tan^{-1}\frac{E_y}{E_x} = 48.9°$ ← −2 if wrong

$\theta = \theta' + 180° = 228.9°$ 40 −2 if not done