PHYS 102: General Physics 2 **KOÇ UNIVERSITY** **Spring Semester 2013**

College of Arts and Sciences

Section 1 **Quiz 3** **28 February 2013**

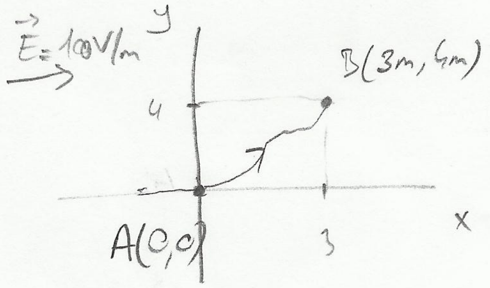
Closed book. No calculators are to be used for this quiz.
Quiz duration: 10 minutes

Name: **Student ID:** **Signature:**

A uniform electric field of magnitude *100 V/m* is directed in the positive x-direction. (+2C)charge moves from origin to the point *(x,y) = (3m, 4m)*.

a) What is the change in the potential energy of this charge?

b) Through what potential difference did the charge move? (k = 9 x 10^9 N.m^2/C^2)



a) $\Delta U = U_B - U_A = -W_{A\to B} = -\int \vec{F}\cdot d\vec{l} = -q\int \vec{E}\cdot d\vec{l}$

$\vec{E} = E\hat{i} \quad d\vec{l} = dx\hat{i} + dy\hat{j} \Rightarrow \vec{E}\cdot d\vec{l} = E\,dx$

$\Delta U = -2\int_0^3 100\,dx = -2 \cdot 100 \cdot 3 = \underline{-600\,J}$

b) $\Delta V = \frac{\Delta U}{q} = \underline{-300\,V}$

PHYS 102: General Physics 2 **KOÇ UNIVERSITY** **Spring Semester 2013**

College of Arts and Sciences

Section 2 **Quiz 3** **28 February 2013**

Closed book. No calculators are to be used for this quiz.
Quiz duration: 10 minutes

Name: **Student ID:** **Signature:**

In an electrical potential field given by *V(x,y) = 50xy – 10x*, calculate the electrostatic force that would act on a charge of q = +2C at location *(x,y) = (1m,2m)*.
(k = 9 x 10^9 N.m^2/C^2)

$$\vec{E} = -\vec{\nabla}V = -\left(\frac{\partial V}{\partial x}\hat{i} + \frac{\partial V}{\partial y}\hat{j}\right) = -(50y - 10)\hat{i} - 50x\hat{j}$$

$$\vec{E}(1,2) = (-90\hat{i} - 50\hat{j})\ N/C$$

$$\vec{F}(1,2) = q\vec{E}(1,2) = (-180\hat{i} - 100\hat{j})\ N$$

PHYS 102: General Physics 2 **KOÇ UNIVERSITY** **Spring Semester 2013**

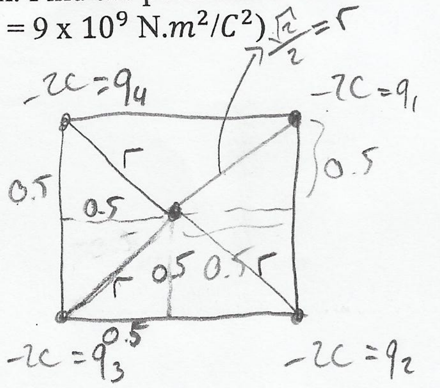
College of Arts and Sciences

Section 3 **Quiz 3** **28 February 2013**

Closed book. No calculators are to be used for this quiz.
Quiz duration: 10 minutes

Name: **Student ID:** **Signature:**

Four equal negative charges q = -2C, are positioned on the corners of a square with side a = 1m. Find the potential at the center of the square, assuming that the potential is zero at infinity. (k = 9 x 10^9 N.m^2/C^2)



$$V_1 = \frac{k(-2C)}{\frac{\sqrt{2}}{2}} = -18\sqrt{2}\times10^9\ V = V_2 = V_3 = V_4$$

$$V = \frac{kq}{r} \quad \text{as } r\to\infty \Rightarrow U\to 0 \checkmark$$

$$V_i = \frac{k q_i}{r}$$

$$V_{tot} = V_1+V_2+V_3+V_4 = -72\sqrt{2}\times10^9\ V$$

by Superposition Principle

PHYS 102: General Physics 2 **KOÇ UNIVERSITY** **Spring Semester 2013**

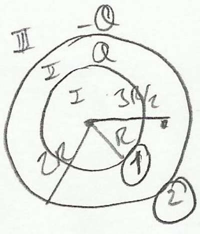
College of Arts and Sciences

Section 4 **Quiz 3** **28 February 2013**

Closed book. No calculators are to be used for this quiz.
Quiz duration: 10 minutes

Name: **Student ID:** **Signature:**

Two concentric spherical shells with radii R and 2R are uniformly charged with Q and –Q respectively. Find the electric potential at a distance 3R/2 from the center.



I: $E_1 = \frac{kQ}{r^2}$ $E_2 = 0 \Rightarrow V_1 = \frac{kQ}{r}$ & $V_2 = \text{const.} = -\frac{kQ}{2R}$

II. $E_2 = -\frac{kQ}{r^2} \Rightarrow V_2 = -\frac{kQ}{r} \Rightarrow V_2(2R) = -\frac{kQ}{2R}$

$\vec{E} = -\vec{\nabla} V$ & since $\vec{E} = E\hat{r} \Rightarrow E = -\frac{\partial V}{\partial r} \Rightarrow V = -\int E\,dr$

$V = V_1 + V_2 = \frac{2kQ}{3R} - \frac{kQ}{2R} = \frac{kQ}{6R}$

(2) (3)

PHYS 102: General Physics 2 **KOÇ UNIVERSITY** **Spring Semester 2013**

College of Arts and Sciences

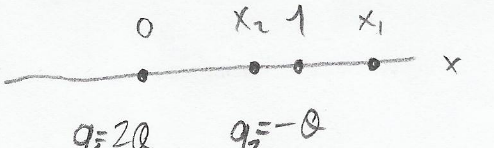
Section 5 **Quiz 3** **28 February 2013**

Closed book. No calculators are to be used for this quiz.
Quiz duration: 10 minutes

Name: **Student ID:** **Signature:**

Point charges 2Q and –Q are located at positions (0,0,0) and (1,0,0) respectively. Find two points (x_1,0,0) and (x_2,0,0) on the x-axis where the electric potential is zero.

$V = \frac{kq}{r}$ (potential of a point charge)



For the total potential $V=V_1+V_2$ to be zero, the points x_1 & x_2 should be closer to $q_2=-Q$ than $q_1=2Q$.

@ x_1: $V = \frac{k(-Q)}{x_1-1} + \frac{k2Q}{x_1} = 0$

$\frac{2kQ}{x_1} = \frac{kQ}{x_1-1} \Rightarrow 2x_1 - 2 = x_1 \Rightarrow x_1 = 2$

@ x_2: $V = \frac{k(-Q)}{1-x_2} + \frac{k2Q}{x_2} = 0$

$\frac{2kQ}{x_2} = \frac{kQ}{1-x_2} \Rightarrow 2 - 2x_2 = x_2 \Rightarrow x_2 = 2/3$

PHYS 102: General Physics 2 **KOÇ UNIVERSITY** **Spring Semester 2013**

College of Arts and Sciences

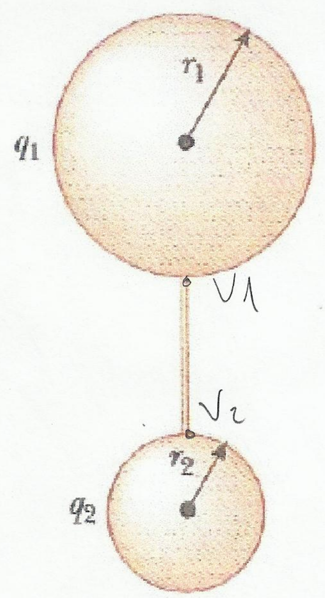
Section 6 **Quiz 3** **28 February 2013**

Closed book. No calculators are to be used for this quiz.
Quiz duration: 10 minutes

Name: **Student ID:** **Signature:**

Two conducting spheres with radii r_1 and r_2 are separated by a distance much greater than both r_1 and r_2. The spheres are connected by a conducting wire as in the figure. If the charges on the spheres in equilibrium are q_1 and q_2 respectively,

i.) Find the ratio of the electric fields (E_1/E_2) at the surfaces of the spheres.
ii.) Which one is greater?



i) $V_1 = V_2 \Rightarrow \frac{kq_1}{r_1} = \frac{kq_2}{r_2} \Rightarrow q_1 = \frac{r_1}{r_2} q_2$

$E_1 = \frac{kq_1}{r_1^2}$ $E_2 = \frac{kq_2}{r_2^2} \Rightarrow \frac{E_1}{E_2} = \frac{q_1 r_2^2}{q_2 r_1^2} = \frac{r_2}{r_1}$

ii) $E_2 > E_1$ as $r_1 > r_2$