PHYS 102: General Physics 2 **KOÇ UNIVERSITY** **Spring Semester 2011**

College of Sciences

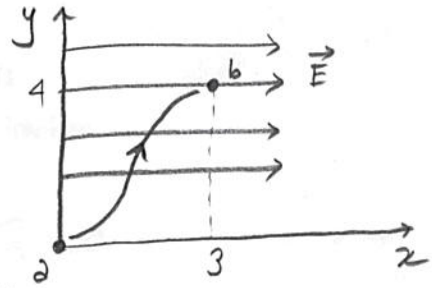
Section 1 **Quiz 3** **03 March 2011**

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. A +2C charge moves from origin to the point $(x, y) = (3\ m, 4\ m)$

a) What was the change in the potential energy of this charge?
b) Through what potential difference did the charge move? ($k = 9\times10^{9}\ N\cdot m^{2}/C^{2}$)



$$\Delta V = V_b - V_a = -\int_a^b \vec{E}\, d\vec{l} \quad I \quad -\int_{m_a}^{m_b} E\, d_m \,.$$

$$\downarrow$$

$$\vec{E} = E\hat{i}$$

$$= -100\,(x_b - x_a) = -100\cdot 3 = -300\ V$$

$$\Delta u = q\cdot\Delta V = -2\cdot 300 = -600\ J$$

a) $\Delta u = -600\,J$

b) $\Delta V = -300\,V$

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Section 2 **Quiz 3** **03 March 2011**

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Quiz duration: 10 minutes

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

(a) What is the net charge on a conducting sphere of radius R = 30 cm if the potential of the sphere is 300 000 V relative to 0 potential at infinity?
(b) What is the potential at the center of the sphere? ($k = 9 \times 10^9 N \cdot m^2 / C^2$)

a) $V_R - V_\infty = 300000 = -\int_\infty^R \vec{E}\, d\vec{l} = -\int_\infty^R E\, dr = \frac{Q}{4\pi\varepsilon_0 R} - \frac{Q}{4\pi\varepsilon_0 \infty} = \frac{Q}{4\pi\varepsilon_0 R}$

since E is in $\hat{r}$ direction

$300000 = 9 \cdot 10^9 \cdot Q \cdot \frac{1}{0,3} \Rightarrow Q = 10^{-5}$ c

b) Since the electric field inside a conducting sphere is zero therefore the potential inside and on the surface is the same.

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Section 3 Quiz 3 03 March 2011

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Quiz duration: 10 minutes

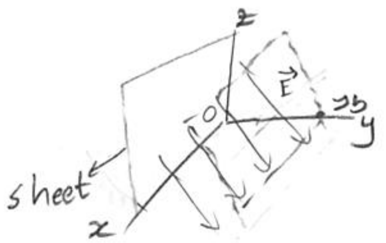
Name: Student ID: Signature:

An infinite nonconducting sheet has a surface charge density $\sigma = 4\epsilon_0$ on one side. How far apart are the equipotential surfaces whose potentials differ by *50 V*?
$(k = 9\times10^9\ N\cdot m^2/C^2)$

$|\vec{E}_{sheet}| = \dfrac{\sigma}{2\varepsilon_0}$ we know, therefore $|E| = \dfrac{4\varepsilon_0}{2\varepsilon_0} = 2$

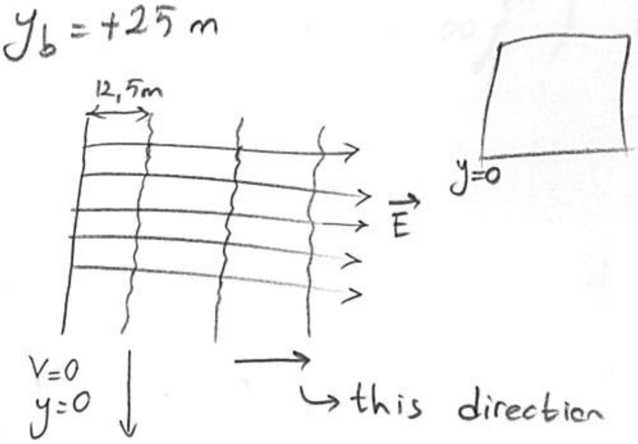
$\Delta V = -\int_a^b \vec{E}\, d\vec{l} = -\int_a^{y_b} E\, dy = -E\, y_b$

(ΔV: ± 50; $\vec{E}$ perpendicular to the surface; E: 2)



Since we just look for potential difference

$\Rightarrow y_b = +25\ m$



↳ this direction potential decrease

Equipotential surface

PHYS 102: General Physics 2 **KOÇ UNIVERSITY** **Spring Semester 2011**

College of Sciences

Section 4 **Quiz 3** **03 March 2011**

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Quiz duration: 10 minutes

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

In an electric 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) = (1 m, 2m)*.
($k = 9\times10^9\ N\cdot m^2/C^2$)

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

$$= -\left[(50y-10)\hat{i} + 50x\hat{j}\right]$$

$$\vec{F} = q\cdot\vec{E} = 2\times\left[(10-50\times2)\hat{i} - 50\times1\hat{j}\right]$$

$$= (-180\hat{i} \quad -100\hat{j})\ N$$

PHYS 102: General Physics 2 KOÇ UNIVERSITY Spring Semester 2011

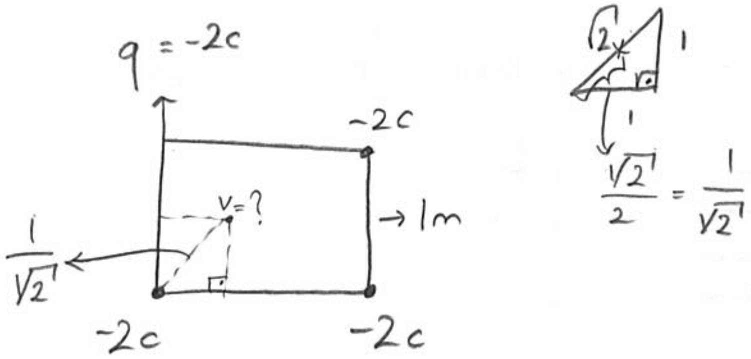
College of Sciences

Section 5 Quiz 3 03 March 2011

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

Name: Student ID: Signature:

Four equal negative charges $q = -2\ C$, are positioned on the corners of a square with side $a = 1\ m$. Find the potential at the center of the square, assuming that the potential is 0 at infinity. ($k = 9 \times 10^9\ N \cdot m^2 / C^2$)



$$V_1 = \frac{q}{4\pi\varepsilon_0 r} = -2 \times (9 \times 10^9) \times \frac{1}{\frac{1}{\sqrt{2}}} = -18\sqrt{2} \times 10^9\ V$$

Since we have the super position law we add the potential of the changes.

$$V = V_1 + V_2 + V_3 + V_4 = 4V_1 = -72\sqrt{2} \times 10^9\ V$$