THE INTERNATIONAL UNIVERSITY (IU) – VIETNAM NATIONAL UNIVERSITY - HCMC

MIDTERM EXAMINATION – CLASS

Student Name:_____ **Student ID:**_____

Date: April 2015

Duration: 90 minutes

SUBJECT: PHYSICS 3	
Chair of Department of Physics: Signature: Full name: Phan Bao Ngoc	Lecturer: Signature: Full name: Phan Bao Ngoc

INSTRUCTIONS: This is a closed book examination. Use of cell phones, laptops, dictionaries is not allowed.

1/ (20 pts) An electron is released from rest in a uniform electric field of 2.0×10^4 N/C. How far will the electron travel in 2 microseconds after its release? ($e = 1.6\times10^{-19}$ C; $m_e = 9.1\times10^{-31}$ kg)

2/ (20 pts) A conducting spherical shell of inner radius a = 2.0 cm and outer radius b = 4.0 cm has charge Q = 4.0 nC. A charge particle of q = 2.0 nC is located at the center of the shell. Sketch the charge distribution on the shell and calculate the magnitude of the electric field at: (a) r = 1.0 cm; (b) r = 3.0 cm and (c) r = 5.0 cm. ($k = 9.0\times10^9$ Nm^2/C^2)

3/ (20 pts) Suppose that in a certain region of space, the electric potential is described by $V(x,y,z) = -x^2+2xy+5z^2$ (V), where x, y and z are in km. Determine the x, y and z coordinates of a point in space where the electric field is $\vec{E} = (-4\hat{i} - 2\hat{j} - 20\hat{k})$ V/km.

4/ (20 pts) Determine the current in the resistors (see Figure 1) if $R_1 = 1\ \Omega$, $R_2 = 2\ \Omega$, $R_3 = 1\ \Omega$, $R_4 = 4\ \Omega$ and $\varepsilon_1 = 2$ V, $\varepsilon_2 = 3$ V.

5/ (20 pts) A resistor $R = 20\times10^6\ \Omega$ is connected in series with a capacitor C = 3.0 μF and a 20-V battery for long time. The battery is removed, then R and C are connected in a loop. What is the energy stored in the capacitor C after thirty seconds?

$R = 20\times10^6\ \Omega$

$W = ?$

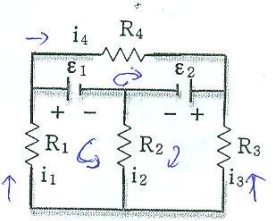

Figure 1

END OF QUESTION PAPER

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1)

$|F| = |q|E = 1{,}6.10^{-19} \cdot 2.10^{+4} = 3{,}2.10^{-15}$ (N)

$F = m.a \Rightarrow a = \frac{F}{m} = \frac{3{,}2.10^{-15}}{9{,}1.10^{-31}} = 3{,}52.10^{+15}$ (m/s²)

$x = x_0 + v_0 t + \frac{1}{2}at^2 = 0 + 0.2.10^{-6} + \frac{1}{2}.3{,}52.10^{15}.(2.10^{-6})^2 = 7040$ (m)

2)

$E_3 = E_{10}$; $(r < R): E = \left(\frac{q}{4\pi\varepsilon_0 R^3}\right) r$; $(r \gg R): E = \frac{q}{4\pi\varepsilon_0 r^2}$

$E_3 = E_{10} \Rightarrow \frac{q}{4\pi\varepsilon_0 R^3}.r_3 = \frac{q}{4\pi\varepsilon_0 r_{10}^2}$

$\Rightarrow \frac{r_3}{R^3} = \frac{1}{r_{10}^2} \Rightarrow R = \sqrt[3]{0{,}1^2.0{,}03} = 0{,}069$ (m)

$\Rightarrow R = \sqrt[3]{0{,}1^2.0{,}03} = 0{,}067$ (m)

$\rho = \frac{q}{V} = \frac{4.10^{-12}}{\frac{4}{3}\pi R^3} = 3{,}18.10^{-9}$ (C/m³)

2)

a) $\varepsilon_0.E.A_s = q_{enc} \Rightarrow E = \frac{q_{enc}}{\varepsilon\varepsilon_0.A} = \frac{2.10^{-12}}{8{,}85.10^{-12}} \frac{2.10^{-9}}{4\pi.0{,}01^2.\varepsilon_0} = 17971$

b) $E = 0$

c) $\varepsilon_0.E.A = q_{enc} \Rightarrow E = \frac{q_{enc}}{\varepsilon_0.A} = \frac{(2+4).10^{-9}}{4\pi\varepsilon_0.0{,}05^2} = 21570$ $(C\frac{N}{C})$

3)

$\vec{E}(x,y,z) = -\nabla\vec{V}$

$-\frac{\partial V}{\partial x} = 2x + 2y$; $-\frac{\partial V}{\partial y} = -2x$; $-\frac{\partial V}{\partial z} = -10z$

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$$\Rightarrow \begin{cases} 2x - 2y = -4 \\ -2x = -2 \\ -10z = -20 \end{cases} \Rightarrow \begin{cases} x = 1 \\ y = 3 \\ z = 2 \end{cases}$$

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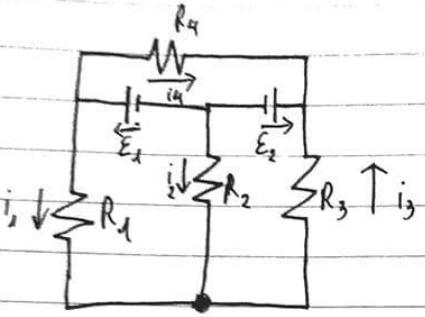

Tips:
- Chọn chiều dòng điện sao cho tiện. Vd ở đây mình cho i_1, i_2 xuống, i_3 lên để tại nút mình tổ đó. $i_3 = i_1 + i_2$

$$\begin{cases} \mathcal{E}_1 - i_1 R_1 + i_2 R_2 = 0 \\ -\mathcal{E}_2 - i_2 R_2 - i_3 R_3 = 0 \\ i_4 R_4 - \mathcal{E}_1 + \mathcal{E}_2 = 0 \\ i_1 + i_2 = i_3 \end{cases} \Rightarrow \begin{cases} i_1 = 0 \\ i_2 = -1 \\ i_3 = -1 \\ i_4 = -\frac{1}{4} \end{cases}$$

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$$q_0 = C.V = 6.10^{-5} \ (C)$$

$$q = q_0 . e^{-t/RC} = 6.10^{-5} . e^{-30/RC} = 3,64.10^{-5} \ (C)$$

$$u = \frac{q^2}{2C} = \frac{(3,64.10^{-5})^2}{2.3.10^{-6}} = 2,21.10^{-4} \ (J)$$