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

MIDTERM EXAMINATION – CLASS

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

Date: November 2014

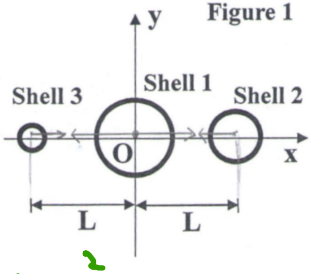
Duration: 90 minutes

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) Three non-conducting spherical shells are fixed in place. Shell 1 has a uniform surface charge density $\sigma_1 = +6.0\ \mu C/m^2$ on its outer surface and radius 3.0 cm; shell 2 has uniform surface charge density $\sigma_2 = +4.0\ \mu C/m^2$ on its outer surface and radius 2.0 cm; shell 3 has uniform surface charge density $\sigma_3 = +2.0\ \mu C/m^2$ on its outer surface and radius 1.0 cm. The shell centers are separated by L = 12 cm as shown in Figure 1. In unit-vector notation, what is the net electric field at the origin O?

Figure 1



$K = \frac{1}{2} m \cdot v^2$

2/ (20 pts) A particle with a charge of +8 nC has a kinetic energy of 50 μJ at point I and moves to point F where the potential is 5.0×10^3 V greater than that at point I. What is the particle's kinetic energy at point F?

$PE = mgh$

3/ (20 pts) A parallel-plate capacitor whose capacitance is 20 pF is charged by a battery to a potential difference of 10 V between its plates. The battery is now disconnected and a dielectric slab with $\kappa = 5$ is slipped between the two plates. Calculate the change in potential energy of the capacitor after the slab is inserted? Does the energy increase or decrease?

$q = CV$

$\frac{q^2}{2C}$

4/ (20 pts) A capacitor of capacitance C = 2 μF is discharging through a resistor of resistance $R = 10^5\ \Omega$. When will the energy stored in the capacitor reduce to one-third of its initial value?

$q = q_0 e^{-t/RC}$ | $\frac{q^2}{2C} = U_f = \frac{1}{3} U_i$

5/ (20 pts) Determine the currents in Figure 2 if $\varepsilon_1 = 10$ V, $\varepsilon_2 = 5$ V, $R_1 = 3\ \Omega$, $R_2 = 1\ \Omega$ and $R_3 = 2\ \Omega$.

always +

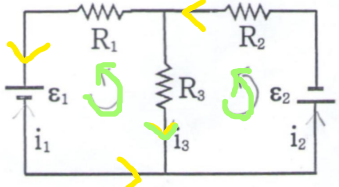


Figure 2

define 1 way

$$\begin{cases} i_1 + i_3 = i_2 \\ \varepsilon_1 - 3i_1 + 2i_3 = 0 \\ \varepsilon_2 - 2i_3 - i_2 = 0 \end{cases}$$

END OF QUESTION PAPER

Mid Nov 2014 - Phy 3

1)

$Q_2 = \sigma_2 . A_2 = 4.10^{-6} . 4\pi . 0,02^2 = 2,01 \ldots . 10^{-5}$ (C)

$Q_3 = \sigma_3 . A_3 = 2.10^{-6} . 4\pi . 0,01^2 = 2,51 . 10^{-9}$ (C)

$\vec{E} = \vec{E_1} + \vec{E_2} + \vec{E_3}$

$= 0 + \frac{1}{4\pi\varepsilon_0}\left(-\frac{Q_2}{L^2} + \frac{Q_3}{L^2}\right)$ Shell theorem

$= -10981,53 \left(\frac{N}{C}\right)$

2) Positive charge move from lower V to higher V → Receive Energy. This Energy is converted into Kinetic energy

$\Rightarrow K_f = K_i + q.\Delta V = 50.10^{-6} + 8.10^{-9} . 5.10^3$

$= 90.10^{-6}$ (J) 1x10^(-5) J

3) $q = C.V = 20.10^{-12} . 10 = 2.10^{-10}$ (C)

$V = \frac{q}{KC} = \frac{2.10^{-10}}{5.20.10^{-12}} = 2$ (V)

Potential Energy $= \frac{1}{2}CV^2 = \frac{q^2}{2C} = \frac{(2.10^{-10})^2}{2.5.20.10^{-12}} = 2.10^{-10}$ (J)

4) $U = \frac{q^2}{2C}$

$U_g = \frac{1}{3} U_i$

$\Leftrightarrow q_g^2 = \frac{1}{3} q_i^2 \Leftrightarrow q_i = q_g\sqrt{3} \Rightarrow \frac{q_g}{q_i} = \frac{\sqrt{3}}{3}$ (1)

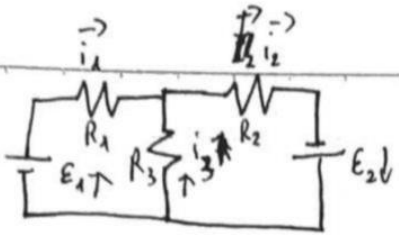
$q = q_0 . e^{-t/RC}$ (2)

(1) and (2) $\Rightarrow e^{-t/RC} = \frac{\sqrt{3}}{3} \Leftrightarrow -\frac{t}{RC} = -0,55$

$\Rightarrow t = 0,55 . RC = 0,11$ (s)

Thứ
Ngày . . No.

5)



; $i_2 = i_1 + i_3$

Loop Rule:

$$\begin{cases} \mathcal{E}_1 - i_1 R_1 + i_3 R_3 = 0 \\ -i_3 R_3 - i_2 R_2 + \mathcal{E}_2 = 0 \end{cases} \Leftrightarrow \begin{cases} 10 - 3i_1 + 2i_3 = 0 \\ -2i_3 - i_2 + 5 = 0 \end{cases}$$

$$\Rightarrow \begin{cases} i_1 = \frac{40}{11} \\ i_2 = \frac{45}{11} \\ i_3 = \frac{5}{11} \end{cases}$$