MENGO SENIOR SCHOOL
MID TERM 1 2003 EXAMINATION
S.6 PHYSICS PAPER 2
TIME: 2 HOURS

INSTRUCTIONS:

-Attempt only four numbers
-Assume $\frac{1}{4\pi\Sigma o} = 9x10^{9}F^{-1}m$

1(a)(i) Explain what is meant by the term e.m.f of a source of electrical energy.

(ii) Show that if a battery e.m.f E and internal resistance r is connected in series with a resistor of constant resistance R, then $\frac{E-V}{R} = \frac{r}{R}$, where v is the p.d across the resistor.

(b) For the circuit shown, prove that the power delivered to the load R is maximum when R=r

(ii)Sketch a graph showing the variation of the power delivered to the load R against resistance R.

(c) State ohms law for homogeneous conductors.
(d) Sketch the I-V characteristics for the following non-ohmic conductors.

(i) Vacuum diode
(ii) Semi conductor diode
(iii) Neon gas
(iv) Diode valve
(v) Junction diode.

2(a)(i) Define the term colomb.
(ii) State colomb's law of electrostatics.
(iii) Describe an experiment you would carry out to charge two small spheres by induction and state the charge acquired by each of them.

(b)(i) Explain how a body gets charged by rubbing.
(ii) Describe with aid of a labeled diagram the action of the van de graff generator.

(c)(i) What is the value of two equal charges which repel each other with a force of 0.1N when situated 50cm apart in a vacuum.

(ii) What would be the value of these charges when they are situated in a medium whose permitivity is twenty times that of a vacuum.

3(a). Define the following terms as applied to a convex mirror.
(i) Principal focus
(ii) Radius of curvature

(b)(i) For a convex mirror of focal length f show that $\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$

where v is the image distance from the mirror and u is the object distance from the mirror.

(iii) An object 4cm tall is stood on the principal axis of a concave mirror of focal length 10cm at a distance of 15cm from it. Find the position and height of the image.

(c) A converging lens of focal length 6cm is 10cm from a screen. A diverging lens of focal length 12cm is placed coaxially between the converging lens and the screen such that an image of an object 24cm from the converging lens is formed on the screen. What is the distance between the lenses?

(c)(i) An erect image 3 times the size of the object is obtained with a concave mirror of radius of curvature 36cm. What is the position of the object?

(ii) Give any two applications of curved mirrors.

4(a)(i) Write down an expression for the force between two point charges Q_1 and Q_2 a distance r apart situated in a vacuum.

(ii) Differentiate between the terms capacitance and dielectric constant as applied to capacitors.

(b) An air capacitor of capacitance 2 F is charged to a p.d of 200v. It is then connected in parallel to another capacitor of equal dimensions but with mica as the dielectric between its plates. If the dielectric constant of mica is 6, calculate;

(i) The p.d across the combination.
(ii) The energy stored in the combination.

(iii) The difference in energy initially stored in the air capacitor to the one stored in the combination.

(c) Explain qualitatively why there is a p.d drop across capacitor plates of the original air capacitor when a second capacitor was connected in parallel with it.

(d)(i) Derive an expression for the energy stored in a capacitor of capacitance "C" charged to a p.d "V".

(ii) In the figure, C_1, C_2, and C_3 are identical air capacitors. If now the space between the plates of C_3 are filled with a material of dielectric constant 4, Find the percentage change in the energy stored in C_3.

5(a) Consider two capacitors of capacitance C_1= 2 μ F charged to a p.d of 50 volts and C_2 = 3 μ F charged to a p.d of 100 volts. The two capacitors are then joined in parallel.

(i) Find the common p.d between the capacitors.

(ii) Find the energy lost in the process of connecting them.

(b) C_1 = 2 μ F C_2 = 4 μ F

In the figure shown, calculate the
The charge on the 4 μ F capacitor.

(c) Three charges of magnitude $-3x10^{-6}$C, $4x10^{-6}$C and 2 μ C are situated in a vacuum as shown below:

$Q_2 = 3\ \mu C$

1.73cm

$Q_1 = 2\ \mu C$ 2cm

$Q_3 = 4\mu C$

Find the resultant force on the 2 μ C charge due to the other two.

(d) In the system of capacitors given below, find the charge on each capacitor and the p.d across each capacitor.

$C_1 = 2\ \mu F$

$C_2 = 2\ \mu F$

$C_3 = 1\ \mu F$

6(a)(i) Using a simple atomic model, explain the effect of inserting an Insulating material between capacitor plates.

(iii) A parallel plate capacitor situated in a vacuum has area A and plate separation d, A slab of dielectric consult k, and thickness $\frac{d}{3}$ is inserted between the plates.

Show that the effective capacitance C after inserting the dielectric is given by:

$$C = \frac{3k}{2k+1} \quad \frac{\Sigma oA}{d}$$

Where Σo is the permitivity of free space.

(b) In the figure shown, Find:
(i) The charge on the 3 μ F capacitor.

(ii) The energy stored in the 4 μ F capacitor.

(c)(i) Define the terms electric field intensity and electric potential at a point in space.

(ii)

In the figure above Q_1 and Q_2 are point charges of magnitude 0.48 C and –0.8 C respectively.
Calculate the electric field Intensity at P.

(d)(i) What is an equipotential surface?

(ii) State the characteristics of an equipotential surface.

(iii) Describe an experiment to show that a charge resides outside a hollow conductor.

END