MENGO SENIOR SCHOOL
DEPARTMENT OF PHYSICS
SENIOR SIX
BEGINNING OF TERM 1 2003
PHYSICS PAPER TWO

Instructions:
-Attempt any three questions
-All questions carry equal marks
-Don't attempt more than three questions
-The following constants can be used.

(i) $g=9.81m/s^2$

(ii) $\frac{1}{4\pi\sum_o} = 9 \times 10^9 FM^{-1}$

1(a) Define terms:

(i) Electric field Intensity
(ii) Electric potential, at a point in space

(b) Derive a mathematical expression showing how the terms you have defined in (a) above rotate.

(c) A charged oil drop of radius 1.3 x 10-^{4}cm is prevented from falling under gravity by a vertical field between two horizontal plates charged to a P.d of 8340 volts. If a distance between the plates is 1.6cm and the density of oil is 920kg/m^3. Calculate the magnitude of the charge on the drop.

(d) A sphere of radius 10cm carries a charge of 4.2nc. Calculate the potential at:
(i) The surface of this sphere
(ii) The center of this sphere.

(e)(i) What is the electric potential energy of a 2.5nc charge placed 15cm from the center of the sphere in (d) above.
(iii) what do you understand by the term electrostatic shielding.

Q2.(a) Define the following terms as applied to telescopes.
(i) Angular magnification
(ii) Normal adjustment

(b) An astronomical telescope in normal adjustment has an eyepiece of focal length 85cm and its lens separation is 85cm.

(i) What is the focal length of its objective.
(ii) Calculate the magnifying power.

(c) With such a telescope in (b) above all the light received by the objective which also passes through the eyepiece eventually goes through a small circular region called the eye ring which is a short distance beyond the eyepiece.
This eye ring coincides in position to the image which would be formed by the eyepiece of the objective lens.
(i) Give arguments to justify the above statement.
(ii) How far behind the eyepiece will the exit pupil be in the case of (b) above.

(d) A telescope has an objective and eyepiece of focal lengths 100cm respectively. It is used to view an object 2000cm away from the objective and the final image is formed 25cm from the eyepiece.
Determine the magnifying power of this telescope.

(e) A lens forms an image of a distant object on a screen 30cm away. Where should the second lens of focal length 30cm be placed so that the screen has to be moved 8cm towards the first lens for a new image to be in focus.

3(a) What do you understand by the following terms:
(i) Electrostatic induction
(ii) Electric field

(b) Three charges of ⁻I C, 2 C and 3 C are placed at the corners A,B,C of an equilateral triangle of side 2m as shown below:

(i) Calculate the potential,
(ii) The Electric field at a point x which is midway between B and C.

(c) The figure below shows two charges x and y a distance of 1m apart in air and having charges of $2x10^{-8}$C and $-2x\ 10^{-8}$C respectively.

Calculate:
(i) The potential at A
(ii) The electric field strength at A
(iii) The potential at B
(iv) The electric field strength at B

(d) Two point charges are arranged as shown below:

Find:
(i) The electric field intensity at P
(ii) The electric potential at P

4(a) Sketch graphs showing the variation of the field intensity and the potential with distance from points inside and outside the sphere.

(b) A charge of 6 C is placed 3cm along the positive y-axis. Another equal charge is placed 3cm along the negative y-axis.
Find the electric field intensity at a point 4cm along the positive x-axis.

(c)(i) Derive the expression for the electric potential at a point "r" meters away from a charge of magnitude Q coulombs.

(ii)Sketch the electric field pattern between two small negative charges placed near each other.

(iii) State coulomb's law of electrostatics.

(d)Charges of magnitude $2x10^{-8}C$, $^{-}5x10^{-8}C$ and $1x10^{-8}C$ are placed at points A,B and P along a straight line as shown below:

(i) What is the net force on the charge at P due to charges at A and B.

(ii) Calculate the distance of the point X from A where another charge of magnitude $^{+}1x10^{-8}$ C should be placed such that the net force on it due to the charges at A and B will be zero.

(e) Two equal but opposite charges of magnitude $2x10^{-8}$ C are placed at the corners of a triangle as shown below:

Find the force on a charge $^{+}1x10^{-8}C$ placed at P.

5(a) what do you understand by the following terms:

(i) Dielectric constant

(ii) Capacitance of a capacitor

(b) Derive an expression for the effective capacitance of three capacitors connected in:

(i) Series

(ii) Parallel

(c)(i) Explain the action of a dielectric placed between capacitor plates.

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

(d)(i) A Potential difference of 90V is applied across uncharged capacitors of 2 F, 3 F and 1.5 F Connected in series. Calculate the p.d across each capacitor.

(ii)Across which capacitor is the p.d least?

(iii) Two capacitors of magnitude 2 F and 3 F are connected in series. What capacitance must be placed in parallel with the 2 F capacitor in order to increase the effective capacitance of the whole system by 0.8 F?

(e)The figure below shows two identical capacitors C_1 and C_2 except for the distance between their plates.

(i) Calculate the p.d across each capacitor.

(ii) Calculate the electric field intensity between each pair of plates.

GOOD LUCK