GLASGOW COLLEGE UESTC

Exam paper

Physics II (Course Code)

Date: (remember to complete when info available from Ruoli)
Time: (remember to complete when info available from Ruoli)

Attempt all PARTS. Total 100 marks

Use one answer sheet for each of the questions in this exam.
Show all work on the answer sheet.
For Multiple Choice Questions, use the dedicated answer sheet provided.

Make sure that your University of Glasgow and UESTC Student Identification Numbers are on all answer sheets.

An electronic calculator may be used provided that it does not allow text storage or display, or graphical display.

All graphs should be clearly labelled and sufficiently large so that all elements are easy to read.

The numbers in square brackets in the right-hand margin indicate the marks allotted to the part of the question against which the mark is shown. These marks are for guidance only.

DATA/FORMULAE SHEET IS PROVIDED AT THE END OF PAPER
(*Keep or delete as appropriate*)

Continued overleaf

Q1 Multiple choice

Choose the ONE alternative that best completes the statement or answer the question.

1. ( ) A thin ring with radius R is non-uniformly charged, the linear density of charge is $\lambda = \lambda_0 \sin\theta$, where λ_0 is constant. What is the direction of electric field at the centre of ring? [3]

(A) + x direction

(B) - x direction

(C) + y direction

(D) - y direction

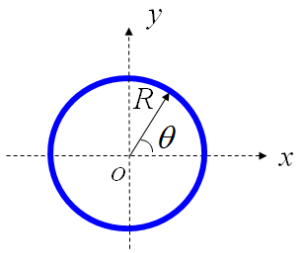

Figure Q1-1.

2. ( ) There are statements about electric field and electric flux. Which of them is correct? [3]

(A) If the net electric flux through a closed surface is 0, then there is no charge enclosed by the surface.

(B) If no electric charge is enclosed by a closed surface, then the electric field at any position on the surface is 0.

(C) If the electric field at any position inside a closed surface is constant, then there is no charge enclosed by the surface.

(D) If two surfaces can be combined to make a closed surface, then the electric flux through them are equal.

3. ( ) There are statements about conductors in electrostatic equilibrium. Which of them is NOT correct? [3]

(A) For any closed surface chosen inside the conductor, it encloses no net charge.

(B) For a position outside the conductor but very closed to it, the magnitude of electric field is proportional to the charge density on the conductor's surface.

(C) If a conductor is connected to the ground, its electric potential is 0.

(D) If a conductor spherical shell carries charge $2Q$, both the inner surface and the outer surface carry equal charge Q.

4. ( ) If three unequal capacitors, initially uncharged, are connected in series across a battery, which of the following statements is true? [3]

Continued overleaf

(A) The equivalent capacitance is greater than any of the individual capacitances.

(B) The largest voltage appears across the smallest capacitance.

(C) The capacitor with the smallest capacitance has the smallest charge.

(D) Three capacitors are stored with equal electric energy.

5. ( ) The capacitance of an air parallel plate capacitor is C, what will be the capacitance if the capacitor is half filled with dielectric material as shown in figure? The dielectric constant of material is K. [3]

(A) $\frac{C}{2}+\frac{KC}{2}$ (B) $\frac{C}{2}+\frac{C}{2K}$

(C) $\frac{KC}{2K+2}$ (D) $\frac{C}{2K+2}$

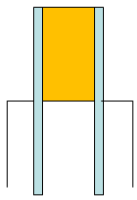

Figure Q1-5.

6. ( ) Infinitely long current I_1 and circular current I_2 are insulated, and lie on the same plane. What is the direction of magnetic force acting on current I_2? [3]

(A) + x direction

(B) - x direction

(C) + y direction

(D) - y direction

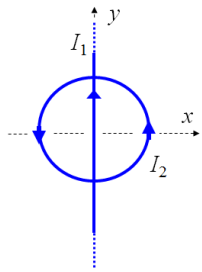

Figure Q1-6.

7. ( ) A circuits consists of two arc-shaped wires and two straight wires as shown in figure. If it carries current I, how much is the magnetic field produced at the center O? [3]

(A) $\frac{\mu_0 I}{4r}$ (B) $\frac{\mu_0 I}{4\pi r}$

(C) $\frac{\mu_0 I}{12r}$ (D) $\frac{\mu_0 I}{12\pi r}$

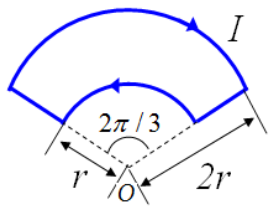

Figure Q1-7.

8. ( ) Which of the following devices can produce uniform magnetic field? [2]

Continued overleaf

(A) Infinitely long straight current

(B) Circular current

(C) infinitely long solenoid.

(D) ring-shaped toroid.

9. ( ) Which of the following motions is NOT possible for a point charge moving in uniform magnetic field? (Only consider the action of magnetic force) [2]

(A) Simple harmonic motion

(B) Circular motion

(C) Motion in a helix

(D) Free motion.

Q2 Consider a hemi-spherical shape object with radius R. Try to obtain the electrostatic quantities at the centre point o of its circular bottom surface.

(a) If electric charge distributes ONLY on the bottom surface with a uniform density σ.

(i) What is the electric field $\vec{E}_1$ at point o? [3]

(ii) How much is the electric potential V_1 at point o? [8]

(b) If electric charge distributes ONLY on the hemi-spherical surface with a uniform density σ.

(i) What is the electric field $\vec{E}_2$ at point o? [10]

(ii) How much is the electric potential V_2 at point o? [4]

Hint: Consider the electric field and potential about a uniformly charged thin ring.

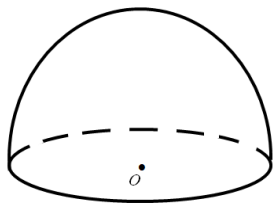

Figure Q2.

Continued overleaf

Q3 (a) A sphere is centred at point O with radius R, it is uniformly charged and the charge density per unit volume is ρ.

(i) What is the electric field outside the sphere? [6]

(ii) What is the electric field inside the sphere? [6]

(b) Suppose there is a spherical hole on the sphere of case (a), the hole centres at O' with radius R', the distance between O and O' is a.

(i) What is the electric field inside the hole? [8]

(ii) How much is the total electric energy in the space of hole? [5]

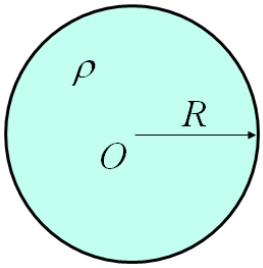

Figure Q3 (a)

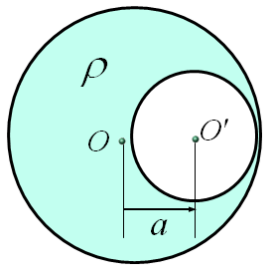

Figure Q3 (b)

Q4 Rotating charged objects can be related to circular currents. Consider a uniformly charged thin disk rotating about its central axis. The surface density of charge is σ, radius of disk is R, mass of disk is m, and angular velocity is ω.

(a) What is the magnetic moment $\vec{\mu}$ of rotating disk? [8]

(b) What is the magnetic field $\vec{B}$ produced at the centre of disk? [8]

(c) If the disk is released at rest in external magnetic field produced by a long straight current I, initially its magnetic moment $\vec{\mu}$ has a small angle θ with the external field, analyze its motion. Suppose the distance d between the disk and straight current satisfies $d >> R$, consider only magnetic forces. [9]

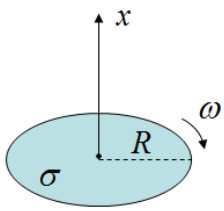

Figure Q4.

End of question paper