

Bago University
Department of Physics
First Semester Examination, March 2019

Second Year (BSc)
(Chemistry/ Geology Specializations)

Phys 2003
Electric & Magnetic Fields
Time Allowed: (3) Hours

Answer any Six questions.

- 1 (a) Define electric dipole and electric flux. Can electric field line cross one another? Does a line of force really exist?
(b) Suppose that positive charge is uniformly distributed throughout a spherical volume of radius R , the charge per unit volume being ρ_v . Using Gauss's law, prove that the magnitude of the electric field inside the volume, at a distance r from the center is $E = \frac{\rho_v r}{3\epsilon_0}$.
 - 2 (a) State Gauss's law in words and in mathematical statement. Write down equation in vector notation for torque on a dipole.
(b) By applying Gauss's law, derive the electric field due to an infinite plane of charge.
 - 3 (a) Define dipole and dipole moment. Illustrate lines of force for equal but opposite charges.
(b) (i) What is the electric field of a gold nucleus, at a distance of 10^{-12} cm from the nucleus? ($Z = 79$, $A = 179$). (ii) What is the electric field of a proton, at a distance of 5.28×10^{-9} cm from the proton?
 - 4 (a) What are homogeneity, linearity and isotropy?
(b) A plane slab of dielectric ($\epsilon_r = 5$) is placed normal to a uniform field with flux density D of 1 Cm^{-2} . If the slab occupies a volume of 0.1 m^3 and is uniformly polarized, what are (i) the polarization in the slab and (ii) the total dipole moment of the slab?
 - 5 (a) Differentiate between polarized and unpolarized atom with their figures.
(b) Derive the electric fields tangential to the boundary.
 - 6 (a) Define polarization, dielectric strength and dielectric breakdown.
(b) A horizontal parallel-plate capacitor has a 10mm plate separation and a 100V potential difference. There is a dielectric of permittivity ϵ and thickness 5mm on the lower plate. The space above is air-filled. (i) Find E , D , and P in the air space and in the dielectric. (ii) Find V as a function of the distance between the plates. ($\epsilon = 3 \epsilon_0$)
 - 7 (a) Define mobility and current density with their equations and symbols used.
(b) A silver wire 1mm diameter transfer a charge of 90 C in 1 hr and 15 min. Silver contains 5.8×10^{28} free electrons per m^3 . (i) What is the current in the wire? (ii) What is the drift velocity of the electrons in the wire?
 - 8 (a) Give a short account of power relations and also write down Joule's law.
(b) A 660 W electric heater is designed to operate from 120 V lines. (i) What is its resistance? (ii) What current does it draw? (iii) What is the rate of dissipation of energy, per second? (iv) If the line voltage drops to 110 V, what power does the heater take, in watts?
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