Physics 230 MidTerm

15 February, 2006; 11:00 AM : TL 12

Time: 1 hour

Resources: 1 sheet of notes (formulas (both sides)): Calculator.

Answers: <u>All</u> answers should be in the Exam Booklet (not on the exam sheets). Use other pages of the booklet for your working notes. These <u>will not be graded</u> but they will be reviewed. Please return your exam sheet with the exam booklet.

This examination has 3 pages.

1. Multiple Choice: (You can add one to two lines (at most) plus a diagram to explain your answer to obtain part marks.). Choose the answer closest to what you consider to be the correct answer.

1.1 **(5 marks):**
A point charge Q= -800 nC is placed at an angle of 30° from the x-axis in the positive y-direction, and 2.0 m from the origin (we have an x-y Cartesian coordinate system). A point charge q_1 is placed along the x-axis at x= 0.5 m and a point charge q_2 a is placed along the y axis at y= -1 m. The electric field at the origin due to charges Q, q_1, q_2 is equal to zero. Consequently the number of **excess** electrons in charge Q must be (note the electron charge is $1.6602\ 10^{-19}$ C):

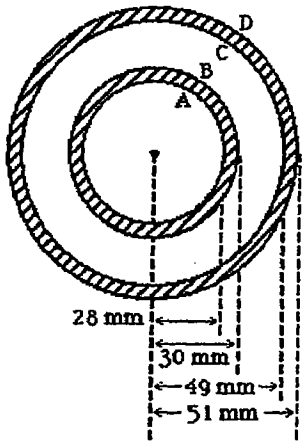
a) 1.2×10^{11} b) 5.3×10^{11} c) 5.3×10^{12} d)6.2×10^{12} e)8.5×10^{12} f)9.0×10^{12}

1.2. **(5 marks):**
Three hollow, concentric spherical conductors have the following total charges:
Inner sphere: Charge Q; middle sphere:Charge -2Q; Outer sphere: Charge -Q.
What is the charge on the outer surface of the middle sphere?

a) -3Q b) -2Q c) –Q d) zero e) Q f) 2Q

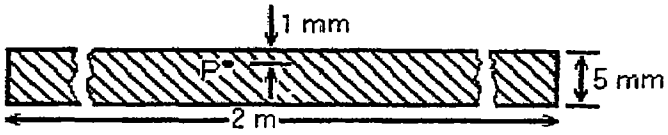
1.3. **(5 marks):**
The cross section of a long coaxial (cylindrical configuration) cable is shown in the diagram below. The conducting regions are hatched. The linear charge density on the inner conductor is -50 nC/m. The linear charge density on the outer conductor is is -20 nC/m. The inner and outer cylindrical surfaces are respectively denoted by A,B,C, and D. The linear charge densities on surfaces A and B in nC/m are:

a) 0 and -50 b) 0 and -30 c) 0 and -20 d) -50 and +20 e) -50 and -20 f) -50 and 0



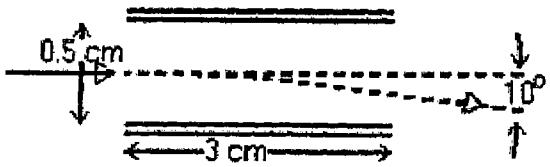
1.4. **(5 marks):**
In the diagram below, a thin insulating slab 5 mm x 2 m has a charge of 8×10^{11} C distributed uniformly throughout its volume. Determine the electric field at point P, which is located within the slab, beneath its center, 1 mm from one of the faces.

a) 0.01 V/m b) 0.68 V/m c) 13.6 V/m d) 26.2 V/m e) 41.3 V/m f) 62.3 V/m



1.5. **(5 marks):**
In the figure below, a charged particle is accelerated through a potential of 1.5×10^4 V after which it passes through the two parallel deflecting plates (hmm… almost like an old CRT TV set). What voltage (the electrical potential difference between the plates) must be applied to these plates to deflect the particle through an angle of 10°.?

a) 5V b) 52V c) 112V d) 520V e) 642V f) 882 V



2. Detailed Answers

2.1 (15 marks)

Charge $q_1 = -1.2 \times 10^{-9}$ C is at the origin, and charge $q_2 = 2.5 \times 10^{-9}$C is on the y-axis at 0.5m. Take the electrical potential to be zero far from both point charges.

a) Plot the intersection of the $V = 5.0$V equipotential surface with the x-y plane.
b) There are two equipotential surfaces corresponding to $V = 3.0$V. Plot their intersections with the x-y plane.
c) Find the value of the potential for which the pattern of the equipotential switches from one surface to two.