Tfy-3.1393 Physics IIA Exam 5.5.2007

Calculators are allowed

1. Four identical charges q are placed at the corners of a square of side L. a) In a free-body diagram, show all of the forces that act on one of the charges. b) Find the magnitude and direction of the total force exerted on one charge by the other three charges.

2. An insulating sphere with radius 0.150 m has uniform charge density 7.50 nC/m^3 throughout its volume. What is the electric field a) just outside the surface of the sphere; b) outside the sphere, 0.300 m from its center; c) inside the sphere, 0.075 m from its center?

3. Find the current through the battery in the circuit shown in Figure 1. What is the equivalent resistance of the resistor network?

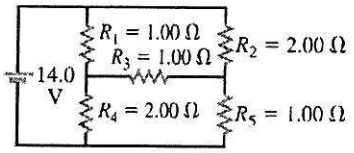

Figure 1

4. A singly charged ion of ^{7}Li (an isotope of lithium) has a mass of $1.16 \cdot 10^{-26}$ kg. It is accelerated through a potential difference of 220 V and then enters a magnetic field with magnitude 0.723 T perpendicular to the path of the ion. What is the radius of the ion's path in the magnetic field?

5. Three parallel wires each carry current I in the directions shown in Figure 2. If the separation between adjacent wires is d, calculate the magnitude and direction of the net magnetic force per unit length on each wire.

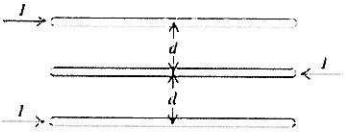

Figure 2

$e = 1.60 \cdot 10^{-19}$ C, $\mu_0 = 4\pi \cdot 10^{-7}$ N/A^2, $\varepsilon_0 = 8.85 \cdot 10^{-12}$ F/m.