# Homework 9

Due Wednesday 4/23/2014 - at beginning of class

## Griffiths' 4 Problems (3rd Edition numbers are the same)

**6.1**

**6.3** - Work part (b) only.

6.8

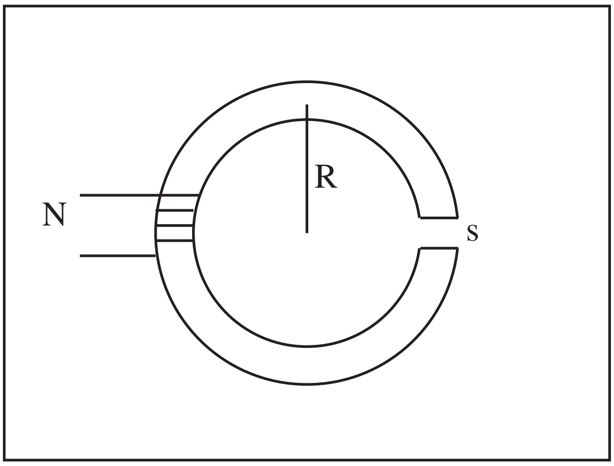
6.12

6.17

6.18

## Additional Problems

**E.9.1** Compute the magnetic field in the gap ($s = 0.15$cm) in a toroidal iron ring. The radius of the ring is $R = 8.1$cm. The ring is wrapped with 100 turns carrying current $I = 0.7$A. At the operating current, the relative permeability of the ring is $\mu_r = 100$.




**E.9.2** Repeat problem E.9.1 where 1/10 the circumference of the iron is replaced with a permanent magnetic material with magnetization $M = 10^5$A/m. The permanent magnet produces a field in the same direction as the field produced by the wraps of wire.

**E.9.3** A manufacturer of Alnico magnets reports a residual field of $12,500$ Gauss. This is the field in the center of an infinitely long magnet. Compute the magnetization $\vec{M}$. Our cylindrical Alnico lab magnets were about 10cm long with radius 0.5cm. Compare the field at the center of the flat surface of this magnet to field at the surface of a disk magnet of height 1mm and radius 0.5cm. You may use the finite solenoid formula. Also compute the field of the disk magnet modelling the bound current as a ring of current. Modelling the two magnets as point dipoles, compare the magnetic field at 30cm in the direction of the moment of the two magnets.

**E.9.4** A circular magnet with radius $a = 1$cm and thickness $d = 1$mm and magnetization $1 \times 10^5$A/m$\hat{z}$ lies in the $x - y$ plane centered at the origin. You may model the disk as infinitely thin.

**a** Calculate the magnetic field at the center of the magnet.

**b** Calculate the torque a magnetic field $\vec{B} = B_0\hat{x}$ would exert on the magnet if $B_0 = 0.2$T.

**E.9.5** A cylindrical stainless steel channel with relative permeability $\mu_r$, inner radius $a$ and outer radius $b$, confines a plasma with current density

$$\vec{J} = \frac{J_0 a}{s} \sin\left(\frac{\pi s}{a}\right)\hat{z}$$

where the axis of the solenoid is the $z$-axis and $J_0$ is a constant. Compute $\vec{H}$, $\vec{B}$, and $\vec{M}$ everywhere.