

**Physics 251 Test 3****Name:** \_\_\_\_\_

- Show all of your work.
  - Read the entire exam before starting.
  - Calculators are allowed on this exam.
1. An alpha particle with kinetic energy  $3.0 \times 10^{-11}$  J enters a uniform magnetic field of 0.5 T. If the angle between the magnetic field and the velocity is  $45^\circ$ ,
- (a) what is the magnitude of the force exerted on the alpha particle?
  - (b) what is the radius of the helical path traced by the particle?
  - (c) what is the magnitude of the change in kinetic energy of the particle as it leaves the magnetic field?

2. A long thin wire carries a current of 10.0 A.
- (a) What is the magnitude of the magnetic field vector at a distance of 5.0 cm from the center of the wire?
  - (b) If another wire carrying a current of 15.0 A in the same direction is placed 10.0 cm from the original wire, what is the force per unit length between the wires?
  - (c) Is the force between the wires attractive or repulsive?

3. A loop of copper wire that has an area of  $5.0 \text{ cm}^2$  carries a current of  $3.0 \text{ A}$ . If the loop is placed in a uniform magnetic field of  $0.75 \text{ T}$  and allowed to rotate,
- (a) what is the maximum torque possible on the loop and at what orientation does it occur?
  - (b) what is the magnitude of the magnetic moment of the loop?

4. Two long thin wires are arranged as shown below.
- (a) What direction is the magnetic field between the wires?
  - (b) If an electron is moving with a velocity of  $3.0 \times 10^7$  m/s to the right, halfway between the wires, what is the magnitude and direction of the force on the electron?

5. A coaxial cable carries a current of 15.0 mA. The direction of current flow on the inner conductor is into the page. The outer conductor has an equal amount of current in the opposite direction. Write an expression for the magnetic field between the conductors and outside the outer conductor.

6. Bonus: A solenoid of length 100 cm and a diameter of 1.0 cm has 10000 turns of copper wire. The wire has a total resistance of  $1.0\ \Omega$ . If 1.5 VDC is applied to the wire, what is the magnitude of the magnetic field at the center of the solenoid? (5 points)