Exam #3 **PS250**

Dr. Darrel Smith June 22, 2016

Show Your Work !!

_____

Name

10 points

1. An alpha particle is moving at a speed of 5.0×10^5 m/s in a direction perpendicular to a uniform magnetic field of strength 0.040 T. The charge on an alpha particle is 3.2×10^{-19} C and its mass is 6.6×10^{-27} kg.

   (a) What is the radius of the path of the alpha particle?

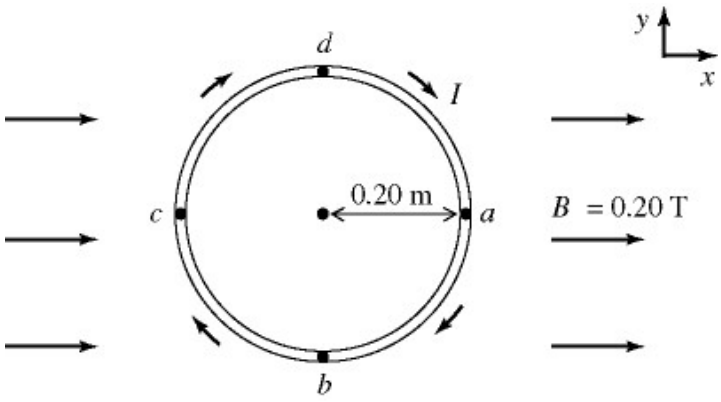
   R = _____ meters

   (b) How long does it take the alpha particle to make one complete revolution around its path?

   T = _____ μs

10 points

2. A rigid circular loop has a radius of 0.20 m and is in the *xy*-plane. A clockwise current *I* is carried by the loop, as shown. The magnitude of the magnetic moment of the loop is 0.75 A · m^2. A uniform external magnetic field, *B*= 0.20 T in the positive *x*-direction, is present.



   (a) What is the current in the loop?

   I = _____

   (b) Find the magnitude of the magnetic torque exerted on the loop.

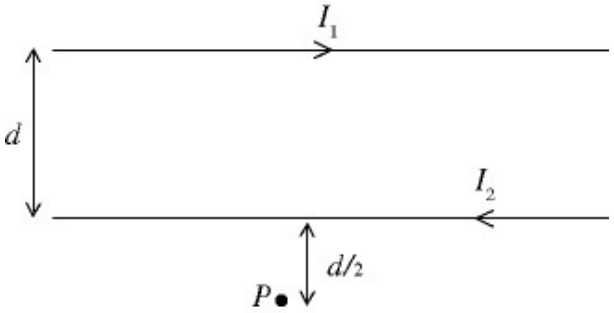
   $\tau =$ _____ N·m

   (c) If the loop is released from rest, in what direction will points *a* and *c* initially move? **(Circle one)**

- *a* moves out of the plane and *c* moves into the plane
- *a* moves into the plane and *c* moves into the plane
- *a* moves into the plane and *c* moves out of the plane
- *a* moves out of the plane and *c* moves out of the plane
- none of the above

10 points

3. As shown in the figure, two long straight wires are separated by a distance of d = 0.4 m. The currents are I_1 = 3.0 A to the right in the upper wire and I_2 = 7.0 A to the left in the lower wire.



(a) What is the magnitude of the magnetic field at point *P*, which is a distance $d/2$ = 0.20 m below the lower wire?
($\mu_0 = 4\pi \times 10^{-7}$ T · m/A)

B_{total} = _____ tesla

(b) What is the direction of the magnetic field at point *P*?
(Circle one)

- directed out of the plane of the paper.
- directed into the plane of the paper.

10 points

4. For a long ideal solenoid having a circular cross-section, the magnetic field strength within the solenoid is given by the equation $B(t) = 5.0t$ T, where *t* is time in seconds. If the induced electric field outside the solenoid is 1.1 V/m at a distance of 2.0 m from the axis of the solenoid, find the radius of the solenoid. **(Circle one) and show your work**

- 0.94 m
- 77m
- 0.30 m
- 9.0 m

10 points

5. You are designing a generator to have a maximum emf of 8.0 V. If the generator coil has 200 turns and a cross-sectional area of 0.030 m^2, what should be the frequency of the generator in a uniform magnetic field of 0.030 T?

   (Circle one) and show your work

- 7.1 Hz
- 22 Hz
- 7.5 Hz
- 44 Hz
- 8.0 Hz

10 points

6. An insulated wire of diameter 1.0 mm and negligible resistance is wrapped tightly around a cylindrical core of radius 5.0 cm and length 30 cm to build a solenoid. What is the energy stored in this solenoid when a current I = 0.20 A flows through it? ($\mu_0 = 4\pi \times 10^{-7}$ T • m/A)

- 1.2×10^{-4} J
- 9.6×10^{-4} J
- 4.8×10^{-4} J
- 2.4×10^{-4} J
- 5.9×10^{-5} J