# PHYSICS 2220 - PRACTICE EXAM #3

1. Use the Biot-Savart law to find the magnetic field at point P, at right. What is the direction of the field at P?

2. Use Ampere's law to find the magnetic field 1.5 cm from a long straight wire carrying a 3 mA current.

3. Two parallel wires carry currents $i_1$ = 3 A and $i_2$ = 2 A in the positive and negative y-directions, respectively, as shown. Find the force (magnitude and direction) on an electron moving in the positive y-direction half-way between the wires at $5 \times 10^4$ m/s.

4. In question 3, find the force per meter that wire 1 exerts on wire 2. What is the direction of the force on wire 2?

5. A circular loop with 120 turns of wire and radius 80 cm has a resistance of 359 $\Omega$. It is placed in a magnetic field of 0.15 T as shown. Find the magnetic flux through the loop.

6. The loop in question 5 is rotated clockwise by 50° in 18 ms, so that the magnetic field is perpendicular to the plane of the loop. What is the current induced in the loop?

7. A wire 3 m long moves perpendicular to a $5 \times 10^{-4}$ T magnetic field. There is an 18 V potential difference between the ends of the wire. How fast is the wire moving?

8. A square loop 5 cm x 5 cm with 180 turns of wire is in a uniform magnetic field of 0.08 T. It rotates about an axis through its centerline with a frequency of 16 Hz. What is the maximum emf induced in the loop?

9. A solenoid has 1500 turns/meter of wire. It is 25 cm long, and 6 cm in diameter. What is the magnetic flux through the solenoid when a current of 2.5 A flows through the wire?

10. How much energy is stored in the solenoid of question 9?
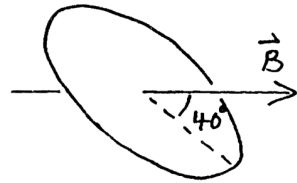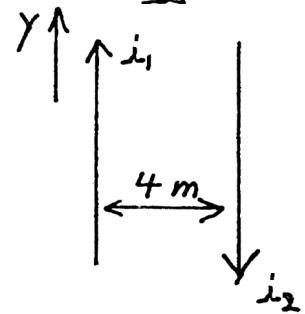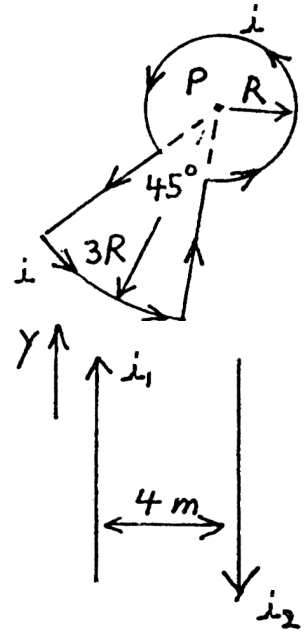
11. If the current in the solenoid in question 9 declines from 2.5 A to 1 A in 0.5 ms, find the magnitude of induced emf.

12. A 20 Ω resistor and a battery are connected to the solenoid in question 9. If the current is initially zero, how much time does it take after the battery is connected for the current to reach 70% of its final value?

13. An RLC circuit has R = 440 Ω, L = 1.60 H, and C = 7.25 μF. The ac generator produces rms voltage of 120 V. The frequency of the generator is 60 Hz. Find the impedence of the circuit, the rms current amplitude, the rms voltage across the resistor, inductor, and the capacitor, and the average power dissipated by the resistor.

14. An RLC circuit has R = 250 Ω, L = 450 mH, and C = 3.9 μF. The ac generator produces a maximum of 170 volts. Find the maximum current produced in the circuit if the angular frequency of the generator is set to half of the resonance angular frequency.

15. The 450 mH inductor is removed from the circuit described in question 14, and is replaced with an inductor of a different value. No other component of the circuit is changed, and the frequency of the generator is not altered. If the maximum current in the circuit does not change, what is the value of the new inductor?

16. The current and voltage in the primary coil of a transformer are 300 mA and 120 V. If the primary coil has 540 turns of wire, how many turns of wire should the secondary coil have if its voltage is to be 40 V? What is the current in the secondary?

ANSWERS:

(1) 0.458 $\mu_o i/R$, out of page  (2) 4 x $10^{-8}$ T

(3) 4 x $10^{-21}$ N, to right  (4) 3 x $10^{-7}$ N/m, right  (5) 0.194 Wb

(6) 2.0 A  (7) 1.2 x $10^4$ m/s  (8) 3.62 V  (9) 1.33 x $10^{-5}$ Wb

(10) 6.25 x $10^{-3}$ J  (11) 6.0 V  (12) 0.12 ms

(13) Z = 500 Ω, $I_{rms}$ = 240 mA, $V_R$ = 106 V, $V_L$ = 145 V,

$V_C$ = 87.8 V, P = 25.4 W  (14) 0.3 A  (15) 3.15 H  (16) 180, 0.9 A