RH = /44 CH1 = / 90

PHYS 202 Test #2 2/20/19 Dr. Holmes NAME____**Key**_____

DO ALL EIGHT PROBLEMS. THE WORTH OF EACH PROBLEM IS MARKED NEXT TO THE PROBLEM. SHOW YOUR WORK FOR PARTIAL CREDIT.
(Use the six directions: ↑N, →E, ↓S, ←W, ⊙up or out, and ⊗ down or in.)

1) Consider an electron moving ↓South at a speed of 3.1×10^6 m/s in a magnetic field of strength 0.076 T directed →East. a) What is the magnitude of the magnetic force on the electron?

[4] __**3.77×10^{-14} Nt**__. b) What is the direction of the magnetic force on the electron?

[4] __**⊗ down**__.

c) What is the magnitude of the acceleration of the electron due to this force?

[2] _**4.14×10^{16} m/s^2**_.

d) Will this force cause the electron to [speed up, slow down, or change direction]?

[2] **change direction**.

e) Would the magnetic force on a proton moving at the same speed in the same direction through the same field be [greater, the same, or less] in magnitude than on the electron?

[2] __**same**_____.

f) Would the magnetic force on the proton moving at the same speed in the same direction through the same field be in the [same, opposite, or other] direction than on the electron?

[2] _**opposite**_____. g) Would the acceleration of the proton be [the same, bigger or smaller] than the acceleration of the electron?

[2] ___**smaller**___.

2) In a certain mass spectrograph, singly charged ions are injected into the magnetic field with a speed of 7.0×10^4 m/s. a) If the ions have a mass of 36 amu (1 amu = 1.66×10^{-27} kg), and the desired DIAMETER of these ions as they orbit in the field is 24 cm, what strength should the magnetic field of the spectrograph be?

[6] __**0.218 T**_____. b) Will iron atoms of atomic mass of 60 amu have a [bigger, the same or smaller] orbit than those of part a (assuming they have the same speed in the same field?

[3] __**bigger**_____. c) If the speed of the ions is decreased with the same magnetic field, will the diameter of the ion's orbits be [smaller, the same, or larger]?

[3] ____**smaller**____.

3) What is the magnetic field strength at the center of a coil of wire that has 900 turns, a radius of 14 cm, and a current of 5.4 amps?

[6] ___**0.022 T**_____. b) If the radius of the coil were decreased by a factor of ½ (to 7 cm) and the number of turns was increased by a factor of 2 (to 1,800) so the amount of wire used was kept the same, what would the field strength at the center become?

[2] ___**0.087 T**_____.

4) a) DESIGN an electric motor that gives an average torque of 1.67 Nt-m.
To do this, draw a picture [4]
and then specify the values of
all the relevant parameters: [6]

b) If this rotates at 60 cycles per second, what is the average power of this motor?
in Watts: in horsepower:
[3] ____**629 W**_____; [1] __**0.844 hp**_____.

5) DESIGN an electric generator that will provide 24 volts rms at 60 cycles per second:
To do this, draw a picture [4]
and then specify the values of
all the relevant parameters: [6]

6) a) If the rms-voltage of an electrical receptacle is 220 volts at 60 Hz, what is the peak voltage at the outlet?

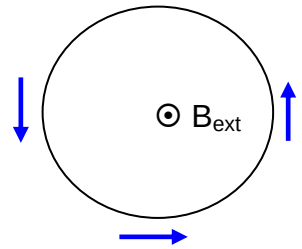
[4] __311 V_____ ____. b) What is the rms-current in a 3,300 Watt electric heater that is connected across the 220 volt-rms outlet?

[4] _15 A_____. c) Assume that a different 3,300 Watt heater uses a 110 volt rms source instead of the 220 volt rms source. With this new heater, will the rms-current it draws be [bigger, the same, or smaller] than the original heater that uses a 220 volt rms source?

[2] ____bigger_____.

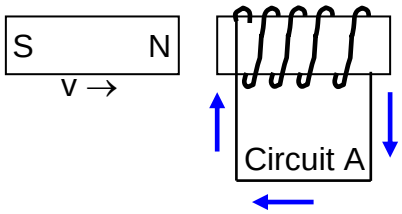
7) In each of the four diagrams below, indicate on the A circuit the direction of the induced current in circuit A due to the situation described (if no current, then write the word NONE on circuit A):

a) the external magnetic field directed UP through circuit A is decreasing in strength: [4]

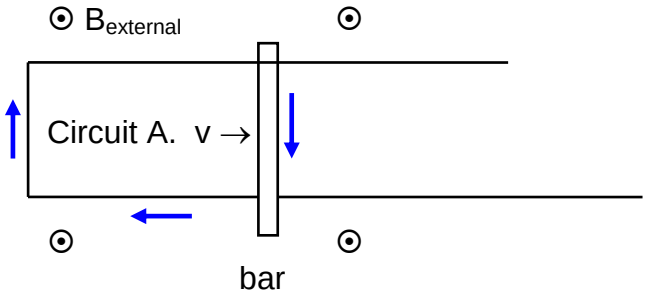


Circuit A is the loop of wire

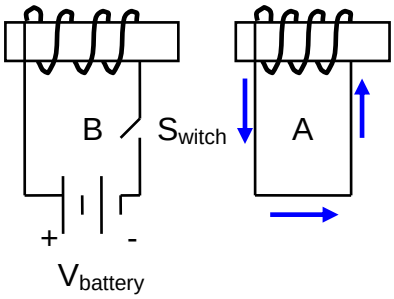
b) the North pole of the bar magnet is pointing toward the solenoid in circuit A and is moving towards it: [4]



c) The bar is moving to the right: [4]



d) The switch in circuit B is being CLOSED (it was open): [4]



8) Consider a series RLC circuit with an oscillating voltage source of 20 volts (rms) at 400 Hz. The resistance is 12 Ω, the capacitance is 2.2 μF, and the inductance is 39 mH.

a) What is the capacitive reactance (X_C)?

[3] **180.9 Ω**.

b) What is the inductive reactance (X_L)?

[3] **98.0 Ω** .

c) What is the impedance (Z) of the circuit?

[3] **83.7 Ω** .

d) What is the rms current through this circuit?

[3] **0.239 A** .