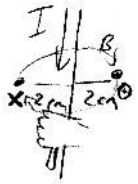
# *Physics*

*Unit 10: Magnetism*

1. *Know the fundamental properties of permanent magnets.*
2. *Know how to induce emf.*
3. *Know the RHR's, and Lenz's Law.*
4. *A solenoid that is 2 m long and has a diameter of 0.5 m has 150 turns. Find the magnitude and direction of the magnetic field at the center of the solenoid if the current is 5 A clockwise.*
5. *A straight wire carries 5 A of current. If the wire is vertical and the current runs down, find the magnitude and direction of the magnetic field 2 cm from the wire.*
6. *A loose proton enters a magnetic field whose direction is coming out of the page. What does its path look like? If the path is bent, what way does it bend?*
7. *The path of a charged particle is bent clockwise in a magnetic field that is pointed out of the page. What is sign of the charge of the particle?*
8. *The force on a 3 cm wire that carries 10 A is 0.051 N. The wire is in a 0.5 T magnetic field. What is the angle between the wire and the magnetic field?*
9. *A current goes down and the magnetic field points to the right. What is the direction of the force on the wire carrying the current?*
10. *A single circular loop of wire is in a 0.5 T B-field. The normal makes an angle of 30° with the B-field. If there is a 5 A current in the loop (r = 5 cm), what is the torque on the loop?*
11. *Two wires are side by side and very close to each other. One wire carries 2 A and the other 3A in the same direction. What is magnetic field 5 cm from the wires?*
12. *A circular loop of wire (r = 5 cm) is in a magnetic field (B = 0.5 T) with the normal of the loop parallel to the B-field. The B-field increases at a rate of 0.1 T/s. What is the induced emf in the loop? What direction would a current flow through the loop?*
13. *A transformer's primary coil has 160 turns and 240 V. How many turns are needed in the secondary coil to get 80 V? Is this a step-up or step-down transformer?*
14. *A solenoid with 10 turns has a cross-sectional area of 2.0 $cm^2$ and length of 5 cm. How much energy is stored in the magnetic field of the solenoid when it carries a current of 5.0 A?*
15. *Two coils share a common axis. The mutual inductance of this pair of coils is 10.0 mH. If the current in coil **1** is changing at the rate of 10 A/s, what is the magnitude of the emf generated in coil **2**?*

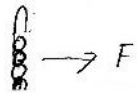
4. $L = 2\ m, d = 0.5\ m, N = 150, I = 5\ A$
$B = \mu_0 nI; n = \frac{N}{L} = \frac{150}{2\ m} = 75\ m^{-1}$
$B = \left(4\pi \times 10^{-7}\frac{Tm}{A}\right)(75\ m^{-1})(5\ A) =$
$\mathbf{4.71 \times 10^{-4}\ T}$
*RHR says points* ***into paper***


5. $I = 5\ A, r = 0.02\ m$
$B = \frac{\mu_0 I}{2\pi r}$
$B = \frac{\left(4\pi\times10^{-7}\frac{Tm}{A}\right)(5\ A)}{2\pi(0.02\ m)} = \mathbf{5 \times 10^{-5}\ T}$
***Goes in on left, out on right***



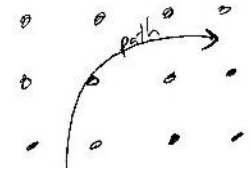

6. *Since the proton is charged, the path is bent.*


*RHR – fingers*
*- thumb in direction of v*
*- palm points in direction of F*

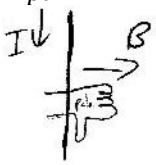



***Bends to clockwise*** *(electron would bend counterclockwise)*

7. ***Positive***

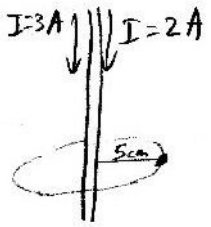



8. $L = 0.03\ m,\ I = 10\ A, F = 0.051\ N, B = 0.5\ T$
$F = ILB\sin\theta$
$0.051\ N = (10\ A)(0.03\ m)(0.5\ T)\sin\theta$
$0.34 = \sin\theta$
$\boldsymbol{\theta = 19.9°}$
9. *RHR – fingers B*
*- thumb I*
*- palm F*




***F is out of page***

10. $N = 1, B = 0.5\ T,\ \theta = 30°,\ I = 5\ A, r = 0.05\ m$
$\tau = NIAB\sin\theta$
$\tau = 1(5\ A)(\pi(0.05\ m)^2)(0.5\ T)\sin 30° =$
$\mathbf{0.00982\ Nm}$
11. *Ampere's Law*




$\Sigma B \cdot \Delta\ell = \mu_0 I$
$B(2\pi r) = \mu_0 I$
$B(2\pi 0.05\ m) = \left(4\pi \times 10^{-7}\frac{Tm}{A}\right)(3\ A + 2\ A)$
$B(0.31416\ m) = 6.2832 \times 10^{-6}\ Tm$
$\boldsymbol{B = 2 \times 10^{-5}\ T}$
12. $N = 1, r = 0.05\ m, B = 0.5\ T, \frac{\Delta B}{\Delta t} = 0.1\frac{T}{s}$
$emf = -N\frac{\Delta\Phi}{\Delta t}, \Phi = BA\cos\theta$
$emf = -1 \cdot \frac{B_f A\cos 0 - B_0 A\cos 0}{\Delta t}$
$emf = -\left(\frac{A(B_f - B_0)}{\Delta t}\right)$
$emf = -\left(A\frac{\Delta B}{\Delta t}\right)$
$emf = -(\pi(0.05\ m)^2)\left(0.1\frac{T}{s}\right) = \mathbf{-7.85 \times 10^{-4}\ V}$
*Flux is getting stronger so induced B-field should cancel the original B-field.*
*RHR – curl your fingers through the loop in the direction of the induced B-field. Your thumb will point the direction of the current.*
13. $N_p = 160, V_p = 240\ V, V_s = 80\ V$
$\frac{V_s}{V_p} = \frac{N_s}{N_p}$
$\frac{80\ V}{240\ V} = \frac{N_s}{160}$
$N_s = 53.3$
***54 turns; Step-down*** *since V decreases.*
14. $L = \frac{u_0 N^2 A}{\ell}$
$L = \frac{\left(4\pi \times 10^{-7}\frac{Tm}{A}\right)(10)^2(0.0002\ m^2)}{0.05\ m}$
$= 5.0265 \times 10^{-7}\ H$
$E_{ind} = \frac{1}{2}LI^2$
$E_{ind} = \frac{1}{2}(5.0265 \times 10^{-7}\ H)(5\ A)^2$
$= \mathbf{6.28 \times 10^{-6}\ J}$
15. $emf_1 = -M\frac{\Delta I_2}{\Delta t}$
$emf_1 = -(0.010\ H)\left(10\frac{A}{s}\right) = \mathbf{-0.100\ V}$