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Chapter 22 Review

<u>Right Hand Rules</u>

1st Right Hand Rule

- use for wires
- 1) point thumb in direction of current (I)
- 2) B is where your fingers point

2nd Right Hand Rule

- use for solenoids or electromagnets
- 1) point fingers toward current (I)
- 2) Wrap fingers around core/iron
- 3) Thumb points north

3rd Right Hand Rule

- use for induced EMF
- 1) Thumb points current (I)
- 2) Fingers point with magnetic field
- 3) Palm points force
- 4) With an induced current, thumb points force/velocity and palm points current

Definitions

<u>EMF</u>- Electromotive force= the potential difference give to the charges by a battery. It is measured in volts.

Induced EMF- the difference in potential.

Electric Generator- converts mechanical energy to electrical energy.

<u>Lenz's Law-</u> the direction of the induced current is such that the magnetic field resulting from the induced current opposes the change in the field that caused the induced current.

<u>Eddy currents-</u>generated from metal moving through a magnetic field. The currents produce a magnetic field that acts to oppose the motion that caused the currents. This results in the metal piece being slowed down.

<u>Self-inductance-</u> the induction of EMF in a wire carrying changing currents. The potential of the top of the coil is more negative than the bottom.

<u>Transformer-</u> a device used to increase or decrease AC voltages. It has two coils, electrically insulated from each other, but around the same iron core. One coil is the <u>Primary coil</u> and one is the <u>secondary coil</u>.

<u>Mutual inductance-</u> a changing current in the primary coil creates a varying magnetic field, and the varying magnetic field is carried through the core to the secondary coil. In the secondary coil, the varying field induces a varying EMF.

Step-up transformer- the secondary voltage is larger than the primary voltage.

<u>Step-down transformer</u>- the voltage coming out of the transformer is smaller than the voltage put in.

Summary

- Michael Faraday discovered that if a wire moves through a magnetic field, an electric current can flow.
- The current produced depends upon the angle between the velocity of the wire and the magnetic field. Maximum current occurs when the wire is moving at right angles to the field.
 (we always use an angle of 90)
- The EMF in a straight length of wire moving through a uniform magnetic field is the product of the magnetic field, B, the length of the wire, L, and the velocity of the moving wire, v, perpendicular to the field.
- A generator converts mechanical energy to electrical energy; whereas, a motor converts electrical energy to mechanical energy.

Equations

F=qvB

F-BIL

EMF=BLv

I=current

B=magnetic field

v=velocity

q=coulombs

 $I_s/I_p = V_p/V_s = N_p/N_s$

mv=rqB

Questions:

- **1)** A straight wire, 0.5 m long, is moved straight up at a speed of 20 m/s through a 0.4 T magnetic field pointed in the horizontal direction. What EMF is induced in the wire?
- A) 4 V b) 4.0 V c) 8 V d) 8.0 V
- 2) What are the fundamental units of Tesla?
- A) kg(m)/s b) kg/s c) kg(s) d) kg/c(s)
- 3) A straight wire, 30.0 m long, moves at 2.0 m/s in a perpendicular direction through a 1.0 T magnetic field. The total resistance of the circuit of which the wire is a part is 15.0. What is the current?
- A) 4.0 A b) 10 A c) 12 A d) 8.0 A
- 4) A step down transformer has 7500 turns on its primary coil and 125 turns on its secondary coil. The voltage across the primary circuit is 7.2 kV. What voltage is across the secondary circuit?
- A) 120 V b) 100 V c) 12 V d) 150 V
- 5) A step up transformer has 300 turns on its primary coil and 90,000 turns on its secondary coil. The EMF of the generator to which the primary circuit is attached is 60.0 V. What is the EMF in the secondary circuit?
- A) 18,000 V b) 15,000 V c) 20,000 V d) 17,500 V
- 6) A straight wire, 25 m long, is mounted on an airplane flying at 125 m/s. The wire moves in a perpendicular direction through Earth's magnetic field (B=5.0*10^-5 T). What EMF is induced in the wire?

- 7) A step up transformer's primary coil has 500 turns. Its secondary coil has 15,000 turns. The primary circuit is connected to an AC generator having an EMF of 120 V. Calculate the EMF of the secondary circuit.
- 8) A permanent horseshoe magnet is mounted so that the magnetic field lines are vertical. If a student passes a straight wire between the poles and pulls it toward herself, the current flow through the wire is from right to left. Which is the N-pole of the magnet?
- **9)** A wire carrying 4.0 A current is kept at right angles in a magnetic field of 0.050 T. The wire experiences a force of 0.20 N. Calculate the length of the wire.
- 10) A stream of electrons travels at a speed of 3.0*10^6 m/s 6 through a magnetic field of 0.50 T at right angles to the field. What is the radius of the path travelled by the electrons?

Answers:

1) A

2) D

3) A

4) A

5) A

6) 0.16 V

7) 3.6*10^3 V

8) North pole is at the bottom

9) 1.0 m

10) 3.4*10^-5 m

References

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