PHYSICS INMOTION
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Unit 5K
Generators and Motors
Practice Problems TEACHER

Work each of the following problems. SHOW ALL WORK.

1. **Faraday's law of magnetic induction states that the voltage produced by a current running through a wire is directly related to the number of loops in the wire and the cross-sectional area of the wire. If the number of loops and the area are both doubled, by what factor will the voltage increase?**

As the voltage produced is directly proportional to both the number of loops in the wire and the cross-sectional area of the wire, if both values are doubled, then the voltage will increase by a factor of four.

2. **What is the magnetic force experienced by 0.50 m of wire that carries 3 A of current and is exposed to a 1.2 T magnetic field?**

$$F_B = IlB$$
$$F_B = (3\ A)(0.50\ m)(1.2\ T)$$
$$F_B = 1.8\ N$$

3. **The magnetic force acting on a current-carrying wire is 5 N. Calculate the length of the wire if it is carrying 2 A of current in a 0.10 T magnetic field.**

$$F_B = IlB$$
$$5\ N = (2\ A)l(0.10\ T)$$
$$l = 25\ m$$

4. **A magnetic field of 0.50 T is applied at a right angle to a coil with 20 turns of wire wrapped around a tube with a cross-sectional area of 1 m^2. If the coil is pulled out of the magnetic field in 5 seconds, what emf is induced in the coil?**

$$N = 20\ turns$$
$$A = 1\ m^2$$
$$\Delta B = 0.50\ T$$
$$t = 5\ s$$

$$emf = \frac{N\Delta BA}{t}$$
$$emf = \frac{(20)(0.50\ T - 0)(1\ m^2)}{(5\ s)}$$
$$emf = 2\ V$$

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5. The resistance of the wire in the previous question is 0.50 Ω. What is the current running through the wire?

$$emf = 2\,V$$
$$R = 0.50\,\Omega$$

$$I = \frac{emf}{R}$$
$$I = \frac{2\,V}{0.50\,\Omega}$$
$$I = 4\,A$$

6. A wire loop with a cross-sectional area of 0.50 m² is pulled through a magnetic field of 0.25 T in 1 second. How many coils are in the loop for an induced emf of 4 V?

$$emf = 4\,V$$
$$A = 0.50\,m^2$$
$$\Delta B = 0.25\,T$$
$$t = 1\,s$$

$$emf = \frac{N\Delta BA}{t}$$
$$4\,V = \frac{N(0.25\,T - 0)(0.50\,m^2)}{(1\,s)}$$
$$N = 32\,coils$$

7. If the wire loop in the previous question is carrying a current of 3 A, what is the resistance of the wire?

$$emf = 4\,V$$
$$I = 3\,A$$

$$I = \frac{emf}{R}$$
$$3\,A = \frac{4\,V}{R}$$
$$R = 1.33\,\Omega$$