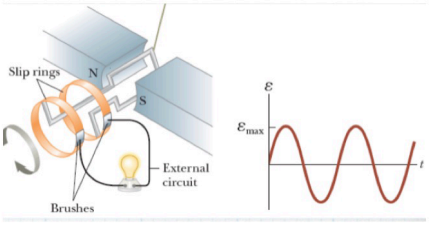
The coil in an AC generator consists of 8 turns of wire, each of area A = 0.0900 m^2, and the total resistance of the wire is 11.5 Ω. The coil rotates in a 0.630 T magnetic field at a constant frequency of 60.0 Hz.



Answer these three questions about this system:

1. Find the maximum induced emf in the coil.

2. What is the maximum induced current in the coil when the output terminals are connected to a low-resistance conductor?

3. What if at a later time, the maximum induced current was measured to be 6.00 A instead. Assuming the magnetic field is unchanged, at what frequency is the loop spinning?

Given: $N = 8$ turns, $A = 0.09\ m^2$, $R = 11.5\ \Omega$, $B = 0.63\ T$, $f = 60\ Hz$

When a coil rotates in a magnetic field, the induced emf is:

$$\mathcal{E}(t) = \underbrace{NAB\omega}_{\mathcal{E}_{max}} \sin(\omega t)$$

The value in front of the sine function is the amplitude, or maximum value, of that function.

(a) $\mathcal{E}_{max} = NAB\omega = NAB(2\pi f)$

$= (8)(0.09\ m^2)(0.63\ T)(2\pi)(60\ Hz) = 171\ V$

(b) $I_{max} = \frac{\mathcal{E}_{max}}{R} = \frac{171\ V}{11.5\ \Omega} = 14.9\ A$

(c) $\mathcal{E}_{max} = I_{max} R = (6A)(11.5\ \Omega) = 69\ V$

$\mathcal{E}_{max} = NAB\omega$

$$\omega = \frac{\mathcal{E}_{max}}{NAB} = \frac{69\ V}{(8)(0.09 m^2)(0.63\ T)} = 152\ rad/s$$

$$f = \frac{\omega}{2\pi} = \frac{152\ rad/s}{2\pi} = 24\ Hz$$