Thursday Reading Assessment: Unit 4, AC Generators

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1 Memory Bank

- $\epsilon = -N\Delta\phi_m/\Delta t$ ... Faraday's Law
- $\phi_m = \vec{B}\cdot\vec{A} = BA\cos(\theta)$ ... Definition of magnetic flux
- $\epsilon(t) = \epsilon_0 \sin(\omega t)$ ... AC voltage generated by generator. ϵ_0 is proportional to ω.
- $P_{max} = V_{max}^2/R$ ... Max power of an AC generator.
- $P_{ave} = \frac{1}{2}P_{max}$ ... Average power of an AC generator.

2 AC Generators

1. Consider Fig. 1. Suppose that the angle between the area vector and the magnetic field is $\theta = \omega t$. (a) Show that

$$\phi(t) = BA\cos(\omega t) \tag{1}$$

(b) Given Eq. 1, it turns out that the voltage generated in the loop is proportional to $\sin(\omega t)$ and ω itself. That is,

$$\epsilon(t) = BA\omega\sin(\omega t) \tag{2}$$

What is the voltage at a time $t = 1/240$ seconds, $\omega = 120\pi$ Hz, $B = 0.1$ T, and $A = 0.01$ m^2? (c) At what time is the voltage zero?

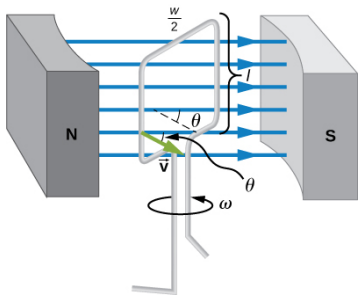

Figure 1: A schematic of the concept of an AC generator.

2. Suppose the AC generator in Fig. 1 has $V_0 = 12$ V/Hz, so that $\epsilon(t) = V_0\omega\sin(\omega t)$. (a) If the AC generator pushes current through a resistance $R = 50\Omega$, what is the **average** power generated? (b) What is the average power generated if the angular frequency is doubled?