Answer on Question #42684-Physics-Electromagnetism

faraday's law is given by this equation V=-N dB/dt where V is the induced voltage, N is the number of loops (inside the changing magnetic field) and dB/dt is just a symbol used in calculus to indicate the rate of change of the magnetic field, The equation for the output of a transformer is: V out= V in n out/n in where n out is the number of turns around the core at the output of the transformer and n in is the number of turns around the input of the transformer. Use these equations to solve the following problem: you have a coil with 20 loops inside a magnetic field generator that is temporarily generating a field that has a rate change of -0.25. The other end of this coil is wrapped around a core with 15 turns. How many turns must a second coil wrapped around the same coil have to produce an output voltage of 25 V?

Solution

So the magnetic field generator produces a voltage that is fed as the input to a transformer.

For the transformer,

$$V_{out} = V_{in} \cdot \frac{N_{out}}{N_{in}}$$

where $V_{in} = -\mathrm{N}\frac{\mathrm{dB}}{\mathrm{dt}}$ is the voltage from the generator.

So

$$V_{out} = -\mathrm{N}\frac{\mathrm{dB}}{\mathrm{dt}} \cdot \frac{N_{out}}{N_{in}},$$

where $V_{out} = 25\ \mathrm{V}, \mathrm{N} = 20, \frac{\mathrm{dB}}{\mathrm{dt}} = -0.25, N_{in} = 15.$

$$N_{out} = -\frac{V_{out}N_{in}}{\mathrm{N}\frac{\mathrm{dB}}{\mathrm{dt}}} = -\frac{25 \cdot 15}{20 \cdot (-0.25)} = 75 \text{ turns.}$$

Answer: 75 turns.