Answer on Question #77020, Physics / Electromagnetism

Question. A magnet that is moving towards a N=20 turn coil of resistance R=12 Ω at v=0.5 m/s results in a current of I=0.25 A produced in the coil. What is the force exerted by the coil on the magnet?

Solution.
Assume that $z \gg r$ (z is a distance between the magnet and the coil). We have

$$F = IB_r l = IB_r 2\pi r ,$$

where

$$B_r = \frac{r}{2}\frac{\Delta B_z}{\Delta z}$$

So,

$$E = IR = N\frac{\Delta\Phi}{\Delta t} = N\frac{\Delta(B_z S)}{\Delta t} = NS\frac{\Delta B_z}{\Delta t} = NS\frac{\Delta B_z}{\Delta z}\frac{\Delta z}{\Delta t} = NS\frac{\Delta B_z}{\Delta z}v \Rightarrow \frac{\Delta B_z}{\Delta z} = \frac{IR}{NSv}$$

We get

$$F = IB_r 2\pi r = I\frac{r}{2}\frac{IR}{NSv}2\pi r = I\frac{r}{2}\frac{IR}{N\pi r^2 v}2\pi r = \frac{I^2 R}{Nv}$$

Finally

$$F = \frac{I^2 R}{Nv} = \frac{0.25^2 \cdot 12}{20 \cdot 0.5} = 0.075N$$

Answer. $F = \frac{I^2 R}{Nv} = 0.075N$