29.9 The armature of a 60-Hz ac generator rotates in a 0.15 T mag. field. If the area of the coil is $2\times10^{-2}\,m^2$, how many loops must the coil contain if the peak output is to be $V_0 = 170V$?

$f = 60\,Hz = 60\,s^{-1}$

$A = 2\times10^{-2}\,m^2$

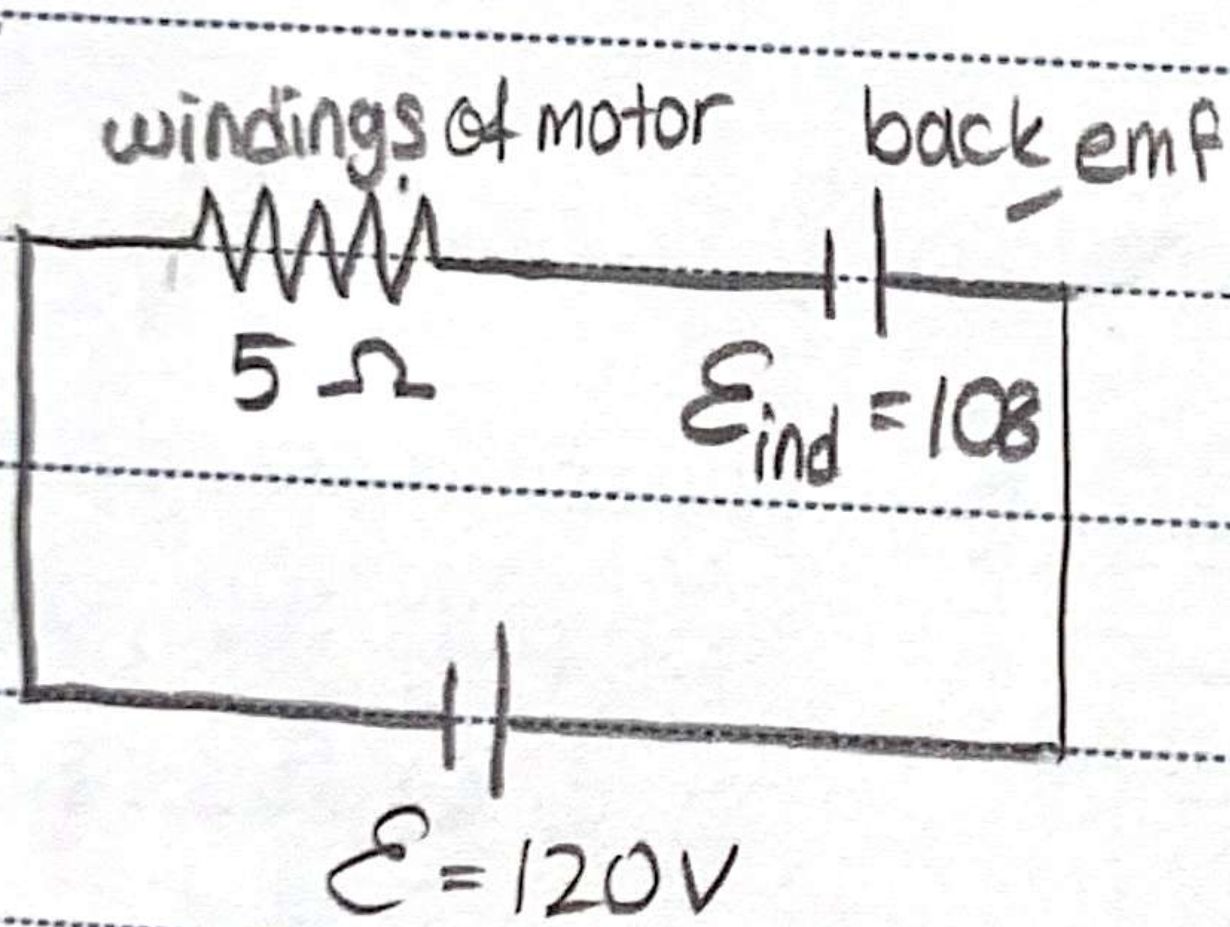
$B = 0.15\,T$

$\mathcal{E}_0 = N \cdot B\,A\,\omega$, $\omega = 2\pi f$

$170V = N \cdot (0.15T) \cdot (2\times10^{-2}) \cdot 2\pi \cdot (60s^{-1})$

$N = 150$ turns //

29.10 When the motor reaches full speed against its normal load, the back emf is 108 V. Calculate



a) the current into the motor when it is just starting up.

$I = \frac{V}{R} = \frac{120V}{5\Omega} = 24A$ //

b) the current when the motor reaches full speed

$120V - 108V = 12V$

$I = \frac{V}{R} = \frac{12V}{5\Omega} = 2.4A$ //

transformers

$$\frac{I_p}{I_s} = \frac{V_s}{V_p} = \frac{N_s}{N_p} \qquad V_s = N_s \cdot \frac{d\Phi_B}{dt}, \quad V_p = N \cdot \frac{d\Phi}{dt}$$

29.12 The charger contains a transformer that reduces 120 V ac to 5 V ac to charge the 3.7 V battery. (It also contains diodes to change the 5 V ac to 5 V dc) Suppose the secondary coil contains 30 turns and the charger supplies 700 mA. Calculate

a) the number of turns in the primary coil

$$\frac{N_p}{N_s} = \frac{V_p}{V_s} \Rightarrow N_p = N_s \cdot \frac{V_p}{V_s} = \frac{30 \cdot (120V)}{(5V)} = 720 \text{ turns}$$

b) the current in the primary

$$I = I_s \cdot \frac{N_s}{N_p} = (0.70A) \cdot \left(\frac{30}{720}\right) \Rightarrow I_p = 29mA$$

c) the power transformed

$$P = I_s \cdot V_s = (0.70A)(5V) = 3.5W$$
$$P = (0.029A) \cdot (120V) = 3.5W$$

There is a 100% effiuency in power transfer for our ideal transformer

29.13 An average of 120 kW of electric power is sent to a town from a power plant 10 km away. The transmission lines have a total resistance of 0.40 Ω. Calculate the power loss if the power is transmitted at

a) 240 V

$$I = \frac{P}{V} = \frac{1.2 \times 10^5 W}{240} = 500A$$

$$P_{Loss} = I^2 \cdot R = (500)^2 \cdot (0.4) = 1000kW$$

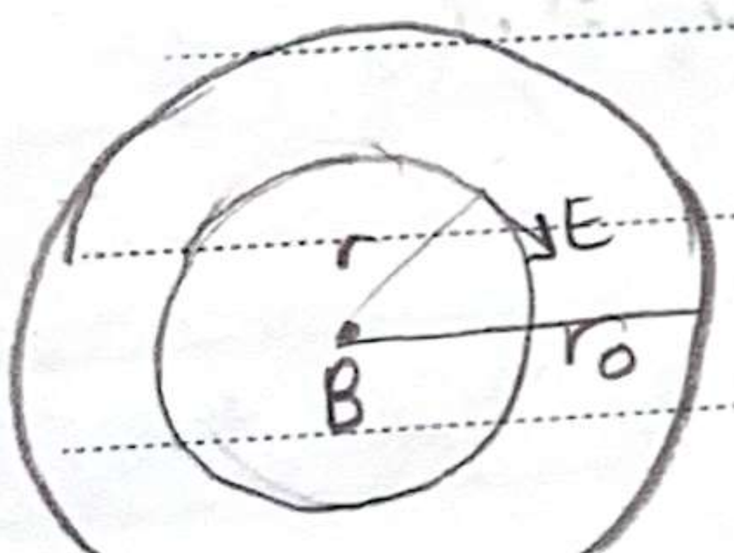
b) 24.000 V

$$I = \frac{P}{V} = \frac{1.2 \times 10^5}{24000} = 5A$$

$$P_{Loss} = I^2 \cdot R = 5^2 \cdot (0.4) = 10W$$

Record : / /

2914 A magnetic field B between the pole faces of an electromagnet is nearly uniform at any instant over a circular area of radius r_0. The current in the windings of the electromagnet is increasing in time so that B changes in time at a constant rate $d\vec{B}/dt$ at each point. Beyond the circular region $(r>r_0)$ we assume $B=0$ at all times. Determine the electric field E at any point P a distance r from the center of the circular area due to the changing B.



for $r<r_0$

$$\oint \vec{E}\cdot d\vec{l} = -\frac{d\Phi_B}{dt}$$

$$E.2\pi r = \frac{d\Phi_B}{dt}$$

$$\Phi_B = B.A = B.(\pi r^2)$$

$$E.2\pi r = \frac{dB}{dt}(\pi r^2)$$

$$E = \frac{r}{2}.\frac{dB}{dt} \text{ //}$$

for $r>r_0$

$$E.(2\pi r) = (\pi r_0^2).\frac{dB}{dt} \Rightarrow E = \frac{r_0^2}{2r}.\frac{dB}{dt} \text{ //}$$

CHAPTER 27 (eksik kısımlar)

$$F = I.aB$$

↓ length of vertical arm of coil

$$\tau = N.I.A.B\sin\theta$$

$$\vec{\mu} = N.I.\vec{A}$$

$$U = -\mu B\cos\theta = -\vec{\mu}.\vec{B}$$

↓ potential E

27.11 A circular coil of wire has a diameter of 20 cm and contains 10 loops. The current in each loop is 3.00A, and the coil is placed in a 200 T external magnetic field. Determine the max and min torque exerted on the coil by the field.

$2r = 20cm = 0.2m$, $r = 0.1m$, $B = 2T$, $I = 3A$, $N = 10$ loops

$A = \pi r^2 = \pi \cdot (0.1)^2 = 3.14 \times 10^{-2}\ m^2$

max → $(\theta = 90)$ $\tau = N.I.A.B \sin\theta = N.I.A.B = 1.88\ N.m$ //

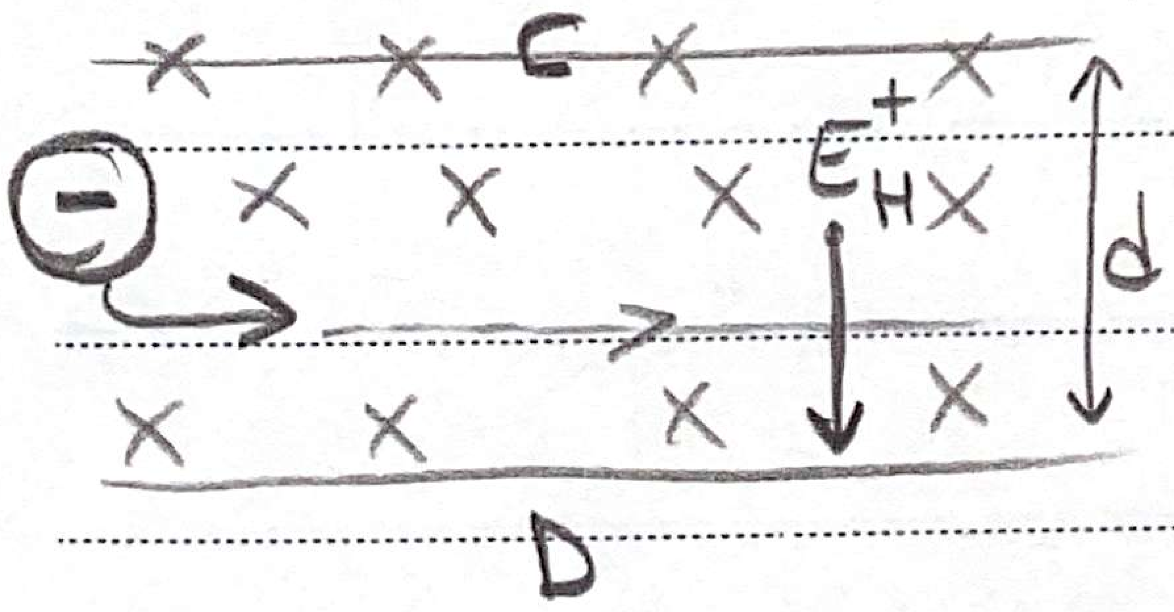
min → $(\theta = 0)$ $\tau = 0$ //

the hall effect

$E_H = V_d \cdot B$

$\mathcal{E}_H = E_H \cdot d = V_d \cdot Bd$ → d: width of the conductor

27.13 A long copper strip 1.8 cm wide and 1 mm thick is placed in a 1.2 T magnetic field. When a steady current of 15 A passes through it, the hall emf is 1.2μV. Determine the drift velocity of the electrons and the density of free electrons in the copper.



$V_d = \frac{\mathcal{E}_H}{B.d} = \frac{(1.02 \times 10^{-6})}{(1.2T)(1.8 \times 10^{-2})} = 4.7 \times 10^{-5}\ m/s$

$I = n.e.V_d.A$

$n = \frac{I}{e V_d A} = \frac{15}{(1.6 \times 10^{-19})(4.7 \times 10^{-5})(1.8 \times 10^{-2})^2}$

$n = 11 \times 10^{28}\ m^{-3}$

Express

Record :

$$m = \frac{q \cdot B \cdot B' \cdot r}{E}$$

27.14 Carbon atoms of atomic mass 12.0 u are found to be mixed with another, unknown. In a mass spectrometer with fixed B', the carbon traverses a path of radius 22.4 cm and the unknown's path has 26.2 cm radius. What is the unknown element? Assume the ions of both elements have the same charge.

$$m_x = \frac{q B B' r_x}{E}$$

$$m_c = \frac{q B B' r_c}{E}$$

$$\frac{m_x}{m_c} = \frac{r_x}{r_c} = \frac{26.2 \text{ cm}}{22.4 \text{ c}} = 1.17$$

$$m_x = (1.17) m_c = (1.17)(12 \text{ u}) = 14 \text{ u}$$

nitrogen