Physics 112, spring 2016 Exam 2 62 pts

Dr. Jared Workman

Rules

You may use an equation sheet with whatever you want on both sides, you may not use a tablet or a smartphone or a laptop as a calculator. Do not forget to include direction in all answers. This exam will be graded our to 58 points so if you get hung up, move one.

Problems

1) A a circular conductor with 10 turns and a radius of 10cm and a resistance of 10 Ω is placed in a region with no magnetic field. A magnetic field oriented perpendicularly to the plane of the conductor is turned on and reaches a value of 3 teslas over the space of 1ms. The field is coming up and out of the conductor as viewed from above. (24 pts)

A) Calculate the emf induced in the conductor. (5 pts)

B) Calculate the magnitude of the induced current. And the power dissipated in the conductor due to it. (6 pts)

C) Calculate the direction of the induced current and the direction of the induced field (it either swirls out of the page or into the page draw it if you need to). (3 pts)

D) Calculate the torque on the conductor after the field has reached its constant value. (3 pts)

The conductor is now rotated 90 degrees with respect to the external field which is THEN turned off.

E) Calculate the induced EMF induced during this period assuming it still takes 1 ms for the field to reach zero. (2 pts)

F) Calculate the torque on the conductor in this configuration using the average induced current during this period. (3 pts)

G) Calculate the magnitude of the induced current and the direction of the induced current and field. (2 pts)

Extra Credit - Explain to me how you can design a generator and set the current output based on materials used, magnets supplied, and spin rates of the conductor.

Constants

$m_e = 9.1 \times 10^{-31} kg$

$m_p = 1.67 \times 10^{-27} kg$

$|e| = 1.6 \times 10^{-19} C$

$\mu_0 = 4\pi \times 10^{-7} Tm/A$

Exam #2.

1: A) $|\mathcal{E}| = \left|\frac{N\Delta\Phi}{\Delta T}\right| = \frac{10}{1.0\cdot10^{-3}} \cdot \left[3\cdot\pi(.11)^2\right] = 942.48\ V$

3 2 1

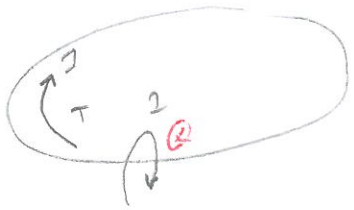
5

B) $\frac{\mathcal{E}}{R} = I = 94.25A$ $P = I^2R = 8.883\cdot10^4 W$

2 1 2 1

6

C)



2 +1 both

D) $\tau = NBIL\sin\theta$ $I=0$ $\theta = 0$ 3

2 2

E) $\theta = 90$ $\mathcal{E} = 0$ 2

1 1 2

F) $\tau = NBIL\sin\theta$ $I=0$ $\mathcal{E}=0$ 3

2 1

24

G.) 0 0 2

1 1

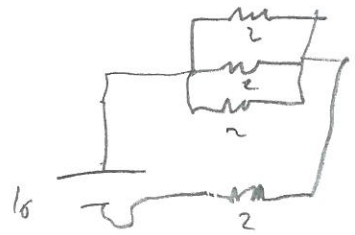
2.)

A). $\frac{1}{R_{eq_{||}}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$

$= \left(\frac{1}{2} + \frac{1}{2} + \frac{1}{2}\right) = \frac{3}{2}$

1

$R_{eq_{||}} = \frac{2}{3}\ \Omega$ 1



5

$R_{eq} = \frac{2}{3} + 2 = \frac{8}{3}\ \Omega$

2

B.) $\Delta V = IR$ 2 $\quad I = \frac{\Delta V}{R} = \frac{16.3}{8} = 6\ Amps$ 2 $\quad$ 3

C.) $2\ \Omega$ Series → $6^2 \cdot 2 = 72\ W$ 1 $\quad I^2R = P$ 2

Current in parallel → $2\ A$ each 2 $\quad P = 18\ W$ 1 $\quad$ 6

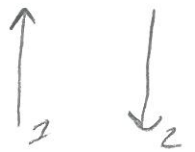
D.) → dimmer 2

E.) → R_{eq} $3\ \Omega$ $I = 4\ A$ $P = 32\ W$ Same 3

14

3: $\vec{F} = \frac{\mu_0 I_1 I_2 \ell \sin\theta}{2\pi d}$ $\theta = 90$ $\frac{\mu_0 I_1 I_2 \ell}{2\pi d} = \frac{2\cdot10^{-7}\cdot(10^2)\cdot 2}{1}$ $N = 2\cdot10^{-5}\,N$

A.) 2 1 1



6

2 2 2

B.) on 2 $2\cdot10^{-5}\,N$ 2

(.) ~~[illegible]~~ 1 can't

D.) $B = \frac{\mu_0 I}{2\pi}\left[-\frac{1}{.25} - \frac{1}{.75}\right] = 5\cdot10^{-6}\,T$

wire 1 wire 2 1

4

$F = qvB = 8.5\cdot10^{-19}\,N$) 1 Left

2 1 2

19