Physics 112, spring 2016 Exam 2 62 pts

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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)

2) Consider the circuit below. (19 pts)

A) Calculate the equivalent resistance of this circuit. (6 pts)

B) Calculate the current drawn by the circuit. (3 pts)

C) Now, calculate the power dissipated in each resistor. (5 pts)

Now, one of the resistors in the parallel portion burns out. Thinking of the resistors as incandescent lightbulbs (and no calculations allowed)

D) How does the brightness of the resistors in the parallel circuit compare to the one in serial? (2 pts)

E) Are the bulbs brighter, dimmer, or the same as they were before the one resistor in parallel burned out? I want an answer for both the serial resistor and the parallel resistor. (3 pts)

3) Two 1 meter wires are each carrying a ten ampere current. The wires are aligned in the north south direction with wire 1's current running to the north and wire 2's current running to the south. The wires are 1 meter apart. (19 pts)

A) What is the force wire 1 exerts on wire 2 and what is it's direction (which direction does wire 2 move)? (7 pts)

B) What is the force wire 2 exerts on wire 1 and what is it's direction (which direction does wire 1 move)? (2 pts)

C) If you were to send a proton towards the north at some location in between the two wires where would you send it relative to wire 1 (how far left or right of wire 1) so that there was no net magnetic force on the proton? (1 pt)

D) A proton is shot vertically upwards 1/4 of a meter to the right of wire 1 at a velocity of $10^6 m/s$. What is the magnitude and direction of the force it experiences? (9 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

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

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

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

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