

Physics 2135 Exam 2

October 20, 2015

Exam Total

/ 200

Printed Name: _____

Rec. Sec. Letter: _____

Five multiple choice questions, 8 points each. Choose the **best** or **most nearly correct** answer.

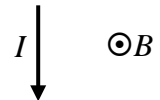
_____ 1. A straight wire segment carries a current I . The wire segment is in a region where there is a uniform magnetic field B as shown. What is the direction of the magnetic force on the wire segment?

[A] \otimes

[B] \leftarrow

[C] \rightarrow

[D] \odot



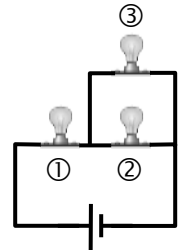
_____ 2. Three identical light bulbs are connected to a battery as shown in the figure to the right. Which light bulb will dissipate the most power?

[A] bulb ①

[B] bulb ②

[C] bulb ③

[D] all three bulbs will dissipate the same power



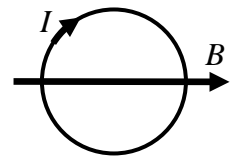
_____ 3. A circular current loop has an area of $A = 200 \text{ cm}^2$ and is oriented so that the plane of the loop is parallel to a constant magnetic field $B = 0.6 \text{ T}$. The magnitude of the torque acting on the current loop is $0.024 \text{ m}\cdot\text{N}$. What is the current I in the loop?

[A] 1 A

[B] 2 A

[C] 4 A

[D] 0 A



_____ 4. A charged particle moves through a region of space that has both a uniform electric field and a uniform magnetic field. In order for the particle to move through this region at a constant velocity,

[A] the electric and magnetic fields must point in the same direction

[B] the electric and magnetic fields must point in opposite directions

[C] the electric and magnetic fields must point in perpendicular directions

[D] the answer depends on the sign of the particle's electric charge.

_____ 5. When will I get a picture of a levitating dog on my Physics 2135 exam?

[A] soon

[B] exam 3

[C] ask Dr. Parris

[D] the answer is always magnetism



6. (40 points total) An air-filled parallel-plate capacitor consists of two square plates of length L and plate separation d . It is charged to an initial voltage V_0 .

(a) (10 points) Calculate the energy U_0 stored in the capacitor in terms of L , d , V_0 , and constants.

(b) (20 points) The capacitor is disconnected from the voltage source. After that, an insulator having a dielectric constant $\kappa > 1$ is inserted between the plates of the capacitor. The dielectric material fills the space between the plates. Find the energy U_1 stored in the capacitor after the dielectric is inserted. Express your answer in terms of L , d , V_0 , κ , and constants.

(c) (10 points) The potential difference V_1 between the capacitor plates after the dielectric has been inserted is (circle one below)

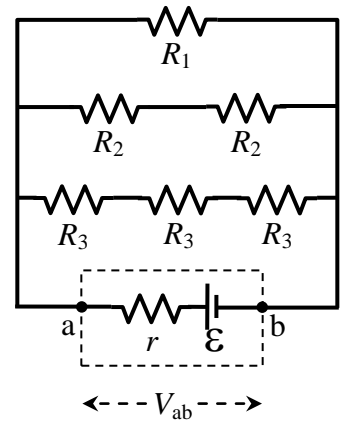
less than V_0

equal to V_0

greater than V_0

7. (40 points total) Consider the circuit shown. The **terminal voltage** of the battery is $V_{ab}=120\text{ V}$.

(a) (20 points) Each resistor dissipates 100W. Calculate R_1 , R_2 , and R_3 . Clearly indicate any OSEs you use.



(b) (10 points) If the battery has an internal resistance of $r = 0.8\ \Omega$, what is its emf?

(c) (10 points) A non-ideal ammeter is connected to measure the current passing through R_1 . How does the power dissipated in R_1 change? (Circle one of the answers below.)

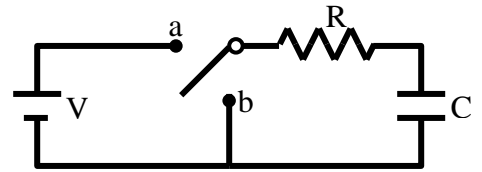
increases

does not change

decreases

_____/40 for page 3

8. (40 points total) In the circuit shown, $R = 50 \text{ k}\Omega$, $V = 25 \text{ volts}$, and $C = 10 \text{ }\mu\text{F}$. The capacitor is initially uncharged.

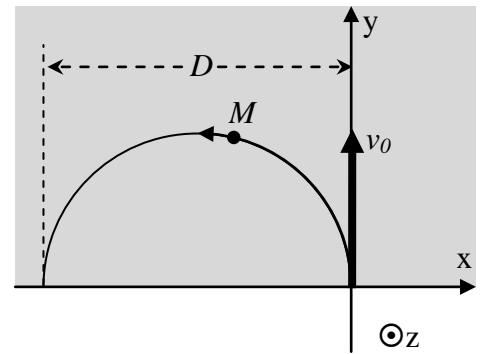


(a) (10 points) What is the initial current through the resistor immediately after the switch is set to position a?

(b) (20 points) What is the voltage across the capacitor 1 second after the switch is set to a?

(c) (10 points) The capacitor is allowed to fully charge. The switch is then set to position b. How much time elapses after the switch is set to position b until the charge stored in the capacitor is equal to one-fourth of its fully-charged value?

9. (40 points total) A particle of mass M and positive charge Q enters a region (indicated by the shaded area) of uniform magnetic field, moving initially with a velocity $\vec{v} = v_0 \hat{j}$. The particle moves in a circular path in the xy -plane and crosses the x -axis at $x = -D$.



(a) (5 points) What is the direction of the magnetic field?

Circle one: $+\hat{k}$ $-\hat{k}$ $+\hat{i}$ $-\hat{i}$

(b) (20 points) Begin with starting equations and calculate the magnitude of the magnetic field. Express your answer in terms of parameters given in the statement of the problem.

(c) (15 points) A second particle of unknown mass having the same charge Q and the same initial velocity $v_0 \hat{j}$ moves in a circular path in the magnetic field region and crosses the x -axis at $x = -0.6 D$. Begin with starting equations or an equation you derived in part (b), and calculate the mass of the second particle. Express your answer in terms of M .

