P196 –FL16 – Test 4A – 11/30/2016

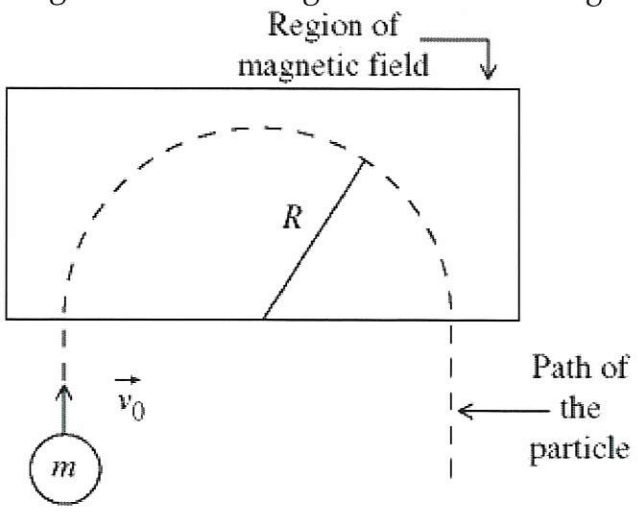
Name: SOLUTIONS

Signature:

RED ID:

Instructions
- This is a closed book examination.
- You can use your own two-sided hand-written formula sheet.
- All questions are multiple choice. Show your work.
- Please write your name, RED ID and sign this paper copy.
- Please write and bubble in your name, RED ID, and test form **A** on the Parscore form.
- Mark your answer both on the paper test and Parscore answer form.
- When finished, show your instructor your exam and give him/her the Parscore answer sheet.

1) (15 points) As shown in the figure, a small particle of charge $q = -9.8 \times 10^{-6}$ C and mass $m = 3.1 \times 10^{-12}$ kg has velocity $v_0 = 5.9 \times 10^{3}$ m/s as it enters a region of uniform magnetic field. The particle is observed to travel in the semicircular path shown, with radius $R = 5.0$ cm. The magnitude of the magnetic field in the regiom is



A) 0.075 T
B) 0.025 T
C) 0.037 T
D) 0.051 T
E) 0.092 T

$$\frac{mv^2}{R} = qvB \Rightarrow B = \frac{mv}{qR} = 0.037\,\text{T}$$

$$=$$

2) (15 points) A circular coil of wire of 200 turns and diameter 2.0 cm carries a current of 4.0 A. It is placed in a magnetic field of 0.70 T with the plane of the coil making an angle of 30° with the magnetic field. What is the magnetic torque on the coil?

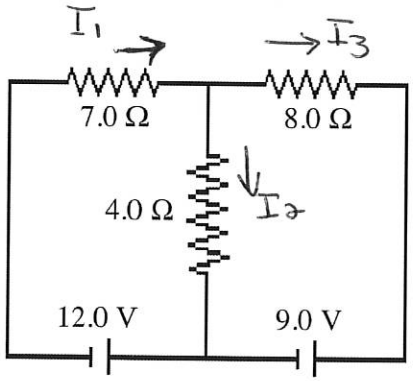
A) 0.40 N • m
B) 0.088 N • m
C) 0.15 N • m
D) 0.076 N • m
E) 0.29 N • m

$\mu = NIA = 200 \times 4 \times \pi \times (0.01)^2 = 0.251$

$\vec{\tau} = \vec{\mu} \times \vec{B}$

$|\vec{\tau}| = \mu B \sin\theta = 0.251 \times 0.7 \times \sin 30^\circ = 0.088\ N \cdot m$

3) (20 points) For the circuit shown in the figure, the current in the 8.0-Ω resistor is



$I_1 = I_2 + I_3$ (1)

LL:
$-7I_1 - 4I_2 - 12 = 0$
$I_2 = -1.75 I_1 - 3$ (2)

outer loop:
$-7I_1 - 8I_3 - 9 - 12 = 0$
$I_3 = -0.88 I_1 - 2.6$ (3)

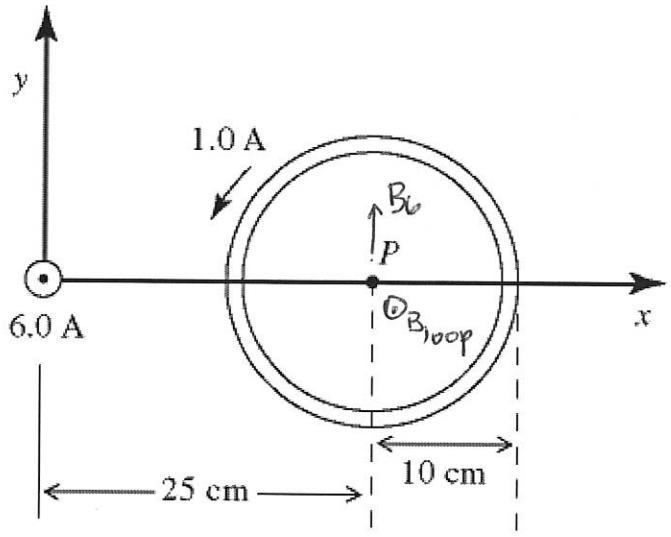
A) 0.30 A
B) 1.54 A
C) 2.25 A
D) 0.86 A
E) 1.25 A

(1) $I_1 = -1.75 I_1 - 3 - 0.88 I_1 - 2.6$

$I_1 = -1.54\ A$

(3) $I_3 = -0.88(-1.54) - 2.6 = -1.25\ A$

4) (20 points) A long straight wire on the z-axis carries a current of 6.0 A in the positive direction. A circular loop in the xy-plane, of radius 10 cm, carries a 1.0-A current, as shown in the figure. Point P, at the center of the loop, is 25 cm from the z-axis. An electron is projected from P with a velocity of 1.0×10^6 m/s in the negative x-direction. The magnitude of the y component of the force on the electron is ($e = 1.60 \times 10^{-19}$ C, $\mu_0 = 4\pi \times 10^{-7}$ T • m/A)



A) 1.0×10^{-18} N
B) 5.0×10^{-18} N
C) 3.0×10^{-18} N
D) 4.0×10^{-18} N
E) 2.0×10^{-18} N

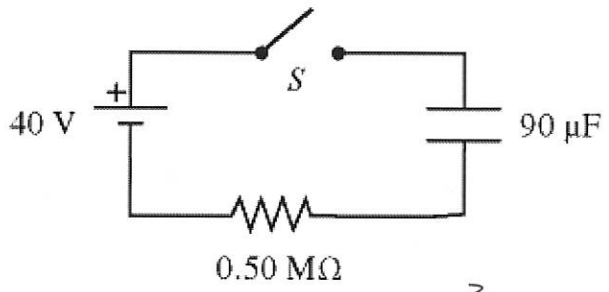
$B_6 = \frac{\mu_0 I}{2\pi r}\hat{j}$ (doesn't contribute to F_y)

$B_{loop} = \frac{\mu_0 I}{2R}\hat{k} = 6.28 \times 10^{-6}\hat{k}$

$|\vec{F}_y| = q|\vec{v} \times \vec{B}| = 1.6 \times 10^{-19} \times 10^6 \times 6.28 \times 10^{-6} \times \sin 90^\circ$

$= 1.0 \times 10^{-18}$ N

5) (15 points) For the circuit shown in the figure, the switch S is initially open and the capacitor is uncharged. The switch is then closed at time $t = 0$. How many seconds after closing the switch will the energy stored in the capacitor be equal to 50.2 mJ?



A) 97 s
B) 130 s
C) 110 s
D) 81 s
E) 65 s

$U = \frac{1}{2}CV^2 = 50.2\times10^{-3} \Rightarrow V = \sqrt{\frac{2U}{C}} = 33.4\,V$

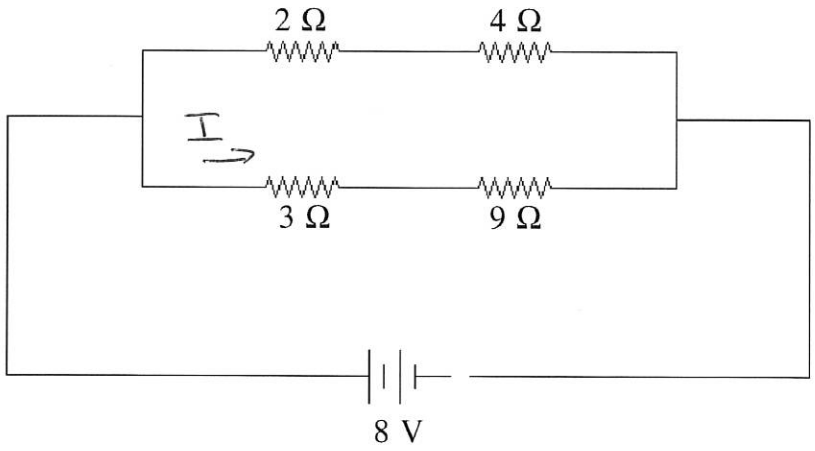
$V_0 = 40\,V$

$V = V_0[1 - e^{-t/RC}] \Rightarrow 1 - e^{-t/RC} = 0.835$

$e^{-t/RC} = 0.165 \Rightarrow \frac{t}{RC} = 1.802 \Rightarrow t = 1.802 \times 0.5\times10^{6}\times90\times10^{-6}$

$= 81\,s$

6) (15 points) Four resistors are connected across an 8-V DC battery as shown in the figure. The power dissipated in the 9-Ω resistor is closest to



A) 1.4 Watts
B) 5.3 Watts
C) 4.0 Watts
D) 2.8 Watts
E) 0.7 Watts

$I = \frac{8}{12} = 0.667\,A$

$P_9 = RI^2 = 9\times(0.667)^2 = 4\,Watts$

7) What color is this exam?
A) white
B) yellow