Physics 2145 Spring 2022 Test 3 (4 pages)

Name:_________________ April 20, 2022 Total Score:_________/120__

$\vec{F} = q\vec{E}$ $\Delta V = Ed$ electron $m_e = 9.11 \times 10^{-31}$ kg $e = 1.602 \times 10^{-19}$ C $\mu_0 = 4\pi \times 10^{-7}$ Tm/A

$F = qvB\,sin\theta$ $F = ILB\,sin\theta$ $B = \frac{\mu_o I}{2\pi r}$ $B = \frac{\mu_o I}{2R}$ $B = \frac{\mu_o N I}{L}$ $\tau = IAB\sin\theta$

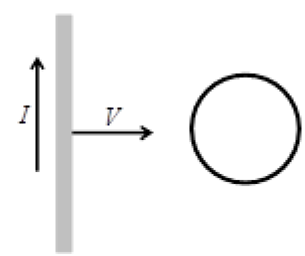
$\Phi = AB\cos\theta$ $\varepsilon = \left|\frac{\Delta\Phi}{\Delta t}\right|$ $V = IR$ $P = IV = \frac{V^2}{R} = I^2R$ $a_c = \frac{v^2}{R}$

_____1. (5) If you were to cut a small permanent bar magnet in half,
A) one piece would be a magnetic north pole and the other piece would be a south pole.
B) neither piece would be magnetic.
C) each piece would in itself be a smaller bar magnet with both north and south poles.
D) one half would have positive charge, the other would have negative charge.

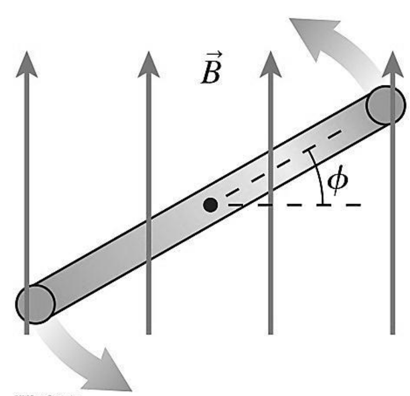
_____2.(5). A long solenoid of length L, N windings, and a certain radius carries a current. If the radius of the solenoid were doubled and all other quantities remained the same, the magnetic field magnitude would

A) remain the same B) double C) halve D) decrease by a factor of 4

___3. (5) A wire carrying a constant current I is moved toward a conducting loop with speed V as shown. The direction of the induced current in the loop is
A) clockwise B) out of the page
C) there is no induced current D) counterclockwise



____4. (5) A circular current loop rotates about an axle through its center. The figure shows a side view. The loop is in an external magnetic field that points towards the top of the page. Which of the following is **false**?
A) At angle Φ =0 the magnetic flux is zero and the torque is maximum.
B) At angle Φ =0 the magnetic flux is maximum and the torque is zero.
C) At angle Φ =90º the magnetic flux is zero and the torque is maximum.
D) The net force on the current loop is zero for any angle Φ.



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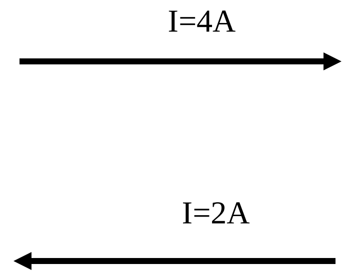
5. (30) Two parallel straight wires of length 40cm are 0.5cm apart. The upper wire carries a current of 4.0A to the right. The lower wire carries a current of 2.0 A to the left, as shown in the figure.



a) (10) Calculate the magnitude of the magnetic field of the upper wire at the location of the lower wire.

b) (5) What is the direction of the magnetic field of the upper wire at the location of the lower wire?

c) (10) Calculate the magnitude of the force the upper wire exerts on the lower wire.

d) (5) What is the direction of the force the upper wire exerts on the lower wire?

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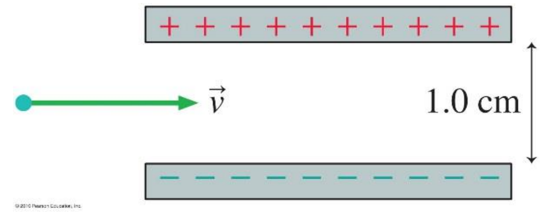
6. (15) An electron travels with speed 2×10^7 m/s between the two parallel charged plates shown in the figure. The plates are a distance 1.0cm apart and are charged to some potential difference. A magnetic field of magnitude 3 mT is directed perpendicular to the electron's motion and perpendicular to the direction of the electric field.



a) (10) Derive a symbolic expression and calculate a numerical answer for the potential difference between the plates for which the electron emerges undeflected.

b) (5) What is the direction of the magnetic field that allows the electron to pass undeflected?

Circle one: $\rightarrow$ $\leftarrow$ $\uparrow$ $\downarrow$ $\otimes$ $\odot$

7. (15) An ion with charge +e and speed of $v = 1.5\times10^5$ m/s is **moving to the left.** It enters a region of uniform magnetic field $B_1 = 2$ T directed **out of the page** which causes it to move in a circle of radius $2\text{x}10^{-6}$ m

a) (10) Derive a symbolic expression and calculate a numerical value for the mass of the ion.

b) (5) What is the initial deflection of the ion in part a?

Circle one: $\rightarrow$ $\leftarrow$ $\uparrow$ $\downarrow$ $\otimes$ $\odot$

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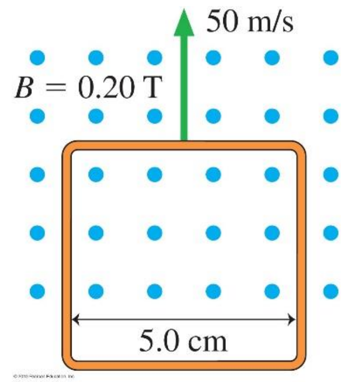
8. (20) The loop in the figure is being pushed into a 0.20 T magnetic field at 50m/s.



a)(5) What is the direction of the induced current? Circle the correct answer.

Clockwise Counter- clockwise

b) (15) Calculate the induced emf. Begin with Faraday's law and show all work.

9.(20) A circular loop of 10cm diameter with a resistance of 0.1Ω is in a magnetic field that points **out of the page**. The induced current is counterclockwise and has a magnitude of 40mA.

a) (5) Calculate the induced emf.

a) (5) Is the magnetic field increasing or decreasing?

b) (10) Find the rate of change of the magnetic field, $\Delta B/\Delta t$.

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