PHY 102 Quiz #3 Name _____

Score _____

Instructions:
1. Do all of your work on this sheet.
2. **Show all of your steps** in problems for full credit.
3. **Be clear and neat** in your work. Any illegible work, or scribbling in the margins, will not be graded.
4. Place your **answers in a box.**
5. If you need more space, you may use the back of the page and write **On back** in the problem space.

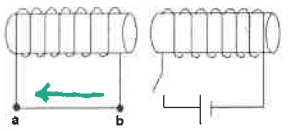
1. **Multiple Guess (3 pts)** Find the answer which best fits the question and write it in the space provided.

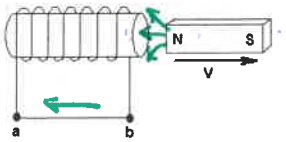
a. Two straight wires that are parallel to each other are carrying currents in opposite directions. What happens to the wires?
a) They stop carrying current because the current directions cancel each other out.
b) Nothing happens. c) They repel each other.
d) They attract each other. C

b. If the B-field points into your paper and a positive charge moves from right to left in this field, then the force is directed
a) towards the bottom; b) out of the paper;
c) into the paper; d) to the left; e) none of these. a

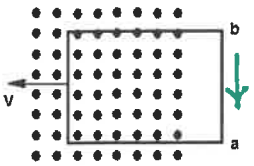
c. A motor
a) converts electrical energy into heat energy.
b) converts heat energy into mechanical energy.
c) converts electrical energy into mechanical energy.
d) converts mechanical energy into electrical energy.
e) converts nuclear energy into heat energy. C

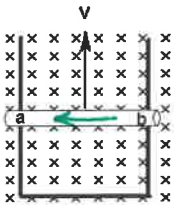
2. **Definition/Principle (5 pts)**
a. In the following closed loops, indicate the direction of the induced current by an arrow between points a and b.



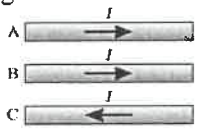


(as switch is closed)





b. Three long, equally spaced, straight wires are carrying currents that have the same magnitude. Which wire experiences the largest net force? B



Constants $m_e = 9.11\times10^{-31}$ kg, $m_p = 1.67\times10^{-27}$ kg, $\mu_0 = 4\pi\times10^{-7}$ Tm/A

3. **Problems (12 pts)**
a. An electron moves 5.6×10^7 m/s East through a 1.4 T magnetic field which points North. What is the force on the electron?

$F = qvB = 1.6\times10^{-19}(5.6\times10^{7})1.4$
$= \boxed{1.3\times10^{-11}\text{ N}}$

b. A wire of length 6.28 m is used to make a circular loop. A current of 0.5 A is applied to the loop. What is the magnetic field at the center of the coil?

$B = \frac{\mu_0 I}{2R} = \frac{4\pi\times10^{-7}(.5)}{2(1)} = \boxed{3.1\times10^{-7}\text{ T}}$

c. A magnetic field has a magnitude of 0.078 T and is uniform over a circular surface that has a radius of 0.10 m. The field is oriented at an angle of 25° with respect to the surface normal. What is the magnetic flux?

$\Phi = BA\cos\theta$
$= (.078)(\pi(.1)^2)\cos 25$
$= \boxed{2.2\times10^{-3}\text{ Tm}^2}$

d. A 30 cm long conducting rod on a conducting rail moves perpendicular to a 0.25 T magnetic field at 2.0 cm/s. If the resistance in the wire is 0.05 Ω, then what is the current in the rod?

$\mathcal{E} = vBL = (.02)(.25)(.3) = 1.5\times10^{-3}\text{ V}$

$I = \frac{\mathcal{E}}{R} = \boxed{.03\text{A}}$

Bonus. A proton beam passes through a velocity selector and the protons are rerouted by a magnetic field.
i. If $E = 100.0$ V/m and $B = 0.50$ T. What is the velocity of the protons that do not get deflected?

$v = \frac{E}{B} = \boxed{200\text{ m/s}}$

ii. What is the radius of the circular path that the protons follow in the magnetic field?

$r = \frac{mv}{qB}$
$= \frac{1.67\times10^{-27}}{1.6\times10^{-19}}\frac{200}{.5}$
$= \boxed{4.2\times10^{-6}\text{ m}}$