(5 pts) **Problem 1.** How much current will be flowing through a 21.0 m length of copper wire with radius 2.1 mm if it is connected to a source supplying 39.0 V? (The resistivity of copper is $1.68 \times 10^{-8} \Omega \cdot m$.

(a) $1500$ A  
(b) $23 \times 10^8$ A  
(c) $320$ nA  
(d) $910$ A  

(1530.75 A)

(5 pts) **Problem 2.** What is the equivalent resistance of the combination illustrated in the figure?

(a) $150\Omega$  
(b) $45.8\Omega$  
(c) $58.7\Omega$  
(d) $123\Omega$

(5 pts) **Problem 3.** Alpha particles (with charge $+2e$ and mass $6.68 \times 10^{-27}$ kg) are accelerated in a cyclotron to a final orbit of radius $0.30m$. The magnetic field of the cyclotron is $0.50T$. The kinetic energy of the alpha particles in the final orbit is closest to

(a) $1.1 \text{ MeV}$  
(b) $0.92 \text{ MeV}$  
(c) $1.2 \text{ MeV}$  
(d) $1.4 \text{ MeV}$  
(e) $1.6 \text{ MeV}$
(5 pts) **Problem 4.** A negatively charged particle is moving to the right directly above a wire having a current flowing to the right as shown in the figure. In which direction is the magnetic force exerted on the particle?

(a) into the page;
(b) out of the page;
(c) downward;
(d) upward;
(e) the magnetic force is zero since the velocity is parallel to the current.

\[ -Q \quad \rightarrow \quad V \]

\[ \rightarrow I \]

(5 pts) **Problem 5.** As shown in the figure, a bar magnet moves away from the solenoid. The induced current through the resistor \( R \) is

(a) zero
(b) from a to b
(c) from b to a
(d) not possible to determine with these data

\[ V \rightarrow [N S] \]

\[ R \]

\[ a \quad b \]

On the following problems show all your work. Partial credit will be given if earned.

(30 pts) **Problem 6.** An uncharged 6.00\( \mu F \) capacitor is connected in series with a 75.0\( \Omega \) resistor and a 12.0V battery having negligible internal resistance. Find

a) the time constant of the circuit;(10pts)
b) the maximum charge the capacitor plates will receive; (10pts)

c) sketch a graph of the current as a function of time. (10pts)

(30 pts) **Problem 7.** An ideal toroidal solenoid containing 825 equally spaced coils is shown in the figure.

a) How large must the current $I$ be so that the magnetic field within the coils at a distance of 17.0 cm from the center is 0.0250$T$? (15pts)

b) What is the magnetic field strength in the region outside the coils? (15pts)

(15 pts) **Problem 8.** A small circular ring is inside a larger loop that is connected to a battery and a switch, as shown in the figure. Use Lenz’s law to find the direction of the current induced in the small ring.

a) just after switch $S$ is closed; (5pts)

b) after $S$ has been closed for a long time; (5pts)

c) just after $S$ has been reopened after being closed for as long time. (5pts)
6. (a) Time Constant \( I = \frac{V}{RC} \)

\[
= 75.00 \times 6.00 \times 10^{-6} \text{s} \\
= 4.5 \times 10^{-4} \text{s}
\]

(b) \( Q = CV = 6.00 \times 10^{-6} \text{F} \times 12 \text{V} \)

\[
= 7.2 \times 10^{-5} \text{C}
\]

(c) \[I = I_0 e^{-\frac{t}{RC}}\]

7. (a) \( B = 0.0250 \text{T} \) \( N = 825 \)

\[
B = \frac{\mu_0 NI}{2\pi r} \Rightarrow I = \frac{2\pi r B}{\mu_0 N} = \frac{2 \times 3.14 \times 0.17 \times 0.0825}{4 \times 10^{-7} \times 825} \text{T} \\
\]

\[
= 25.8 \text{A}
\]

(b) \( B_{\text{outside}} = 0 \)
Problems.

(a) Clockwise

(b) No current induced

(c) Counter-clockwise