Answer Key

ÇANKAYA UNIVERSITY
MATHEMATICS AND COMPUTER SCIENCE DEPARTMENT

PHYS 122 General Physics II
Second Midterm Examination
26.04.2011

NAME: Surname
NUMBER
DEPARTMENT
SECTION
SIGNATURE

TOTAL NUMBER OF QUESTIONS: 4

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<th>Questions</th>
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IMPORTANT:
1) Write your name and department.
2) Check that there are 4 questions.
3) Show all your work. Correct answers without the intermediate steps may not get credit.
Show that, according to the free-electron model of electrical conduction in metals and classical physics, the resistivity of metals should be proportional with $\sqrt{T}$, where $T$ is the temperature in kelvins.

Explain clearly your answer.

\[
p = \frac{m}{e^2 n z}, \quad \rho \approx z^2 \approx \nu_{eff}
\]

\[
\nu_{eff} \approx \sqrt{T}, \quad \rho \approx \sqrt{T}
\]
(a) Calculate the current through each ideal battery in Figure 1. Assume that $R_1 = 1.0 \, \Omega$, $R_2 = 2.0 \, \Omega$, $E_1 = 2.0 \, V$, and $E_2 = E_3 = 4.0 \, V$.

(b) Calculate $V_a - V_b$.

Explain clearly your answer.

\[ i_a = i_2 + i_3 \]

**Loop 1:**
\[ E_1 - 2i_1 R_1 - i_2 R_2 - E_2 = 0 \]

**Loop 2:**
\[ E_2 + i_2 R_2 - 13i_1 + E_3 - i_3 R_3 = 0 \]

\[ i_1 = \frac{2}{3} \, A, \quad i_2 = -\frac{5}{3} \, A, \quad i_3 = \frac{7}{3} \, A \quad \text{and} \quad i_2 \text{ has opposite direction} \]

\[ V_a + i_2 R_2 - E_2 = V_b \]

\[ V_a - V_b = 4 - 2 \cdot \frac{5}{3} = \frac{3}{5} \, V \]
An electron is accelerated from rest by a potential difference of $V_0$. It then enters a uniform magnetic of magnitude $B_0$ with its velocity perpendicular to the field. Calculate:

a) the speed of the electron.
b) the radius and its path in the magnetic field.

Explain clearly your answer.

\[
\frac{1}{2}m_e v^2 = \frac{eV_0}{m_e}
\]

\[
v = \sqrt{\frac{2eV_0}{m_e}}
\]

\[|e| V B_0 = \frac{m_e v^2}{r}
\]

\[
r = \frac{|e| B_0}{m_e \sqrt{\frac{2eV_0}{m_e}}}
\]
A solenoid has length $L = 1.23 \text{ m}$ and inner diameter $d = 3.55 \text{ cm}$, and it carries a current $I = 5.57 \text{ A}$. It consists of five close-packed layers, each with 850 turns along length $L$. What is $B$ at its center?

Explain clearly your answer.

\[ B = \mu_0 n I \]

\[ B = \left(4\pi \times 10^{-7} \text{T} \cdot \text{m/A}\right) \left(5 \times 850 \text{turns} \right) \frac{5 \times 850 \text{turns}}{1.23 \text{m}} \]

\[ B = 2.42 \times 10^{-2} \text{T} = 24.2 \text{ mT} \]