Physics 227 - Second Common Hour Exam
November 13, 2005
Prof. Coleman

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Your name sticker with **exam code**

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Your signature ______________________________

Turn off and put away cell phones now!

1. The exam will last from 3:00 PM to 4:20 PM. Use a #2 pencil to make entries on the answer sheet. Enter the following ID information now, before the exam starts.

2. In the section labeled NAME (Last, First, M.I.) enter your last name, then fill in the empty circle for a blank, then enter your first name, another blank, and finally your middle initial.

3. Under STUDENT # enter your 9-digit student ID.

4. Enter 227 under COURSE, and your section number (see label above) under SEC.

5. Under CODE enter the exam code given above.

6. During the exam, you may use pencils, a calculator, and one **handwritten** 8.5 x 11 inch sheet with formulas and notes, without attachments.

7. There are 16 multiple-choice questions on the exam. Mark only one answer on the answer sheet. There is no deduction of points for an incorrect answer, so even if you cannot work out the answer to a question, you should make an educated guess. **At the end of the exam, hand in the answer sheet and the cover page.** Retain this question paper for future reference and study.

8. When you are asked to open the exam, make sure that your copy contains all 16 questions. Raise your hand if this is not the case, and a proctor will help you. Also raise your hand during the exam if you have a question.

9. Please SIGN the cover sheet under your name sticker and have your student ID ready to show to the proctor during the exam.

Some possibly useful information:

c = speed of light = 3.00×10^8 m/s

$q_e = -e$ = charge on an electron = -1.602×10^{-19} Coulombs

$q_p = +e$ = charge on a proton = $+1.602 \times 10^{-19}$ Coulombs

m_e = electron mass = 9.11×10^{-31} kg

m_p = proton mass = 1.67×10^{-27} kg

$k_e = 8.99 \times 10^9\ \mathrm{N \cdot m^2/C^2}$

$\epsilon_0 = 8.85 \times 10^{-12}\ \mathrm{C^2/N \cdot m^2}$

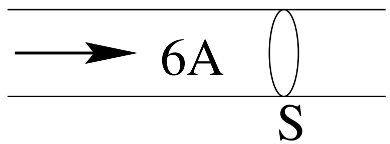
$\mu_0 = 4\pi \times 10^{-7}\ \mathrm{T \cdot m/A}$

$g = 9.80\ \mathrm{m/s^2}$

1 mC = 10^{-3} C　　1 μC = 10^{-6} C

1 nC = 10^{-9} C　　1 pC = 10^{-12} C

1. In the piece of copper wire shown in the figure, a current of 6A flows from left to right. The perpendicular cross-section of the wire is S. Which is correct?

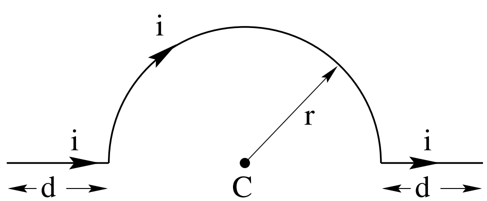


   a. electrons only cross S from left to right.
   b. electrons cross S in both directions but more cross from right to left than the other way.
   c. every electron in the wire moves with a speed of 100 km/s.
   d. the electrons in the wire all move to the right with a speed of 0.1mm per second.
   e. electrons cross S in both directions but more cross from left to right than the other way.

2. A thin copper wire of 0.20 mm diameter carries a current of 2 A. Copper has a density of 8.4×10^{28} free electrons per m^3. What is the drift speed of the electrons?

   a) 6.06×10^3 m/sec
   b) 2.1×10^6 m/sec
   c) 6.11×10^{-4} m/sec
   d) 4.7×10^{-3} m/sec
   e) 1.48×10^5 m/sec

3. The wire shown carries a current i. The magnetic field at C is



   a) $\mu_0 i/4r + \mu_0 i/d$
   b) $\mu_0 i/2\pi r$
   c) $\mu_0 i/2r$
   d) $\mu_0 i/4r + 2\mu_0 i/d$
   e) $\mu_0 i/4r$

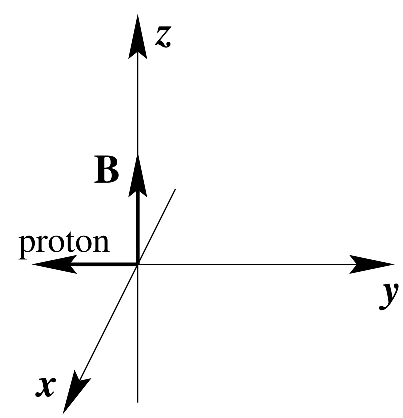
4. A circuit consists of a battery (without internal resistance) and a resistor whose resistance is R. The power dissipated in the resistor is P.
   A second resistor whose resistance is also R is now connected in series with the first resistor, and the pair is connected across the battery.
   The total power dissipated is now

   a) $4P$
   b) P
   c) $P/4$
   d) $2P$
   e) $P/2$

5. A proton (charge $= +e$; mass $= m_p$) and a deuteron (charge $= +e$; mass $\approx 2m_p$) have the **same** kinetic energy. They enter a magnetic field, and both move in circular paths. How are the radii of the paths related?

   a) $r_d = 2r_p$ b) $r_d = \sqrt{2}r_p$ c) $r_d = r_p$
   d) $r_d = r_p/\sqrt{2}$ e) $r_d = r_p/2$

6. A proton is traveling in the negative y-direction. It enters a uniform magnetic field pointing in the positive z-direction. The force on the proton is in the

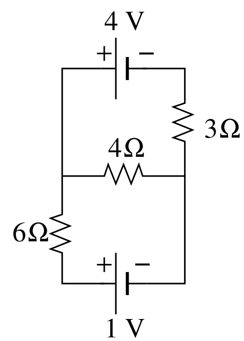


   a) positive x-direction
   b) positive y-direction
   c) negative z-direction
   d) negative x-direction
   e) positive z-direction

7. A copper wire of radius 1 mm carries a current of 10 A. What is the magnetic field inside the wire, at a distance 0.5 mm from the axis of the wire?

a) 0.001 T b) 0 T c) 0.002 T
d) 5×10^{-4} T e) 10^{-6} T

8. What is the current through the 4 Ω resistor?



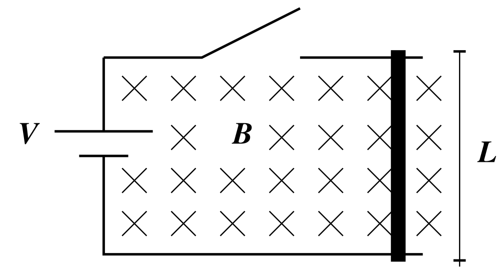
a) 0.125 A
b) 1.25 A
c) 1 A
d) 0.75 A
e) 0.5 A

9. Gold has a resistivity of 2.44×10^{-8} Ω· m. If the electric field in a piece of gold wire is 0.5 V/m, what is the current density?

a) (2.0×10^7) A/m^2
b) (1.2×10^{-8}) A/m^2
c) (4.9×10^{-8}) A/m^2
d) (8.2×10^7) A/m^2
e) (3.2×10^3) A/m^2

10. A metal bar of mass 1 kg, length $L = 50$ cm, and resistance 0.1 Ω is lying across two wires as shown. When the switch is closed, the circuit is completed and the 9-Volt battery causes current to flow through the bar. If there is a magnetic field $B = 0.1$ T pointing into the page, what is the acceleration of the bar (neglecting gravity)?

a) 4.5 m/s^2 to the right
b) 4.5 m/s^2 to the left
c) 0 m/s^2
d) 450 m/s^2 to the right
e) 450 m/s^2 to the left



11. A 60-watt light bulb carries a current of 0.5 ampere. The total charge passing through it in one hour is:

a) 120 C
b) 3600 C
c) 3000 C
d) 2400 C
e) 1800 C

12. A resistance of 1 MΩ is in series with a 1 μF capacitor, a switch and a 200 V power-supply. The capacitor is uncharged, and the switch is suddenly closed. What will the current through the resistor be three seconds later?

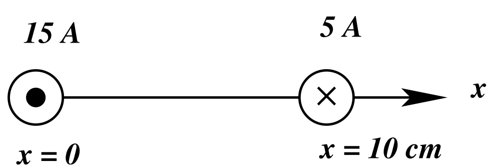
a) 9.95 μA b) 190.43 μA c) 0.2 μA
d) 25 μA e) Essentially zero

13. A static magnetic field CANNOT:

a) change the kinetic energy of a charge
b) accelerate a charge
c) change the momentum of a charge
d) exert a force on a charge
e) exist

14. Two very long parallel wires are positioned at $x = 0$ and $x = +10$ cm. The wire at $x = 0$ is carrying 15 A of current out of the paper, while the wire at $x = +10$ cm is carrying 5 A of current into the paper. At what point along the x axis is the magnetic field B equal to zero (other than $x = \pm\infty$)?

a) +5 cm
b) +7.5 cm
c) +15 cm
d) +25 cm
e) no solution other than $\pm\infty$



15. A current passes through a conductor at right angles to an applied magnetic field $\vec{B}$. If the carriers are negatively charged, which of the figures below correctly represents the deflection of the carriers and the generation of an electric field $\vec{E}$?