# Physics 227– Exam II
November 14, 2007
Prof. Coleman and Prof. Rabe

Your name sticker

with exam code ⇒

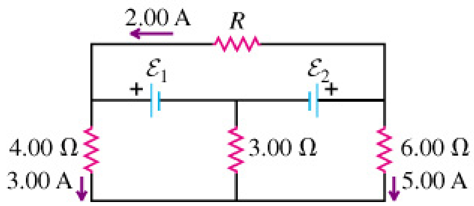
**SIGNATURE:** ________________

1. The exam will last from 9:40 p.m. to 11:00 p.m. 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 labelled 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 Identification Number.
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. For each question, 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.** A proctor will check your name sticker and your student ID sometime during the exam. Please have them ready.

## Useful Information

c = speed of light = $3.00 \times 10^8$ m/s
$q_e = -e$ = charge on an electron = -$1.602 \times 10^{-19}$ Coulombs
$q_p = +e$ = charge on a proton = $+1.602 \times 10^{-19}$ Coulombs
$m_e$ = electron mass = $9.11 \times 10^{-31}$ kg
$m_p$ = proton mass = $1.67 \times 10^{-27}$ kg
$k = 9 \times 10^9$ N m$^2$/C$^2$
$\epsilon_0 = 8.85 \times 10^{-12}$ C$^2$/(Nm$^2$)
$\mu_0 = 4\,\pi \times 10^{-7}$ T m/A
$g = 9.80$ m/s$^2$
1 $eV = 1.602 \times 10^{-19}$ J
1 mC = $10^{-3}$ C    1 $\mu$C = $10^{-6}$ C
1 nC = $10^{-9}$ C    1 pC = $10^{-12}$ C

1. In the circuit shown, the current in the 3.00 Ω resistor is




a) 3.00 A
b) 4.00 A
c) 5.00 A
d) 8.00 A
e) impossible to determine from given information

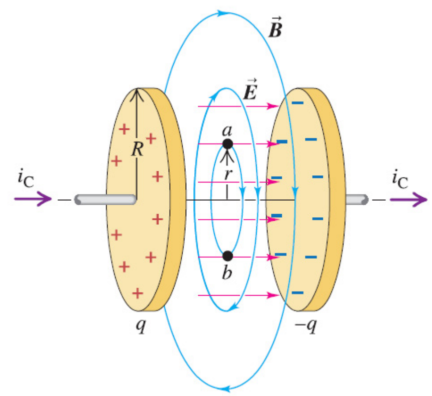
2. A long solenoid has 15 turns per centimeter. What current must we put through its windings if we wish to achieve a magnetic field of $5.0 \times 10^{-2}$ T in its interior?

a) 77 A
b) 12 A
c) 333 A
d) 27 A
e) 135 A

3. A 12.0 $\mu$F capacitor is charged to a potential of 50.0 V and discharged through a 175 Ω resistor. How long does it take the capacitor to lose half its charge?

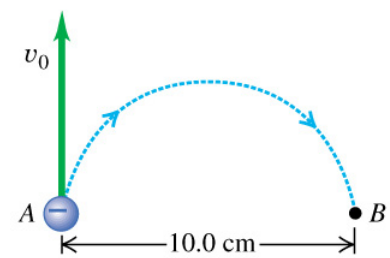
a) $2.1 \times 10^{-3}$ s
b) $1.5 \times 10^{-3}$ s
c) $3.0 \times 10^{-3}$ s
d) 0.29 s
e) $3.0 \times 10^{-4}$ s

4. A current $i_C = 10$ A charges a capacitor of radius R = 10 cm, as shown in the figure. What is the induced magnetic field $B$ at its outer rim?




a) $2 \times 10^{-5}$ T
b) $2 \times 10^{2}$ T
c) $10^{5}$ T
d) 15.9 T
e) $1.13 \times 10^{6}$ T

5. An electron at point A in the figure has a speed $v_0$ of $1.4 \times 10^{6}$ m/s. Recall that the electron mass is $9.1 \times 10^{-31}$ kg and the electron charge is $-1.6 \times 10^{-19}$ C. For the electron to follow the semicircular path of radius 5.0 cm from A to B, the magnetic field must be



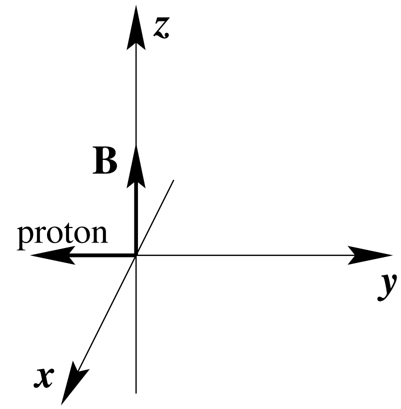

a) zero
b) $1.6 \times 10^{-4}$ T, out of the page
c) $8.0 \times 10^{-5}$ T, out of the page
d) $1.6 \times 10^{-4}$ T, into the page
e) $8.0 \times 10^{-5}$ T, into the page

6. Which of the following statements about a current loop in a uniform magnetic field is FALSE?
   a) The net force on the loop is zero.
   b) The torque on the loop is zero when the field is perpendicular to the plane of the loop.
   c) The magnetic moment of the loop increases with the current in the loop.
   d) The potential energy of the loop is highest when the magnetic moment is in the same direction as the field.
   e) The direction of the magnetic moment is perpendicular to the plane of the loop.

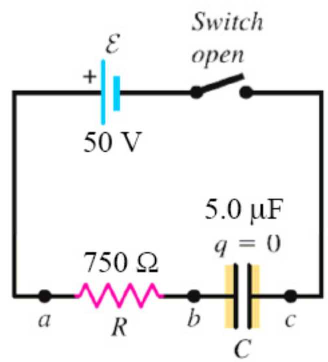
7. A long straight wire of superconducting niobium, $2 \times 10^{-3}$ m in **diameter**, carries a current of 1900 A. What is the magnitude of the magnetic field just outside the wire?
   a) 2.4 T
   b) 1.2 T
   c) 0.19 T
   d) 3.8 T
   e) 0.38 T

8. Which of the following is **FALSE**?
   a) A superconductor is a perfect diamagnet.
   b) Diamagnets are attracted to regions of high field.
   c) A paramagnet concentrates field lines within it.
   d) The magnetization of a diamagnet is directed in the opposite direction to an applied field.
   e) The magnetization of a paramagnet is proportional to the applied field.

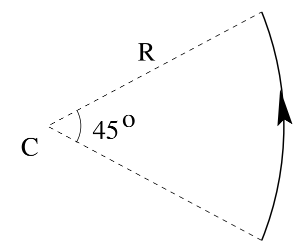
9. A proton is traveling in the negative $y$-direction. It enters a uniform magnetic field pointing in the positive $z$-direction. The force on the proton is in the
   a) positive $x$-direction
   b) positive $y$-direction
   c) negative $z$-direction
   d) negative $x$-direction
   e) positive $z$-direction



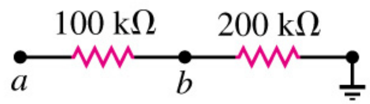

10. Consider the circuit in the figure. The capacitor is initially uncharged. Just after the switch is closed, the current through the resistor is
   a) $2.5 \times 10^{-4}$ A
   b) 250 A
   c) $1.2 \times 10^{-2}$ A
   d) 10 A
   e) $6.7 \times 10^{-2}$ A




11. A segment of a wire is in the shape of an arc of a circle of radius R, and carries current I in the direction shown. The arc subtends a 45° angle. What is the contribution to the magnetic field at the center C by the current in this arc?
   a) $\mu_0$ I/4R out of the paper
   b) $\mu_0$ I/4R into the paper
   c) $\mu_0$ I/2R into the paper
   d) $\mu_0$ I/16R into the paper
   e) $\mu_0$ I/16R out of the paper



12. Point $a$ in the figure is maintained at a constant potential of 600 V above ground. When connected between point $b$ and ground, the reading of a voltmeter with resistance 200 kΩ is

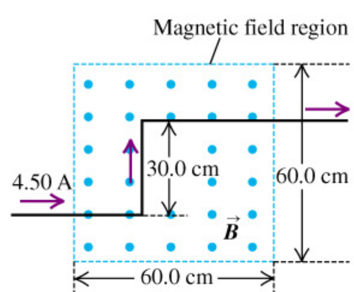



a) 300 V
b) 400 V
c) 200 V
d) 480 V
e) 120 V

13. A circular area with a radius of 6.0 cm lies in the xy-plane. If there is a uniform magnetic field $\vec{B} = 1.2\ \mathrm{T}\ \hat{\imath} + 0.8\ \mathrm{T}\ \hat{\jmath} + 2.0\ \mathrm{T}\ \hat{k}$, the magnitude of the magnetic flux through the circle is

a) zero  b) $1.4 \times 10^{-2}$ Wb  c) $9.0 \times 10^{-3}$ Wb
d) $2.3 \times 10^{-2}$ Wb  e) $4.5 \times 10^{-2}$ Wb

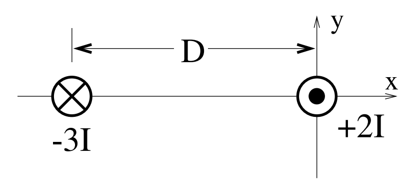
14. A long wire carrying 4.5 A of current makes two 90° bends, as shown in the figure. The bent part of the wire passes through a square region of space where the magnetic field is 1.0 T, pointing out of the page. The force exerted by the magnetic field on the wire is



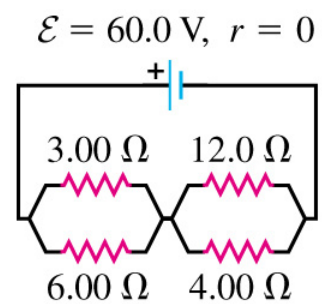

a) up and to the right
b) up and to the left
c) down and to the right
d) down and to the left
e) zero

15. At $x = 0$, a long straight wire carries current $2I$ **out** of the plane of the paper. At $x = -D$, another long straight wire carries current $3I$ **into** the plane of the paper. What is the direction of the force on the wire at $x = -D$?

a) in the positive $x$-direction
b) in the negative $x$-direction
c) in the positive $y$-direction
d) in the negative $y$-direction
e) none of the other answers




16. The equivalent resistance of the network in the figure is




a) 0.83 Ω
b) 5.76 Ω
c) 5.00 Ω
d) 6.00 Ω
e) 25.00 Ω