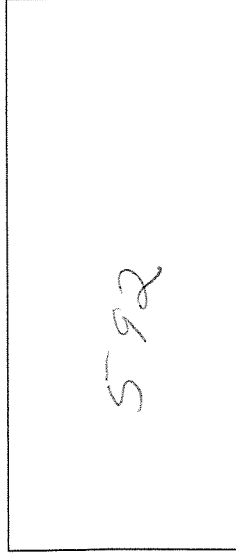


Physics 227- Exam II
November 12, 2006
Prof. Coleman and Prof. Rabe

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.



Your name sticker
⇒
with exam code

SIGNATURE: _____

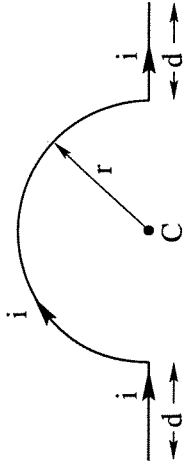
1. The exam will last from 3:00 p.m. to 4:20 p.m. Use a #2 pencil to make entries on the answer sheet. Enter the following ID information now, before the exam starts.
2. In the section labelled NAME (Last, First, M.I.) enter your last name, then fill in the empty circle for a blank, then enter your first 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 15 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 15 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.

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 = 9×10^9 N m²/C²
 ϵ_0 = 8.85×10^{-12} C²/(Nm²)
 μ_0 = $4 \pi \times 10^{-7}$ Tm/A
 g = 9.80 m/s²
1 eV = 1.602 × 10⁻¹⁹ J
1 mC = 10⁻³ C 1 μC = 10⁻⁶ C
1 nC = 10⁻⁹ C 1 pC = 10⁻¹² C

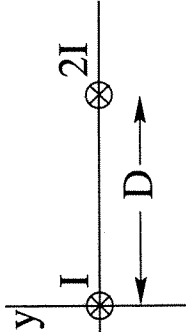
1. The wire shown carries a current i . The magnitude of the magnetic field at C is

- $\mu_0 i / 2r$
- $\mu_0 i / 4r + 2\mu_0 i / d$
- $\mu_0 i / 2\pi r$
- $\mu_0 i / 4r$
- $\mu_0 i / 4r + \mu_0 i / d$



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

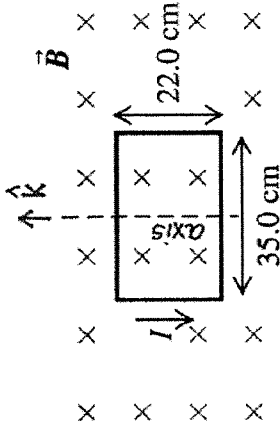
- towards the positive y -direction
- towards the positive x -direction
- None of the other answers
- towards the negative x -direction
- out of the plane of the paper



3. Resistors R_1 and R_2 are connected in parallel to an 18 V battery. This combination of the two resistors has an equivalent resistance of 5 Ω . If the current in the resistor R_2 is 1.5 A, which of the following statements is true?

- $10 \Omega \leq R_1 < 16 \Omega$
- $8 \Omega \leq R_1 < 10 \Omega$
- $R_1 \geq 16 \Omega$
- $R_1 < 4 \Omega$
- $4 \Omega \leq R_1 < 8 \Omega$

4. A rectangular coil of wire, 22.0 cm by 35.0 cm and carrying a counterclockwise current of 1.40 A, is oriented with the plane of its loop perpendicular to a uniform magnetic field pointing into the paper $\vec{B} = -1.50 \text{ T } \hat{i}$ and its axis along \hat{k} , as shown in the figure. The torque exerted by the magnetic field on the loop is



- +0.16 \hat{j} Nm
- +0.16 \hat{k} Nm
- 0 \hat{j} Nm
- 0.16 \hat{j} Nm
- 0.16 \hat{k} Nm

5. Which of the following statements about the magnetic force on a moving charge is TRUE?

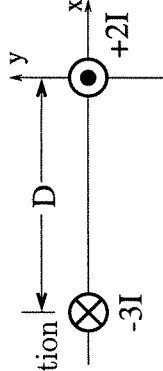
- The magnetic force on a moving charge is $qvB\sin\theta$, which vanishes when the charge moves perpendicular to the magnetic field.
- The magnetic force per unit charge is equal to the product of the magnetic field strength and the component of the velocity parallel to the field.
- The magnetic force per unit charge is equal to the product of the magnetic field strength and the component of the velocity perpendicular to the field.
- The magnetic force acts parallel to the magnetic lines of force, and is a maximum when a particle is moving perpendicular to the field.
- The magnetic force changes sign when both the velocity and magnetic field are reversed.

6. A proton (charge = $+e$; mass = M) and a deuteron (charge = $+e$; mass = $2M$) enter the same magnetic field, and both move in circular paths. The radius of the proton's path is twice that of the deuteron's. It follows that the proton's speed is

- half that of the deuteron's
- one-quarter of the deuteron's
- eight times that of the deuteron's
- four times that of the deuteron's
- twice that of the deuteron's

7. 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. Midway between them, i.e. at $x = -D/2$, what is the magnetic field?

- $5\mu_0 I/\pi D$ in the positive y -direction
- $5\mu_0 I/\pi D$ in the negative y -direction
- Zero
- $\mu_0 I/\pi D$ in the positive y -direction
- $\mu_0 I/\pi D$ in the negative y -direction

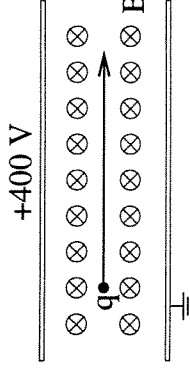


8. A $1\ \mu\text{F}$ capacitor is charged up to a voltage of 100V . The capacitor is discharged through a $10\ \Omega$ resistor. What is the current flowing after 30 microseconds?

- $9.5\ \text{A}$
- $4.97\ \text{A}$
- $0.05\ \text{A}$
- $0\ \text{A}$
- $0.50\ \text{A}$

9. A charged particle moves in a straight line as shown between the metal plates, through a uniform magnetic field $B = 4 \times 10^{-3}\ \text{T}$. The velocity of the particle is $1.2 \times 10^7\ \text{m/s}$, and the potential difference between the plates is $400\ \text{V}$. The separation between the plates is therefore

- impossible to state without knowing the charge q .
- $133.3\ \text{mm}$
- $120\ \text{m}$
- $8.33\ \text{mm}$
- $1.2\ \text{m}$

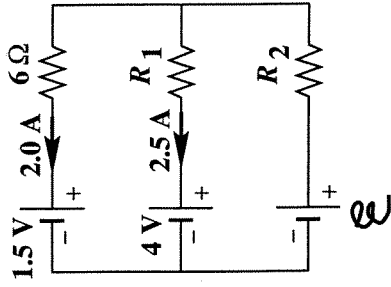


10. The working element of a toaster is a nichrome wire which acts as a resistor. All other wires have negligible resistance. The toaster heats up the bread by consuming $1000\ \text{W}$ of power when plugged into a DC voltage source of $110\ \text{V}$. What is the resistance of the nichrome wire?

- $12.1\ \Omega$
- $1.1 \times 10^5\ \Omega$
- $8.3 \times 10^{-2}\ \Omega$
- $9.1\ \Omega$
- The information given is not sufficient — we need to be given the current drawn as well.

11. Two straight wires A and B of circular cross-section are made of the same metal and have equal lengths, but the resistance of wire A is four times greater than that of wire B. How do their radii compare?

- $r_A = 2r_B$
- $r_A = r_B/2$
- $r_A = r_B/16$
- $r_A = 4r_B$
- $r_A = r_B/4$



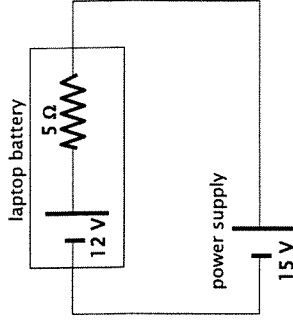
12. What is the resistance of R_1 in the circuit shown?

- a) 3.8Ω
- b) 2.6Ω
- c) 7.0Ω
- d) 5.8Ω
- e) None of the other answers

13. A parallel-plate capacitor is charged and then disconnected from the charging battery. A dielectric slab is inserted in the gap between the capacitor plates. As a result,

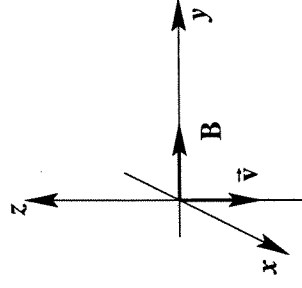
- a) the capacitance and electric field both increase
- b) the capacitance and electric field both decrease
- c) the capacitance stays the same, while the electric field increases
- d) the capacitance increases, while the electric field decreases
- e) the capacitance stays the same, while the electric field decreases

14. A 15V DC power supply is used to charge a laptop battery that has a maximum output EMF of 12V and an internal resistance of 5Ω , as shown in the figure. At what rate is energy being stored inside the battery?



- a) 9 W
- b) 1.8 W
- c) 28.8 W
- d) 7.2 W
- e) 45 W

15. Consider an electron in a uniform magnetic field of magnitude 2 T in the $+y$ direction. When the velocity of the electron is 5×10^6 m/s in the $-z$ direction, the magnetic force on the electron is in the



- a) $-x$ direction
- b) $+z$ direction
- c) $-y$ direction
- d) $+y$ direction
- e) $+x$ direction