

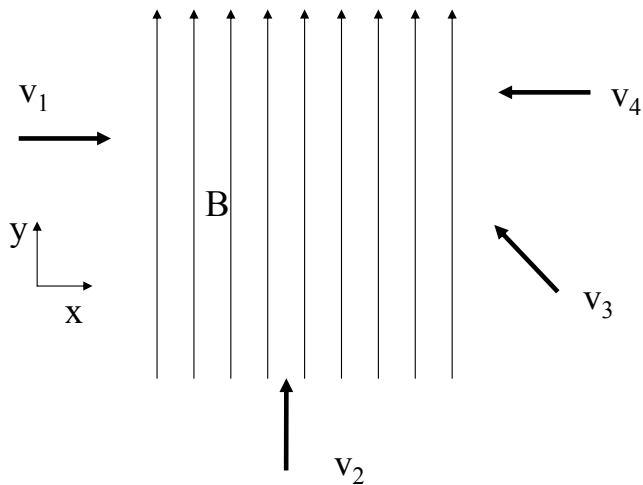
## Physics 102 Spring 2006: Exam #2 —Multiple-Choice Questions

1. A charged particle,  $q$ , is moving with speed  $v$  perpendicular to a uniform magnetic field. A second identical charged particle is moving with speed  $2v$  perpendicular to the same magnetic field. The time to complete one full circular revolution for the first particle is  $T_1$ . The time to complete one full circular revolution for the particle moving with speed  $2v$  is

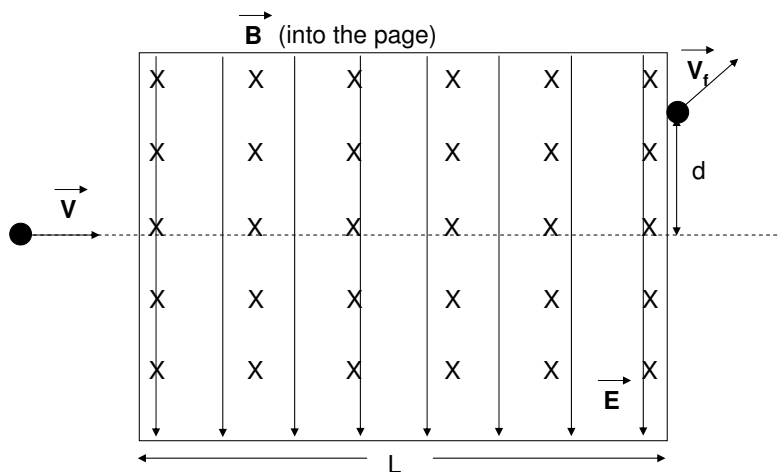
- (a)  $\frac{T_1}{4}$ .  
 (b)  $\frac{T_1}{2}$ .  
 (c)  $T_1$ .  
 (d)  $2T_1$ .  
 (e)  $4T_1$ .

2. Four free-particles with the same **negative** charge and the same initial speed are incident on the same region of constant magnetic field pointed in the  $+y$ -direction (as shown below). Rank the  $z$ -component of the force due to the magnetic field on the particles from greatest to least. (The  $+z$ -direction points out of the page.)

- (a)  $F_{z_{v1}} = F_{z_{v2}} = F_{z_{v3}} = F_{z_{v4}}$ .  
 (b)  $F_{z_{v1}} = F_{z_{v4}} > F_{z_{v3}} > F_{z_{v2}}$ .  
 (c)  $F_{z_{v2}} > F_{z_{v3}} > F_{z_{v1}} = F_{z_{v4}}$ .  
 (d)  $F_{z_{v1}} > F_{z_{v2}} > F_{z_{v3}} > F_{z_{v4}}$ .  
 (e)  $F_{z_{v4}} > F_{z_{v3}} > F_{z_{v2}} > F_{z_{v1}}$ .



For questions 3, refer to the figure below, depicting a positively charged particle deflected upward a distance  $d$  in a region of length  $L$ . Uniform magnetic and electric fields are contained in the region specified by the box. The magnetic field is directed perpendicular to the plane of the page and is directed into the page. The electric field is directed down the page.

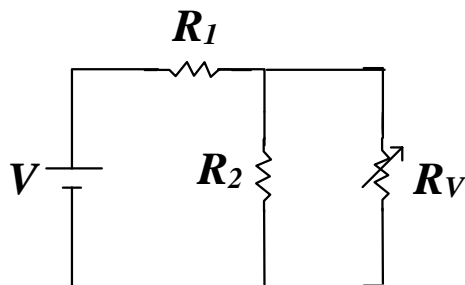


3. Which of the following statement(s) is (are) true?

- I. The electric field does positive work.
- II. The electric field does no work.
- III. The electric field does negative work.
- IV. The speed of the particle is such that  $v > \frac{E}{B}$ .
- V. The speed of the particle is such that  $v = \frac{E}{B}$ .
- VI. The speed of the particle is such that  $v < \frac{E}{B}$ .

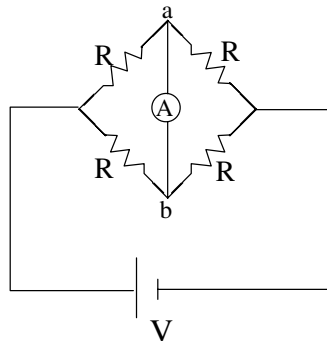
- (a) only I and IV are true
- (b) only III and IV are true
- (c) only III and VI are true
- (d) only II, III and IV are true
- (e) only I, III, and IV are true

4. In the circuit depicted below,  $R_V$  is a variable resistor. If the resistance of  $R_V$  is increased, what happens to  $V_1$  (the potential difference across  $R_1$ ) and  $V_2$  (the potential difference across  $R_2$ ).



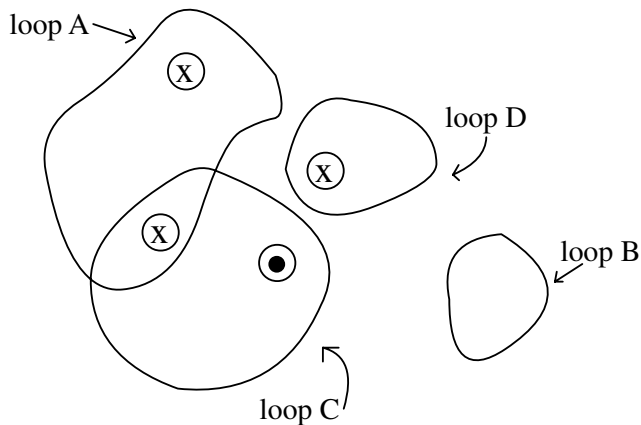
- (a)  $V_1$  decreases and  $V_2$  increases.  
(b)  $V_1$  decreases and  $V_2$  decreases.  
(c)  $V_1$  increases and  $V_2$  increases.  
(d)  $V_1$  increases and  $V_2$  decreases.
5. If the potential difference across a capacitor of capacitance  $C$  doubles, the capacitance of the capacitor is
- (a)  $4 C$ .  
(b)  $2 C$ .  
(c)  $C$ .  
(d)  $1/2 C$ .  
(e)  $1/4 C$ .

6. An ideal ammeter  $A$  is connected between points  $a$  and  $b$  in the circuit below, in which the four resistors are identical. The current through the ammeter is

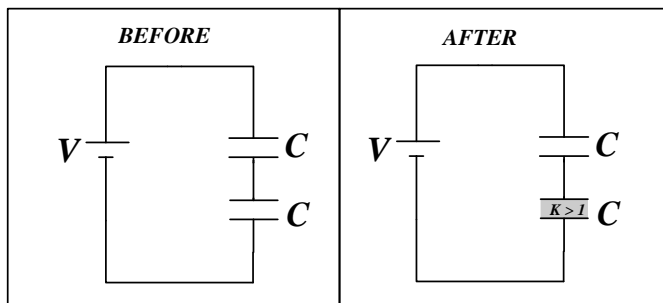


- (a)  $I$ .  
 (b)  $I/2$ .  
 (c)  $I/4$ .  
 (d)  $0$ .
7. Consider four equal currents going into or out of the page as indicated in the figure below. Rank the line integral of the magnetic field  $\oint \vec{B} \cdot d\vec{l}$  (from greatest to least) taken in the clockwise direction.

- (a)  $A = B = C = D$   
 (b)  $A > C > B > D$   
 (c)  $D > B > C > A$   
 (d)  $B = C > D > A$   
 (e)  $A > D > C = B$

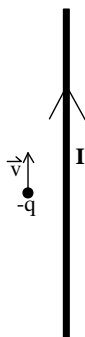


8. Two identical capacitors are connected in series as shown in the figure below. A dielectric slab ( $\kappa > 1$ ) is placed between the plates of one capacitor, and the battery remains connected. Which of the following statement(s) is (are) correct following the insertion of the dielectric?



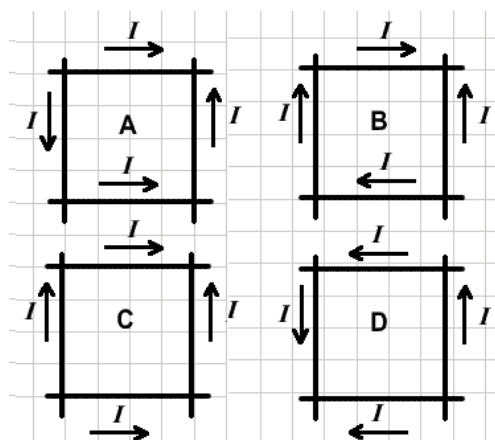
- I. The charge supplied by the battery decreases.
  - II. The charge supplied by the battery does not change.
  - III. The capacitance of the system increases.
  - IV. The capacitance of the system decreases.
  - V. The electrostatic potential energy decreases.
- (a) Only I is correct.  
(b) Only II is correct.  
(c) Only III is correct.  
(d) Only IV is correct.  
(e) III, and V are correct.

9. A negative charge  $-q$  is moving parallel to a long straight wire carrying a constant current as illustrated in the figure below. Which arrow correctly describes the direction of the magnetic force experienced by the charge?

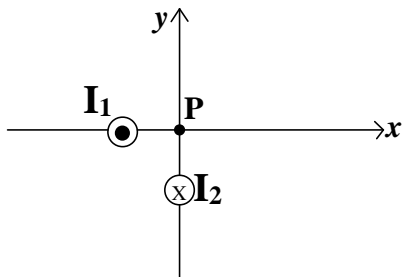


- (a)  $\otimes$ (into the page)
- (b)  $\leftarrow$
- (c)  $\rightarrow$
- (d)  $\odot$ (out of the page)
- (e) 0

10. The figure below shows four *different* sets of wires that cross each other *without actually touching*. The magnitude of the current is the same in all four cases, and the directions of current flow are as indicated. For which configuration will the magnetic field at the center of the square formed by the wires be equal to zero?

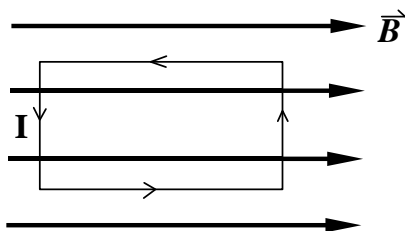


11. The figure below shows two long wires carrying equal currents  $I_1$  and  $I_2$  flowing in opposite directions. Which of the arrow correctly represents the direction of the magnetic field at the origin of the coordinate system defined in the figure. Point **P** is located at an equal distance  $d$  from each wire?



- (a)
- (b)
- (c)
- (d)
- (e) 0

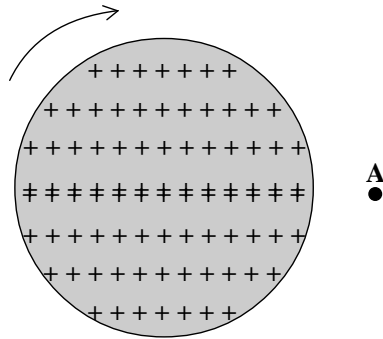
12. A rectangular loop of wire of length  $l$  and width  $w$  carrying current  $I$  is placed in a uniform magnetic field  $\vec{B}$  as shown in the figure below. The magnetic field is parallel to the plane containing the loop. Which of the following statement(s) is (are) correct?



- I. The current loop experiences a net force.
  - II. The current loop experiences no net force.
  - III. The magnetic dipole moment of the current loop,  $\vec{\mu}$ , points into the page.
  - IV. The magnetic dipole moment of the current loop,  $\vec{\mu}$ , points out of the page.
  - V. The current loop experiences no net torque.
  - VI. The current loop experiences a net torque.
- (a) Only II and V are correct.
  - (b) Only I and VI are correct.
  - (c) Only I, III and IV are correct.
  - (d) Only II, IV and V are correct.
  - (e) Only II IV and VI are correct.
13. A metal spring can be used as a solenoid. The spring is stretched slightly, and a current is passed through it. The resulting magnetic field will cause the spring to
- (a) collapse.
  - (b) stretch out further.
  - (c) not change because nothing happens.

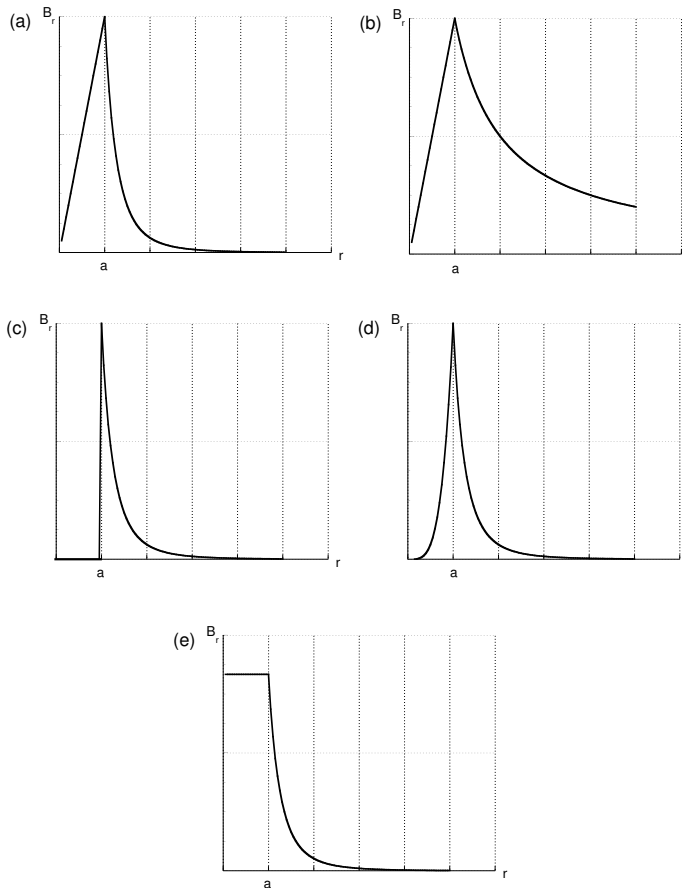


14. A positively charged disk is rotated clockwise as shown in the figure below. What is the direction of the magnetic field at point **A** in the plane of the disk?



- (a)  $\otimes$  (into the page)
- (b)  $\longrightarrow$
- (c)  $\longleftarrow$
- (d)  $\odot$  (out of the page)
- (e) 0

15. A wire of radius  $a$  carries a current  $I$  uniformly distributed throughout its interior. Which graph below best represents the magnitude of the magnetic field as a function of  $r$ , the distance from the center of the wire?



Last Name:

First Name:

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Physics 102 Spring 2006: Exam #2 —Multiple-Choice Answers

	A	B	C	D	E
1					
2					
3					
4					
5					
6					
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8					
9					
10					
11					
12					
13					
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