

## PHYSICS DEPARTMENT

PHY 2054  
B. Whiting

Practice Exam #2

October 18, 2001

Name (print): \_\_\_\_\_ Signature: \_\_\_\_\_

*On my honor, I have neither given nor received unauthorized aid on this examination.***YOUR TEST NUMBER IS THE 5-DIGIT NUMBER AT THE TOP OF EACH PAGE.****DIRECTIONS**

- (1) **Code your test number on your green answer sheet (use 76–80 for the 5-digit number).** Code your name on your answer sheet. **Darken circles completely (errors can occur if too light).** Code your student number on your answer sheet.
- (2) Print your name on this sheet and sign it also.
- (3) Do all scratch work anywhere on this exam that you like. At the end of the test, this exam printout is to be turned in. No credit will be given without both answer sheet and printout with scratch work most questions demand.
- (4) Work the questions in any order. Incorrect answers are not taken into account in any way; you may guess at answers you don't know if you feel that a correct answer is listed. Guessing on all questions will most likely result in failure.
- (5) If none of the answers is correct, please leave the answer sheet blank. It is not our intention to omit the right answer, but in case of a mistake, please leave the answer sheet blank.
- (6) **Blacken the circle of your intended answer completely, using a number 2 pencil.** Do not make any stray marks or the answer sheet may not read properly.
- (7) As an aid to the examiner (and yourself), in case of poorly marked answer sheets, please circle your selected answer on the examination sheet.
- (6) Good luck!!!

>>>>>>>**WHEN YOU FINISH**<<<<<<<<

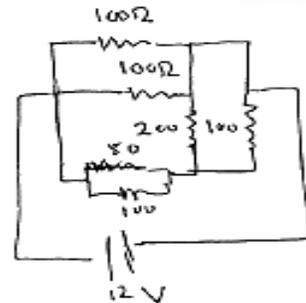
Hand in the green answer sheet separately.

**Constants**

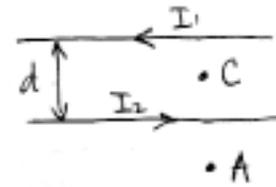
$k = 1/(4\pi\epsilon_0) = 9.0 \times 10^9 \text{ N m}^2/\text{C}^2$	$\epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2/(\text{N m}^2)$	$e = 1.6 \times 10^{-19} \text{ C}$
$1\mu\text{C} = 10^{-6} \text{ C}$	$g = 9.8 \text{ m/s}^2$	electron mass: $m_e = 9.11 \times 10^{-31} \text{ kg}$
Avogadro's number: $6.023 \times 10^{23}$	Atomic mass of Al = 27 g	

1. A charged particle of charge  $q_0 = 3.2 \times 10^{-19} \text{ C}$  and of speed  $10^5 \text{ m/s}$  moves along the axis of a long cylindrical solenoid. The solenoid has a length of 20 cm, 2400 windings and carries a current of 2A. The force on the particle (in Newtons) is
  - (1)  $9.6 \times 10^{-16}$
  - (2)  $9.6 \times 10^{-8}$
  - (3) 0
  - (4)  $2.4 \times 10^{-16}$
  - (5)  $3.5 \times 10^{-8}$
2. What is the equivalent resistance (in  $\Omega$ ) of the circuit shown?

- (1) 50
- (2) 33.3
- (3) 200
- (4) 100
- (5) 66.7

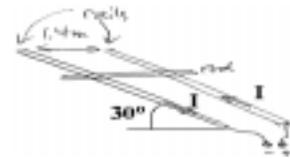


3. Two long, straight parallel wires separated by a distance  $d = 10\text{cm}$  carry currents in opposite directions as shown in figure 3. The ratio of the current values  $I_1/I_2 = 6$ . What is the ratio of the  $B$  fields,  $B_A/B_C$ ? Both points are located in the plane of the wires,  $C$  halfway between the wires and  $A$  a distance of  $5\text{ cm}$  below the bottom wire.



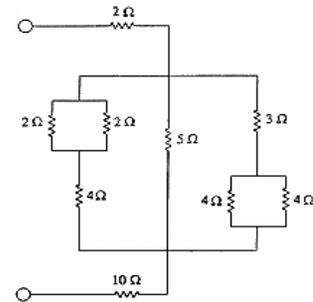
- (1) 0.14                      (2) 0.09                      (3) 0.23                      (4) 0.11                      (5) 1.35

4. Suppose the two parallel conducting rails separated  $1.4\text{ m}$  are tilted upward so each makes an angle of  $30.0^\circ$  with respect to the horizontal. The magnetic field is vertical and has a magnitude of  $0.05\text{ T}$ . The  $0.20\text{-kg}$  aluminum rod, that is perpendicular to the rails, slides *without friction* at a constant velocity. How much current (in Amps) flows through the rod?



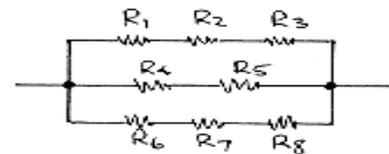
- (1) 16.2                      (2) 13.5                      (3) 28                      (4) 142                      (5) 0.14

5. Compute the equivalent resistance (in  $\Omega$ ) of the resistor network shown.



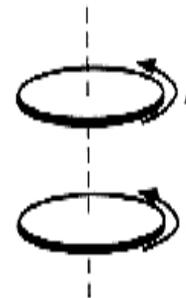
- (1) 13.66  
 (2) 12.66  
 (3) 2.54  
 (4) 22.76  
 (5) 14.33

6. Consider the resistor network shown. If the power dissipated in  $R_7$  is  $300\text{ mW}$ , what is the voltage (in  $\text{V}$ ) across resistor  $R_5$ ?  $R_1 = 150\Omega$ ,  $R_2 = 125\Omega$ ,  $R_3 = 125\Omega$ ,  $R_4 = 80\Omega$ ,  $R_5 = 120\Omega$ ,  $R_6 = 60\Omega$ ,  $R_7 = 120\Omega$ , and  $R_8 = 70\Omega$ . Select the closest answer.



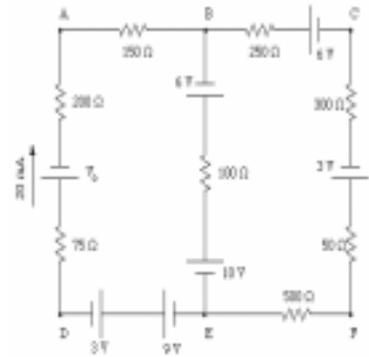
- (1) 7.5                      (2) 6                      (3) 5                      (4) 3                      (5) 9

7. Two loops carry equal currents  $I$  in the same direction. The loops are held in the position shown in the figure and are then released. Which one of the following statements correctly describes the subsequent behavior of the loops?



- (1) The top loop moves to the right; the bottom loop moves to the right.  
 (2) The loops repel each other.  
 (3) Both loops move to the left.  
 (4) The loops remain the positions shown.  
 (5) The loops attract each other.

8. You are given the electrical circuit shown. Note the unknown battery  $V_0$  and the labelled 20 mA current ( $1 \text{ mA} = 10^{-3} \text{ A}$ ). What is the potential change (in V) in going from point B to point F? Select the closest answer.

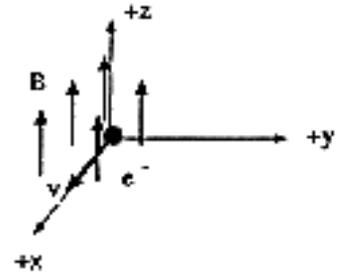


- (1)  $-3.5$   
 (2)  $+3.5$   
 (3)  $+4.5$   
 (4)  $-4.5$   
 (5)  $-6$

9. Which of the following statements is **incorrect**?

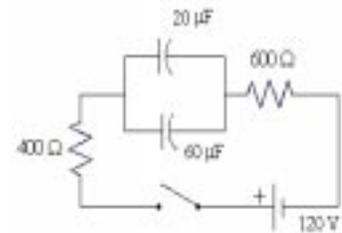
- (1) If a charged particle experiences no magnetic force as it moves through a region of space, then the magnetic field in that region must be zero.  
 (2) The magnetic force vector on a moving charge is unchanged if both the velocity and magnetic field directions are reversed.  
 (3) The direction of the magnetic force on a charged particle depends on the sign of the charge, but the magnitude of the force does not.  
 (4) The direction of the magnetic force on a current-carrying wire depends on the current direction, but the magnitude of the force does not.  
 (5) A charged particle moving at a  $45^\circ$  angle with respect to a uniform magnetic field has a helical trajectory.

10. An electron moving in the  $+x$  direction with a velocity of  $3.2 \times 10^6 \text{ m/s}$  enters a region of constant magnetic field (magnitude  $0.45 \text{ T}$  pointed in the  $+z$  direction) and electric field. The electron does not deflect and continues along its initial path. What are the magnitude (in V/m) and direction of the electric field acting on the electron?



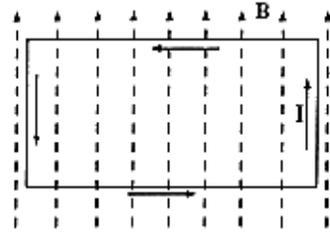
- (1)  $2.8 \times 10^6$ ,  $-y$  direction  
 (2)  $2.8 \times 10^6$ ,  $+y$  direction  
 (3)  $1.4 \times 10^6$ ,  $+y$  direction  
 (4)  $1.4 \times 10^6$ ,  $-y$  direction  
 (5)  $2.8 \times 10^6$ ,  $-z$  direction

11. An RC circuit consists of two resistors  $600\Omega$  and  $400\Omega$ , a  $120 \text{ V}$  battery and two capacitors of capacitances  $20\mu\text{F}$  and  $60\mu\text{F}$  each. The capacitors initially are uncharged. The switch is closed at time  $t = 0$ . After  $0.1$  seconds, the charge on capacitor  $60\mu\text{F}$  is (in C)

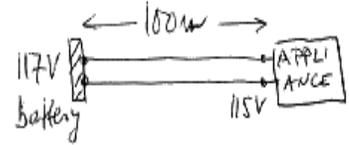


- (1)  $9.18 \times 10^{-3}$       (2)  $5.14 \times 10^{-3}$       (3)  $7.79 \times 10^{-3}$       (4)  $9.00 \times 10^{-3}$       (5)  $6.85 \times 10^{-3}$

12. A rectangular loop is placed in a uniform magnetic field with the plane of the loop parallel to the direction of the field. If a current flows through the loop in the direction indicated by the arrows, the field exerts on the loop:

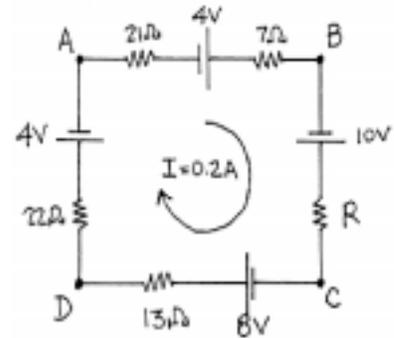


- (1) not enough information given  
 (2) a net force and a net torque  
 (3) a net torque  
 (4) neither a net force nor a net torque  
 (5) a net force
13. You are to run a pair of wires from an appliance that is 100 m from a battery. If the appliance is rated to use 5 kW when connected to a 115 V potential, and you do not want to drop more than 2 V from the battery to the appliance because of Joule heating, the radius (in cm) of the copper wires (of resistivity  $1.7 \times 10^{-8} \Omega \cdot \text{m}$ ) must be



- (1) 0.48                      (2) 3.2                      (3) 2.4                      (4) 0.048                      (5) 0.024

14. You are given the electrical circuit shown. What is the value of the resistor R (in  $\Omega$ ) if the current in the circuit is 0.2 A?



- (1) 27  
 (2) 67  
 (3) 45  
 (4) 71  
 (5) 20

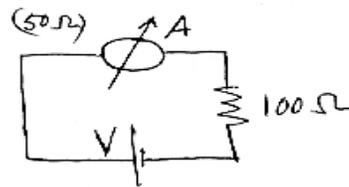
15. A long straight wire is bent such that a portion of it forms 3 circular loops of radius 3 cm (see Figure 1). What is the current (in A) in the wire if the B field in the center of the loops is  $2 \times 10^{-3} \text{ T}$ ?



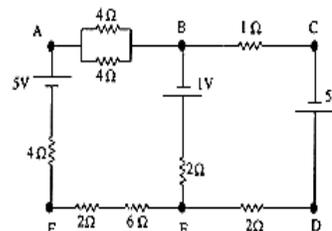
- (1) 56.9                      (2) 31.8                      (3) 35.6                      (4) 28.8                      (5) 24.9
16. Consider an RC circuit consisting of a series-connected battery (12V), resistor ( $5 \text{ k}\Omega$ ), capacitor ( $10 \mu\text{F}$ ), and a switch. Initially the switch is open and the capacitor is discharged. At a certain time the switch is closed. Which of the following statements are now **true**?

- (1) The current in the circuit decreases exponentially in time.  
 (2) There is zero current in the circuit because the electrons cannot flow across the gap in the capacitor.  
 (3) The voltage across the resistor increases exponentially in time.  
 (4) The current in the circuit is constant in time, since the emf provided by the battery is constant.  
 (5) The current in the circuit increases exponentially in time.

17. A  $50\Omega$  galvanometer carries a current of  $2 \times 10^{-3}\text{A}$  at full deflection. A  $100\Omega$  resistor is then placed in series with the galvanometer. At what voltage reading does full deflection occur for this combination?

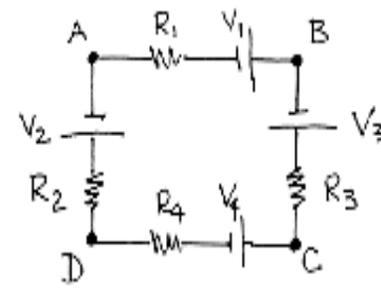


- (1) 0.3V                      (2) 450V                      (3) 870V                      (4) 5000V                      (5) 0.1V
18. Examine the circuit shown. What is the value of the current (in A) passing from points E to B along the center branch?



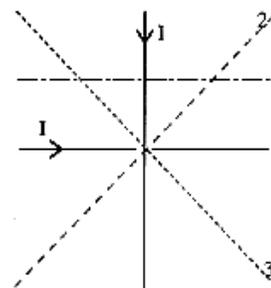
- (1)  $-0.1$   
 (2)  $-1.3$   
 (3)  $0.2$   
 (4)  $-2.1$   
 (5)  $0.5$

19. In the circuit shown, what is the potential difference (in V) in going from point B to point D? The values of the components are:  $R_1 = 125\Omega$ ,  $R_2 = 75\Omega$ ,  $R_3 = 50\Omega$ ,  $R_4 = 125\Omega$ ,  $V_1 = 3\text{ V}$ ,  $V_2 = 6\text{ V}$ ,  $V_3 = 1.5\text{ V}$ , and  $V_4 = 3\text{ V}$ . Select the closest answer.



- (1) 0.9  
 (2) 1.1  
 (3)  $-0.9$   
 (4) 0.6  
 (5)  $-0.5$

20. Two very long, fixed wires cross each other but do not touch each other as shown. Equal currents flow through the wires in the directions shown. Along which line is the magnetic field identically zero?



- (1) 1,2,3                      (2) 3                      (3) 2                      (4) 1                      (5) 2,3