If \( R_1 = R_3 = R \) and \( R_2 = R_4 = R_5 = R/2 \) and the potential difference across the power supply is \( V \), what is the potential difference across the \( R_1 \) resistor?
11. The current through the $3\Omega$ resistor is:

a) 4.7 A  
b) 2.0 A  
c) 0.67 A  
d) 8.2 A  
e) 0.50 A
In Fig. 27-46, $\varepsilon = 12.0 \text{ V}$, $R_1 = 2000 \ \Omega$, $R_2 = 3000 \ \Omega$, and $R_3 = 4000 \ \Omega$. What are the potential differences (a) $V_A - V_B$, (b) $V_B - V_C$, (c) $V_C - V_D$, and (d) $V_A - V_C$?
Note that two of the resistors have the same resistance $R$, while the one on the far right has resistance $2R$. The current through the middle resistor is 2.0 A down. What is the value of $R$?
30. The figure shows a multiple loop circuit, with the numbers labeling the resistors giving their resistance in Ohms. What is the value of the current $I_2$?

a) 3.0 A  
b) 12 A  
c) 4.0 A  
d) 1.0 A  
e) $-3.0$ A
A toaster of resistance $10 \, \Omega$ is connected to a $120 \, V$ dc source. What will be the approximate cost of operating the toaster for 2 minutes, if electricity in New Jersey costs 17 cents per kilowatt-hour?
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 that of wire $B$. How do their radii compare?
1. Consider a proton in a uniform magnetic field of magnitude 2.0 T in the +y direction. When the velocity of the proton is 5.0 × 10^6 m/s in the −z direction, the direction of the magnetic force on the proton is

a) in the −x direction
b) in the +x direction
c) in the −y direction
d) in the +y direction
e) in the −z direction
31. 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
The statement $F = q(E + \vec{v} \times B)$ implies that:

a) Charged particles can never move in a straight line unless $E$ and $B$ are zero.

b) In the absence of a $B$-field, a static $E$-field cannot do work on a moving charge.

c) Magnetic fields do no work on moving charges.

d) In the absence of an $E$-field, a static $B$-field will always exert a force on a moving charge.

e) The force on a moving charge in the presence of both static $E$- and $B$-fields can never be equal to zero.
9. What is the line integral $\int \vec{B} \cdot d\vec{s}$ CLOCKWISE around the path shown in the figure?

a) $\mu_0(I_1 - I_2 - I_3)$
b) $\mu_0(I_2 - I_1 + I_3)$
c) $\mu_0(I_1 + I_2 + I_3)$
d) 0
e) $\mu_0(I_1 - I_2)$
13. Two infinitely long straight wires perpendicular to the page are shown in the figure. Each carries a current $I$ in the $+\hat{z}$ (out of the paper) or $-\hat{z}$ (into the paper) direction as indicated. What is the magnetic field at the origin?

a) $\vec{B} = \frac{\mu_0}{2\pi} I \left[ \frac{1}{2} \hat{x} + \frac{1}{3} \hat{y} \right]$  

b) $\vec{B} = \frac{\mu_0}{2\pi} I \left[ 2\hat{x} + 3\hat{y} \right]$  

c) $\vec{B} = \frac{\mu_0}{2\pi} I \left[ \frac{1}{2} \hat{x} - \frac{1}{3} \hat{y} \right]$  

d) $\vec{B} = \frac{\mu_0}{2\pi} I \left[ -\frac{1}{2} \hat{x} - \frac{1}{3} \hat{y} \right]$  

e) $\vec{B} = \frac{\mu_0}{2\pi} I \left[ -2\hat{x} - 3\hat{y} \right]$
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 $x = -D$ (the wire on the left)?

   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) the force is zero
14. 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 $45^\circ$ angle. What is the contribution to the magnetic field at the center C by the current in this arc?

a) $\mu_0 \frac{I}{4R}$ out of the paper
b) $\mu_0 \frac{I}{4R}$ into the paper
c) $\mu_0 \frac{I}{2R}$ into the paper
d) $\mu_0 \frac{I}{16R}$ into the paper
e) $\mu_0 \frac{I}{16R}$ out of the paper
15. A long solenoid of 800 turns of wire is 30 cm in length. If it carries a current of 2.0 A, what is the magnetic field inside the solenoid at its center?

   a) About 2.0 mT  
   b) About 6.7 mT  
   c) About 3.4 mT  
   d) About 1.7 mT  
   e) About 1.0 mT
33. Which of the following statements is false?

a) The magnetic force does zero work on a charged particle moving in a magnetic field.

b) A current-carrying planar loop of wire in a constant, uniform magnetic field has zero net magnetic force on it.

c) The net magnetic flux through any closed surface is zero.

d) The magnetic force on a charged particle moving along a magnetic field line is zero.

e) Magnetic field lines cannot form closed loops.
9. A potential difference of 4.0 V is applied between the ends of a wire, resulting in a current of 16 A. If the wire is 2.5 m in length and 0.60 mm in radius, then the resistivity of the material of which the wire is made is
   a) 4.0 Ω
   b) 1.1 \times 10^{-7} \Omega m
   c) 4.5 \times 10^{-7} \Omega m
   d) 2.8 \times 10^{-8} \Omega m
   e) 0.25 \Omega
10. Consider the circuit shown in the figure. The circuit element at the top is a battery with internal resistance \( r \), and \( R = 5.30 \ \Omega \) for the resistor at the bottom. If the terminal voltage of the battery is 21.2 V, what is the power dissipated in the resistor \( R \)?

a) 109 W  

b) 127 W  

c) 4.00 W  

d) 84.8 W  

e) 112 W