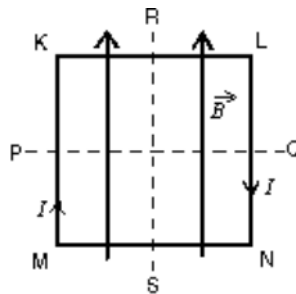


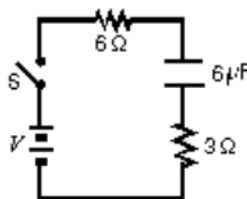
1. Which of the following statements about cylindrical wire resistors is false?
  - A) The greater the potential difference between the ends of the wire, the greater is the electric field in the wire.
  - B) If the temperature is increased, the number of electrons per volume decreases.
  - C) If the temperature is increased, the average time between successive collisions of the electrons with the atoms has to increase.
  - D) If the potential difference between the ends of the wire is increased, the conductivity does not change.
  - E) None of these statements is false.

2. A square loop of wire lies in the plane of the page and carries a current  $I$  as shown. There is a uniform magnetic field  $\vec{B}$  parallel to the side MK as indicated. The loop will tend to rotate:
  - A) about PQ with KL coming out of the page
  - B) about PQ with KL going into the page
  - C) about RS with MK coming out of the page
  - D) about RS with MK going into the page
  - E) about an axis perpendicular to the page



- A) about PQ with KL coming out of the page
  - B) about PQ with KL going into the page
  - C) about RS with MK coming out of the page
  - D) about RS with MK going into the page
  - E) about an axis perpendicular to the page
  
3. Identical, singly-ionized particles of unknown mass each have a kinetic energy of 2.0 million electron-volts (2 MeV). These particles are deflected by a magnetic field of 3.0 T that is perpendicular to their velocity. The radius of the resulting circular paths followed by the particles is 5.0 cm. What is the mass of the particles (in kg)? Note: the charge of the singly-ionized particles is  $1.6 \times 10^{-19}$  C.
  - A)  $9.00 \times 10^{-28}$
  - B)  $4.08 \times 10^{-27}$
  - C)  $6.55 \times 10^{-24}$
  - D)  $9.07 \times 10^{-26}$
  - E) none of these

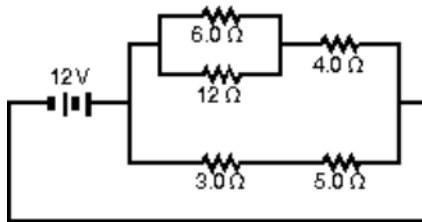
4. A certain wire has resistance  $R$ . Another wire, of the same material, has half the length and half the diameter of the first wire. The resistance of the second wire is:
- $R/4$
  - $R/2$
  - $R$
  - $2R$
  - $4R$
5. The current density is the same in two wires. Wire A has twice the free electron concentration of wire B. The drift speed of electrons in A is:
- twice that of electrons in B
  - four times that of electrons in B
  - half that of electrons in B
  - one-fourth that of electrons in B
  - the same as that of electrons in B
6. An certain resistor dissipates  $0.5 \text{ W}$  when connected to a  $3 \text{ V}$  potential difference. When connected to a  $1 \text{ V}$  potential difference, this resistor will dissipate:
- $0.5 \text{ W}$
  - $0.167 \text{ W}$
  - $1.5 \text{ W}$
  - $0.056 \text{ W}$
  - none of these
7. In the circuit shown, the capacitor is initially uncharged. At time  $t = 0$ , switch S is closed. If  $\tau$  denotes the time constant, the approximate current through the  $3 \Omega$  resistor when  $t = \tau/10$  is:



- $0.38 \text{ A}$
- $0.50 \text{ A}$
- $0.75 \text{ A}$
- $1.0 \text{ A}$
- $1.5 \text{ A}$

8. A certain capacitor, in series with a resistor, is being charged. At the end of 10 ms its charge is half the final value. The time constant for the process is about:
- A) 0.43 ms
  - B) 2.3 ms
  - C) 6.9 ms
  - D) 10 ms
  - E) 14 ms

9. The current in the 5.0-Ω resistor in the circuit shown is:



- A) 0.42 A
  - B) 0.67 A
  - C) 1.5 A
  - D) 2.4 A
  - E) 3.0 A
10. A portion of a circuit is shown, with the values of the currents given for some branches. What is the direction and value of the current  $i$ ?

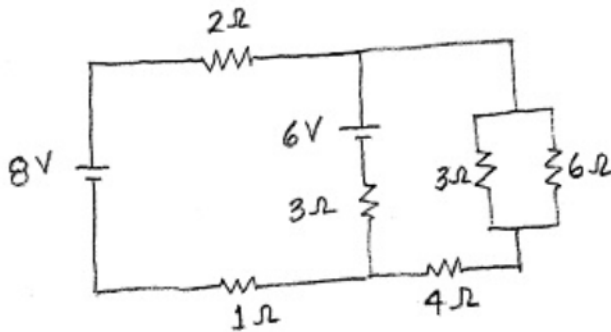


- A) ↓, 6A
- B) ↑, 6A
- C) ↓, 4A
- D) ↑, 4A
- E) ↓, 2A

11. Two identical batteries, each with an emf of 18 V and an internal resistance of  $1\ \Omega$ , are wired in parallel by connecting their positive terminals together and connecting their negative terminals together. The combination is then wired across a  $4\text{-}\Omega$  resistor. The current in each battery is:

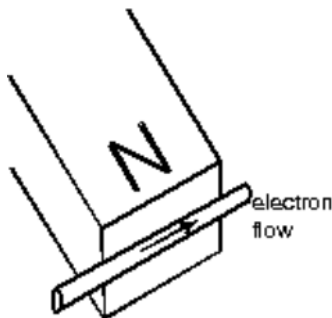
- A) 1.0 A
- B) 2.0 A
- C) 4.0 A
- D) 3.6 A
- E) 7.2 A

12. What is the current in the  $6\text{-ohm}$  resistor, in amperes?



- A) 0.36
  - B) 0.78
  - C) 0.44
  - D) 1.08
  - E) None of these
13. A hydrogen atom that has lost its electron is moving east in a region where the magnetic field is directed from south to north. It will be deflected:
- A) up
  - B) down
  - C) north
  - D) south
  - E) not at all

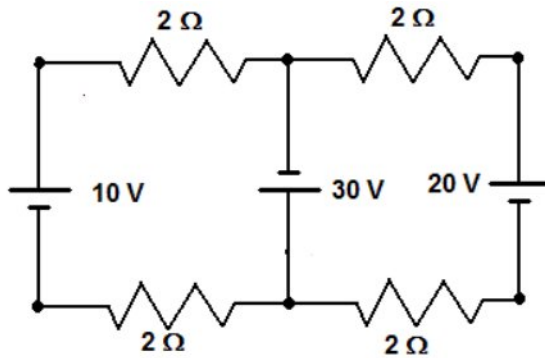
14. The figure shows the motion of electrons in a wire which is near the N pole of a magnet. The wire will be pushed:



- A) toward the magnet  
B) away from the magnet  
C) downwards  
D) upwards  
E) along its length
15. A current is clockwise around the outside edge of this page and a uniform magnetic field is directed parallel to the page, from left to right. If the magnetic force is the only force acting on the page, the page will turn so the right edge:
- A) moves toward you  
B) moves away from you  
C) moves to your right  
D) moves to your left  
E) does not move
16. A loop of wire carrying a current of 1.0 A is in the shape of a right triangle with two equal sides, each 0.10 m long. A 2 T uniform magnetic field is parallel to the hypotenuse. The resultant magnetic force (in newtons) on the triangle has a magnitude of:
- A) zero  
B) 0.21  
C) 0.30  
D) 0.41  
E) None of these

17. A battery with an emf of 12 V and an internal resistance of  $1\ \Omega$  is used to charge a battery with an emf of 10 V and an internal resistance of  $1\ \Omega$ . The power output (in watts) of the 12 V emf is
- A) 12
  - B) 2
  - C) 22
  - D) 24
  - E) None of these

18. What is the current (in amperes) in the 30-volt battery in the circuit below?



- A) 15.5
  - B) 20.0
  - C) 10.0
  - D) 22.5
  - E) None of these
19. A current of 20 amperes is being drawn from a battery whose emf is 24 volts. The internal resistance of the battery is 0.2 ohms. By how many volts is the battery "loaded down"?
- A) 2
  - B) 3
  - C) 5
  - D) 4
  - E) None of these

20. Which of the following statements about current in a metal cylindrical wire resistor more likely to be false than the others?
- A) The larger the electric field is in the resistor, the greater is the drift velocity of electrons.
  - B) The greater the density of the metal, the smaller will be the collision time,  $\tau$ .
  - C) The greater the temperature of the metal, the greater will be the collision time,  $\tau$ .
  - D) Doubling the length and halving the radius of of the wire will increase its resistance by a factor of 8.
  - E) None of these statements is false.

**Answer Key**

1. C
2. A
3. A
4. D
5. C
6. D
7. D
8. E
9. C
10. A
11. B
12. A
13. A
14. D
15. A
16. E
17. A
18. D
19. D
20. C