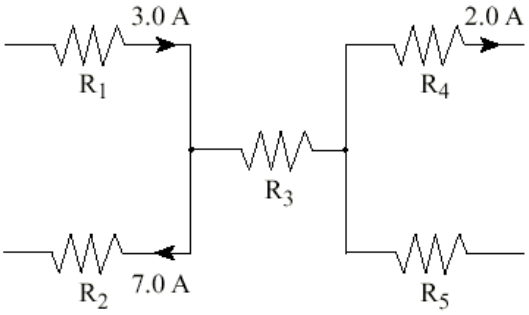
Unit 7: Electric Circuits

Multiple Choice Portion

1. The diagram below shows part of an electrical circuit.



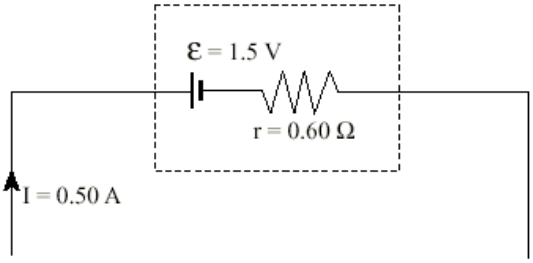
What are the magnitude and direction of the current passing through resistor R 5 ?

a. 6.0 A towards the left
b. 12.0 A towards the left
c. 2.0 A towards the right
d. 8.0 A towards the right

2. A 12 V battery is connected to a 60 Ω resistor. How much charge will flow through the resistor in 20 s?

a. 0.010 C
b. 0.20 C
c. 4.0 C
d. 48 C

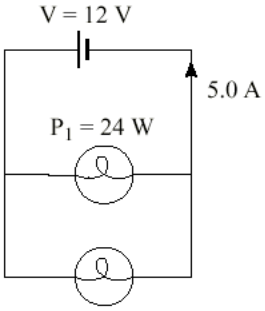
3. A cell whose emf is 1.5 V and internal resistance is 0.60 Ω is charged by supplying a 0.50 A current in the direction shown.



What is the terminal voltage of the cell while being charged?

a. 0.30 V
b. 1.2 V
c. 1.5 V
d. 1.8 V

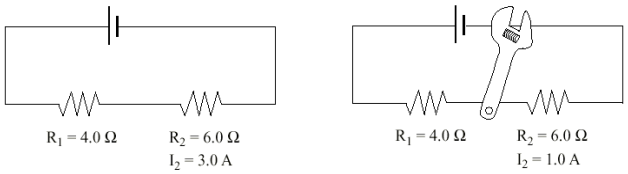
4. A 12 V battery supplies a 5.0 A current to two light bulbs as shown below.



The power output of one of the bulbs is $P_1 = 24$ W. What is the power output of the other bulb?

a. 14 W
b. 24 W
c. 36 W
d. 60 W

5. A student measures the current through the resistor R_2 to be 3.0 A, as shown in the left-hand diagram.



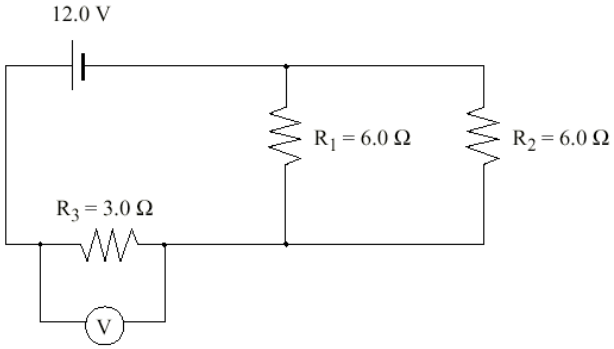
When a wrench that has a small resistance is dropped on the circuit as shown, the current through R_2 is reduced to 1.0 A. What is the current flowing through the wrench? (Assume the supply voltage remains constant.)

a. 1.0 A
b. 2.0 A
c. 5.0 A
d. 7.5 A

6. A battery whose emf is 6.0 V is connected to a 2.0 Ω resistor. The voltage drop across the 2.0 Ω resistor is 5.0 V. What is its internal resistance?

a. 0.40 Ω
b. 1.7 Ω
c. 2.4 Ω
d. 2.5 Ω

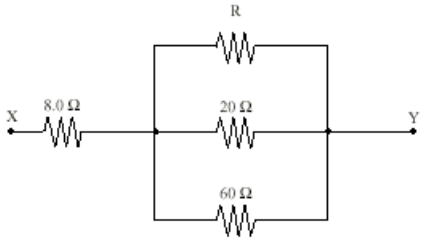
7. A voltmeter is connected across a 3.0 Ω resistor in the circuit shown below.



What is the reading on the voltmeter?

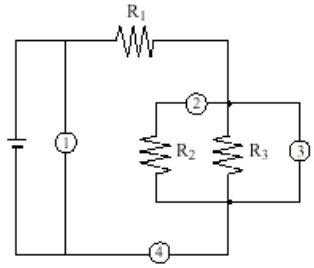
a. 4.0 V
b. 6.0 V
c. 8.0 V
d. 12.0 V

8. The total resistance between points X and Y is 14.0 Ω. What is the value of R?



a. 6. 0 Ω
b. 8. 3 Ω
c. 10 Ω
d. 210 Ω

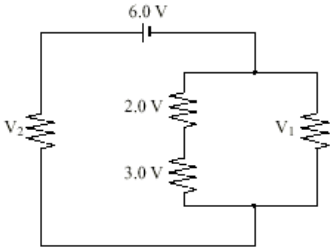
9. The diagram below shows a circuit with four possible meter locations.



In which locations should an ammeter and voltmeter be connected to correctly measure the current through R_2 and the voltage drop across R_2?

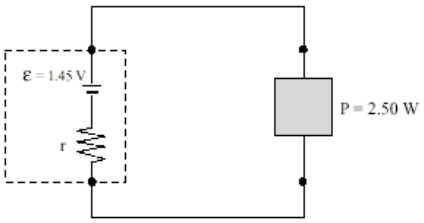
	CURRENT THROUGH R_2	VOLTAGE DROP ACROSS R_2
a.	2	1
b.	2	3
c.	4	1
d.	4	3

10. What are the potential differences, V_1 and V_2, in the circuit shown below?



	Potential Difference V_1	Potential Difference V_2
a.	1.0 V	5.0 V
b.	1.0 V	6.0 V
c.	5.0 V	1.0 V
d.	5.0 V	5.0 V

11. A 2.50 W device requires 1.20 V to operate properly. A 1.45 V cell, with internal resistance r, is used to power this device. What value of r enables the cell to provide 1.20 V to the device?

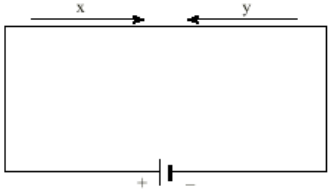


a. 0.120 Ω
b. 0.145 Ω
c. 0. 576 Ω
d. 0.841 Ω

12. A flashlight contains two batteries in series with a bulb of resistance 12 Ω. Each battery has an emf of 1.5 V and an internal resistance of 0.26 Ω. What is the potential difference across the bulb?

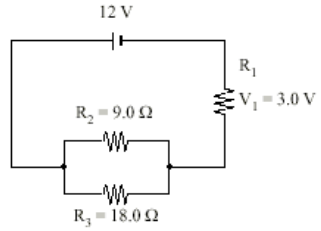
a. 0.12 V
b. 1.5 V
c. 2.9 V
d. 3.0 V

13. In the diagram below, which arrows represent the direction of conventional current and electron flow?



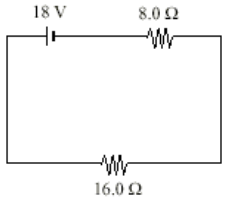
	CONVENTIONAL CURRENT	ELECTRON FLOW
a.	x	x
b.	x	y
c.	y	x
d.	y	y

14. Find the current through the battery in the circuit shown below.



a. 0.33 A
b. 1.5 A
c. 2.0 A
d. 2.5 A

15. Calculate the power dissipated by the 8.0 Ω resistor in the circuit below.



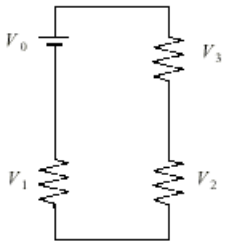
a. 4.5 W
b. 6.0 W
c. 10 W
d. 41 W

16. Which of the following correctly states Kirchhoff's first rule or junction rule?
a. The magnitude of the current in each wire leaving a junction is always equal.
b. In a complete circuit, the current leaving the battery must be lost in the circuit.
c. The sum of the currents leaving the junction is equal to the sum of the currents entering the junction.
d. The sum of the currents leaving the junction is less than the sum of the currents entering the junction.

17. A 12 V battery is connected to a 20 Ω resistor. How much charge flows through the battery in 3.5 s ?
a. 2.7×10^{-8} C
b. 0.60 C
c. 2.1 C
d. 25 C

18. A 660 W electric heater is designed to operate from a 120 V source. If the source voltage drops to 80.0 V, what will be the power dissipated by the same heater? (Assume the resistance of the heater is constant.)
a. 73.3 W
b. 293 W
c. 440 W
d. 660 W

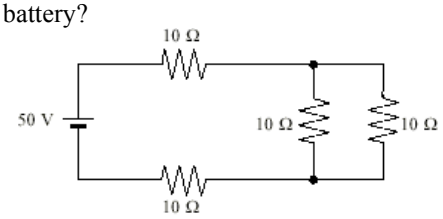
19. Which of the following relationships correctly applies to the circuit shown below?



a. $V_0 = V_1 + V_2 + V_3$
b. $V_0 + V\,1 = V_2 + V_3$
c. $V_0 = V_1 = V_2 = V_3$
d. $V_0^{-1} = V_1^{-1} + V_2^{-1} + V_3^{-1}$

20. A 9.0 V battery was recharged with a current of 1.2 A in 1.8×10^4 s. How much charge was transferred during that time?
a. 1.1×10^1 C
b. 2.2×10^4 C
c. 1.6×10^5 C
d. 1.9×10^5 C

21. In the following circuit, what current is drawn from the battery?

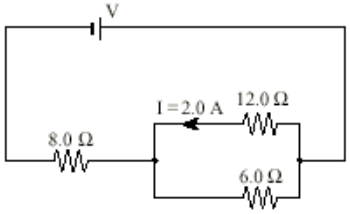


a. 1.3 A
b. 1.7 A
c. 2.0 A
d. 5.0 A

22. How should an ammeter and a voltmeter be correctly placed in a circuit?

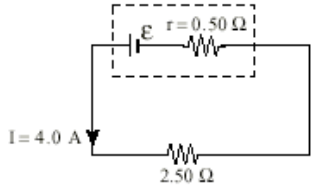
	AMMETER	VOLTMETER
a.	In Parallel	In Parallel
b.	In Parallel	In Series
c.	In Series	In Parallel
d.	In Series	In Series

23. What is the voltage, V, of the power supply shown in the circuit?



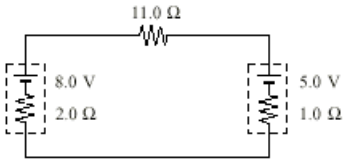
a. 24 V
b. 52 V
c. 72 V
d. 96 V

24. What is the emf of the battery shown?



a. 2.0 V
b. 8.0 V
c. 10 V
d. 12 V

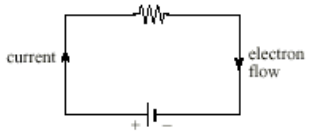
25. What current flows through the 11.0 Ω resistor?



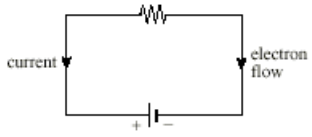
a. 0.21 A
b. 0.27 A
c. 0.93 A
d. 1.2 A

26. Which of the following correctly shows the direction of conventional current and electron flow?

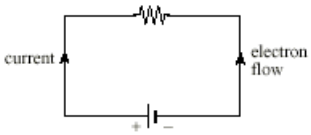
a.



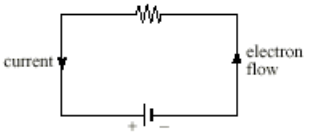
b.



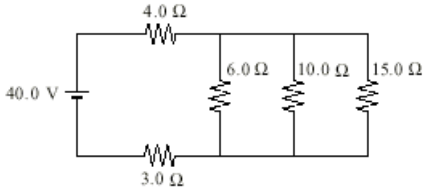
c.



d.

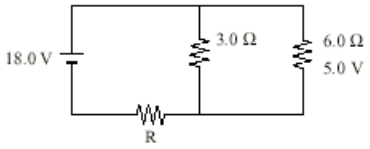


27. Calculate the current through the 6.0 Ω resistor in the circuit shown.



a. 1.1 A
b. 2.0 A
c. 4.0 A
d. 6.7 A

28. In the following circuit, determine the value of resistor R.



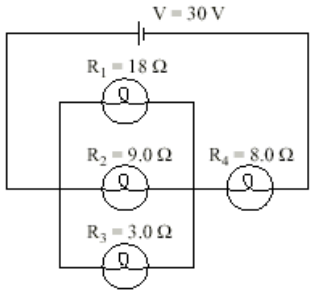
a. 3.2 Ω
b. 5.2 Ω
c. 9.0 Ω
d. 23 Ω

29. A battery provides 3.20 W of power to an external resistance. What power is dissipated as heat by the internal resistance within the battery?

a. 0.19 W
b. 3.4 W
c. 3.6 W
d. 60 W

Written

1. a) Find the current in the 8.0 Ω bulb shown below.

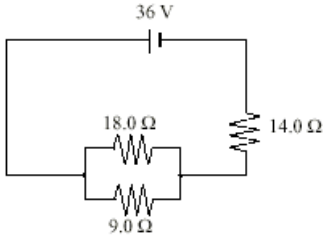


b) (i) The 3.0 Ω bulb is removed from the circuit so that only 3 bulbs remain. The 8.0 Ω bulb will now: check one

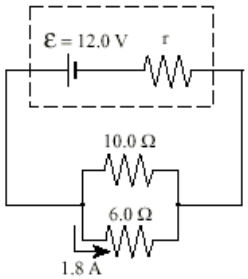
- o be dimmer.
- o be brighter.
- o remain the same.

ii. Using principles of electrical circuits, explain your answer to b(i).

2. What is the power dissipated in the 9.0 Ω resistor in the following circuit?

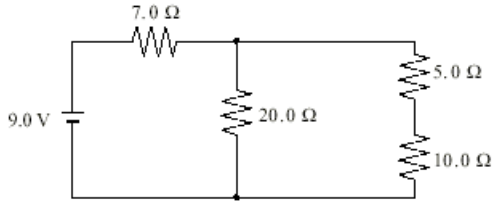


3. A battery with an emf of 12.0 V and an internal resistance r is connected to a circuit as shown below.

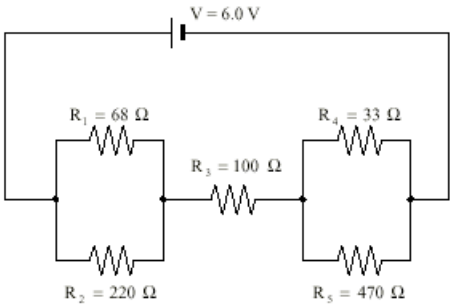


If the current through the 6.0 Ω resistor is 1.8 A , what is the internal resistance r ?

4. In the circuit shown below, determine the current through the 5. 0 Ω resistor.



5. Consider the circuit shown in the diagram below.



a. What is the total resistance of the circuit?
b. What is the current through the 100 Ω resistor?
c. What is the power dissipated in the 100 Ω resistor?

Answer Key:

Part 1: Multiple Choice

1.	A	7.	B	13.	B	19.	A	25.	A
2.	C	8.	C	14.	B	20.	B	26.	C
3.	D	9.	B	15.	A	21.	C	27.	B
4.	C	10.	C	16.	C	22.	C	28.	B
5.	C	11.	A	17.	C	23.	C	29.	A
6.	A	12.	C	18.	B	24.	D		

Part 2: Written Response

1a. $1/R = 1/18 + 1/9.0 + 1/3.0 = 9/18$ Therefore $R_p = 2.0\ \Omega$
$R_T = 2.0\ \Omega + 8.0\ \Omega = 10.0\ \Omega$
$I = V / R = 30 / 10.0 = 3.0$ A

1b Dimmer

c. With fewer bulbs in the parallel combination, the overall resistance of the circuit will be greater. The total current flow from the battery will now be smaller. Since the total current must flow through the 8.0 Ω resistor, it will be dimmer.

2. $1/ R_{parallel} = 1/18.0 + 1/9.0$ $R_{parallel} = 6.0\ \Omega$
$R_{total} = 20\ \Omega$
$I_{total} = V / R = 36 / 20 = 1.8$ A
$V_{9.0\ \Omega} = 36 - (14)(1.8) = 10.8$ V
$P_{9.0\ \Omega} = V^2 / R = 10.8^2 / 9.0 = 13$ W

3. $V_6 = V_T = (1.8)(6.0) = 10.8$ V
$I_{10} = V_{10} / R = 10.8 / 10 = 1.08$ A
$I_T = 1.8 + 1.08 = 2.88$ A
$V_T = Emf - Ir \rightarrow 10.8 = 12 - (2.88)r \rightarrow r = 0.42\ \Omega$

4. $1/ R_{parallel} = 1/20 + 1/15 \rightarrow R_{parallel} = 8.57\ \Omega$
$R_T = R_7 + R_{parallel} \rightarrow R_T = 15.57\ \Omega$
$I_T = V_T / R_T = 9.0$ V $/ 15.57 = 0.578$ A
$V_7 = IR_7 = 0.578\ (7) = 4.05$ V
Net V across parallel branch 4.95 V
So $I = V / R = 4.95 / 15 = 0.33$ A

5a. $1/R_1 = 1/68 + 1/220 \rightarrow R_1 = 51.9\ \Omega$
$1/R_2 = 1/33 + 1/470 \rightarrow R_2 = 30.8\ \Omega$
$R_T = 51.9 + 100 + 30.8 = 182.7\ \Omega$

b. $I_{circuit} = I_{100} = V / R_T = 6.0$ V $/ 182.7\ \Omega = 3.3 \times 10^{-2}$ A

c. $P_{100} = I^2 * R = (0.0328A)^2 * 100 = 0.11$ W

